Housing Wealth and Consumption: A Micro Panel Study

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Abstract

There is strong evidence that house prices and consumption are closely synchronized. There is, however, disagreement over the causes of this link. This paper examines if there is a wealth effect of house prices on consumption. We use a rich household level panel data set with information about house ownership, income, wealth, and demographics for a large sample of the Danish population in the period 1987-1996. We model the dependence of the growth rate of total household expenditure with unanticipated innovations to house prices. Controlling for factors related to competing explanations, we find little evidence of a housing wealth effect on consumption: unexpected innovations to house prices are uncorrelated with changes in total expenditure at the household level. A reform in 1992 allowed – for the first time - house owners to use their housing equity as collateral for consumption loans. We find that young house owners likely to be affected by credit constraints react to house price changes after 1993. Our findings suggest that house prices impact total expenditure through improved collateral rather than directly through wealth.

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1. Introduction

It is a widespread empirical finding that house prices and consumption are synchronized. However, there is disagreement over the causes of this link. In particular, the previous literature has emphasized the importance of housing wealth as a direct determinant of consumption. Understanding the impact of housing wealth on consumption is not only of great interest for policy makers trying to influence consumption, but it is also of primary interest for academics trying to understand household consumption and savings behaviour. The objective of this paper is to investigate whether innovations to housing wealth directly cause adjustments to the level of consumption expenditures at the household level.

The previous literature investigating the correlation between house prices changes and consumption changes focuses on four alternative explanations. The first explanation is that changes in house prices affect *household wealth*. According to the life-cycle hypothesis, households adjust their lifetime plan regarding consumption, labour supply etc. when receiving new information about lifetime wealth. Thus, unexpected changes in the value of assets, stemming from house price changes, may affect household consumption through a wealth effect. Recent paper based on micro data supporting this hypothesis include Campbell and Cocco (2007), Carroll *et al* (2006), Muellbauer and Murphy (1990), Case, Quigley and Schiller (2005) and Skinner (1994).

The second explanation focuses on the role of housing capital as *collateral* available to homeowners. House price increases may generate additional equity and thereby improve the possibility for households to borrow against their housing equity. Iacoviello (2004) argues in favour of this explanation. Also Aoki *et al* (2001), Campbell and Cocco (2007), Muellbauer and Murphy (1990), Aron and Muellbauer (2006) and Leth-Petersen (2010) find evidence for the presence of collateral constraints.

The third hypothesis is that both house prices and consumption are influenced by common factors. Expectations about *productivity* growth affect wages and expected income over the life cycle, King (1990) and Pagano (1990). These common factors may affect *both* house prices *and* consumption in the same direction. In this case the correlation between house prices and consumption does not reflect a causal relationship between house prices and consumption, but is an effect related to common factors simultaneously affecting house prices and consumption. Attanasio and Weber (1994) and Attanasio *et al* (2009) both analyze the British Family Expenditure Survey and find support for this explanation.

The fourth explanation focuses on the general effects of *financial liberalisations* which may *both* drive up house prices *and* stimulate consumption by relaxing borrowing constraints for all consumers. Attanasio and Weber (1994), and Aron, Muellbauer and Murphy (2007) point at the financial liberalizations that took place in the UK in the 1980's and 1990's as important drivers of the development in private consumption in the UK. If financial liberalisations are indeed the main driver of the simultaneous process of house price and consumption growth, the observed correlation between house prices and consumption does not reflect a causal relationship.

This paper examines the empirical importance of a wealth effect from house prices on consumption expenditures for Danish households. The paper exploits a rich panel data set with information on housing ownership, income, wealth, and background factors for 10 percent of the Danish population in the period 1987-1996. The life cycle framework amended with rational expectations suggests that households should respond only to *unanticipated* changes to house prices. We test for the presence of wealth effects of house prices on consumption by correlating changes in household level total expenditure with unanticipated house price innovations. We include controls related to the competing explanations. Specifically, we control for income. Furthermore, we exploit institutional restrictions limiting access to collateralized borrowing in the first half of our data period, allowing us to cleanly separate effects relating to the credit market from wealth and productivity effects.

One main advantage of using micro data is that they allow us to investigate the link between house prices and consumption for subgroups of the population. In particular, we can compare the reactions to house price changes across younger and older households. On the one hand, if the wealth mechanism is the main driver of the correlation between house prices and consumption, we note that not only do increasing house prices generate increasing wealth for homeowners, but they also increase the price of future housing needs, Sinai and Souleles (2005). Thus, younger house owners are likely to be less willing to convert a house price increase for non housing consumption than older house owners. On the other hand, if productivity is the common driver for house prices and consumption, then younger house owners are expected to react more strongly to house price innovations because they have more years left to reap the benefits of the gain in productivity. Another important distinction is between renters and owners. If the wealth explanation is dominating, renters should not increase total expenditure when house prices rise unexpectedly. A final important distinction is between households that are credit constrained and others that are not. We use the micro data to distinguish the reactions of young and old households, between long-term renters and house owners, and between households that are likely to be credit-constrained and unconstrained.

The methodology used in our paper is closest to that used by Campbell and Cocco (2007) and Disney *et al* (2010). Campbell and Cocco (2007) correlate consumption changes for older/young renters/owners with unanticipated house price changes using a synthetic panel constructed from the British Family Expenditure Survey[1]. Anticipated income and house price changes are identified by estimating income and house price equations. Disney *et al* (2010) use subjective expectations to the overall financial situation of the household in the following year to control for income expectations[2], but identify unanticipated house price shocks from an estimated house price process. Since we do not have subjective expectations data, we follow Campbell and Cocco and estimate processes for both house prices and incomes in order to identify expected and unexpected innovations to income and house prices.

Our study differs from Campbell and Cocco (2007) and Disney *et al* (2010) in at least three important respects. First, we put more emphasis on estimating the house price process. Estimation of the house price process is crucial for separating anticipated from (unanticipated) price innovations. Unlike the two studies mentioned we emphasize estimating a dynamic house price process and carefully testing for the presence of a unit root. The unit root test is essential; a stationary process for house prices would rule out large effects since unanticipated changes (which eventually die away) will not have a permanent effect on the level of house prices.

Second, we use true household level panel data with a relatively long panel dimension. The advantage of using a true panel is that it allows us to control for the possible influence from unobserved household-specific parameters governing time preferences, attitudes to risk and self-selection in the owner market. Furthermore, our rich data set enables us to disregard cohort effects and to distinguish between long-term owners and long-term renters. In contrast,

[1] Campbell and Cocco (2007) and Attanasio *et al* (2009) use the same data but different specifications and reach different conclusions. Cristini and Sevilla Sanz (2011) perform a careful comparison study between the two studies and conclude that the reason that Campbell and Cocco (2007) finds evidence of a wealth effect and Attanasio *et al* (2009) do not is because of the differences in model specification. In this paper we follow the methodology of Campbell and Cocco (2007). Following the conclusions of Cristini and Sevilla Sanz (2011) this gives us a potential bias towards finding a wealth effect compared to using the approach of Attanasio *et al* (2009).

[2] This is an important advantage because they do not have to rely on a parametric specification of income expectations. The general nature of the questions, however, has the drawback that it may include expectations to other things than income, for example house prices.

analyses based on synthetic panel data suffer from the disadvantage that the group composition changes endogenously. Synthetic panel data analyses do not take proper account of unobserved heterogeneity. If moving (from renter to owner and vice versa) is correlated with income and house prices, the results may be biased. Short panels can handle compositional effects but do not possess a strong ability to distinguish between households who are short and long in the owners and renters market.

Third, we exploit institutional restrictions limiting the access for home-owners to use housing equity for consumption loans before 1993. Exploiting such restrictions allows us to rule out consumption effects of house price changes going through access to collateralised credit and thereby to make a more focussed test for wealth effects.

We find little evidence of a housing wealth effect on consumption. Estimates suggest that the house price process is stationary. This is the first piece of evidence against the presence of a major housing wealth effect. Moreover, unexpected innovations to house prices are uncorrelated with changes in total expenditure at the household level. We also find that young house owners likely to be affected by credit constraints react to house price changes after the 1992 credit market reform which - for the first time - permitted house owners to use housing equity as collateral for consumption loans. This finding suggests that house prices impact total expenditure through collateral.

The next section presents the Danish institutional context. Section 3 describes the data. Section 4 goes through the methodology and section 5 presents the results. Section 6 sums up and concludes.

2. Institutional background and the housing market in Denmark

Homeownership is widespread in Denmark. Almost 2/3 of all households were homeowners at some point in the period covered by our sample, 1987-1996. Housing wealth was by far the most important asset for house owners; 55 percent of total gross wealth was held as housing wealth. Holding financial assets was much less common with around ¼ of the population holding stocks, and less than 1/10 owning bonds. In the period considered the Danish housing market underwent dramatic changes, and due to the prominent role of housing wealth these changes are likely to have had a significant impact on the financial situation of house owners.

House prices peaked in 1986 after a period of increasing prices. During 1987-1993, real house prices decreased by approximately 30 percent on average. The fall in house prices in this period followed a fiscal tightening in the second half of 1986 and a tax reform in 1987 which implied a considerable cut in the value of tax deductions on interest payments on (mortgage) loans. The tax reform had severe implications for many Danish house owners who had taken up fixed interest rate loans in a period where the interest rate was close to 20 percent and the inflation rate was high. In 1994, house prices started increasing again; and up to 2001, real house prices more than doubled in certain parts of the country.

The increase in house prices was preceded by a credit market reform that took effect on 21 May 1992. The financing of property in Denmark takes place via mortgage banks offering loans where the borrower's property is used as collateral for the loan. It is possible to mortgage up to 80 percent of the property value. Housing loans are typically associated with lower costs than loans established in commercial banks. A minimum down payment of 5% of the house value is required at purchase. The house owner needs to provide other financing for the remaining 15 percent of the value of the house. Loans through the mortgage banks are funded by the issue of callable mortgage credit bonds. The principal of the loan depends on the price of the underlying bond. When the bond price is below par, a higher number of bonds must be sold to meet the funding requirements. This typically makes the principal of the loan larger than the loan proceeds paid out. The 1992 reform introduced the possibility for house owners to establish mortgage loans for financing non-housing expenditure. Before the reform, mortgage loans based on bonds had a maximum maturity of up to 20 years, and they could only to be used to finance property. In the period considered in this paper it was only possible to establish fixed interest rate loans.

The 1992 reform changed the rules about mortgaging in three ways. First and foremost, the reform introduced the option of using the proceeds from a mortgage loan for purposes other than financing property. Specifically, the reform introduced the possibility to use housing equity as collateral for consumer loans established through mortgage banks with a limit of 80 percent of the house value for loans for non-housing purposes.

Second, the reform increased the maximum maturity of credit loans from 20 to 30 years.

Third, the reform gave the option to re-finance. Refinancing allows borrowers to lower the cost of the loan when the market interest rate falls. A borrower is entitled to redeem a credit bond at par at any time prior to maturity by prepayment. This enables the borrower to exploit changes in the market rate of interest in order to reduce the costs of funding. If the interest rate falls, the borrower may prepay his loan and raise a new mortgage loan at the lower coupon rate. This may not only lower the monthly payment, but may also imply a larger principal of the new loan relative to the old loan if the price of the bond underlying the new loan is below par. While the first two parts of the reform influence the access to credit, the third element of the reform provides house owners with the option to lock in low market interest rates in order to obtain lower monthly payments on their mortgages and an overall gain in wealth.

In our analyses, we distinguish between the two sub-periods before and after 1993. This allows us to distinguish between a regime where households could not use housing equity as collateral, 1987-1992, and a regime where they could, 1993-1996. Table 1 below summarizes the institutional setup before and after 1993.

[Table 1 about here; see end of paper]

3. An empirical model of consumption and house prices

The life cycle model asserts that agents choose a consumption path to keep the marginal utility of consumption constant over time. A common interpretation of the life cycle model with rational expectations is that individuals smooth consumption over their life, given all available information at the beginning of the planning horizon and their expectations on the development of wealth over the planning horizon. Wealth includes financial assets, human capital, housing capital etc. The model in its general form assumes that households are forward looking and credit markets are perfect. Deviations from the individual consumption plan are due to the arrival of new information or *unexpected* changes in wealth.

Innovations to human capital through unexpected individual productivity changes may lead to an adjustment of the permanent income and consumption level. Moreover, changes in housing wealth through unexpected price changes may affect total expenditure. In principle, price changes that were already expected at the beginning of the planning period do not affect consumption, provided capital markets are perfect and there are no credit market constraints. Given perfect capital markets, a household that expects wealth (for example, housing or human capital) to change tomorrow can borrow or save today to smooth its consumption path.

If we observe that consumption reacts to *expected* house price changes, this may indicate that the household is myopic or that the household is credit constrained due to credit market imperfections. This test is obviously not a perfect test of credit constraints, since households who experience a true positive wealth shock may also be relieved from their credit constraint at the same time. Nonetheless, dividing innovations into expected and unexpected innovations increases the focus on the theory-consistent notion that household consumption should only respond to unanticipated innovations.

We propose and investigate an empirical model in which changes in log consumption are regressed on expected and unexpected changes in house prices, expected and unexpected changes in disposable income and the real after-tax interest rate. We also control for demographic characteristics:

$$\Delta c_{it} = \pi_0 + \pi_1 r_{it} + \pi_2 E\left(\Delta y_{it}\right) + \pi_3 \theta_{it}^{y} + \pi_4 E\left(\Delta p_{it}\right) + \pi_5 \theta_{it}^{p} + \pi_6 Z_{it} + \lambda_t + u_{it} + \Delta m_{it}^{c} \qquad (1)$$

c_{it} is log total household consumption expenditure (excluding housing expenditure) for household *i* at time *t*. r_{it} is the after-tax interest rate. $E\left[\Delta y_{it}\right]$ denotes the household's expected[3] change in disposable income between *t-1* and *t*, and $\theta_{it}^{y} = \Delta y_{it} - E\left[\Delta y_{it}\right]$ is the surprise or innovation to income changes in period *t;* that is, the difference between expectations formed at *t-1* about the income change in period *t* and the realized income change in period *t*. $E\left[\Delta p_{it}\right]$ denotes household expectations for the development of house prices between *t-1* and *t*, and $\theta_{it}^{p} = \Delta p_{it} - E\left[\Delta p_{it}\right]$ is the difference between expectations formed at *t-1* of the house price change in *t* and the realized house price change in period *t*. π_5 is intended to capture effects of unanticipated price changes on the growth rate of total expenditure and is the parameter of interest in this study.

We also control for county-specific year effects[4]; these effects are contained in the term λ_t. These summarize shocks that are common to households in a particular county in a particular year, and include revisions to expectations that are common across households in the county.

[3] Here and below, the expectations operator is conditional on the information at time *t-1*.
[4] In the period considered there are 275 municipalities covered by 14 counties.

u_{it} is an independent error term. In the empirical analysis, c_{it} is imputed from income and wealth information. The variable Δm_{it}^{c} is the measurement error relating to the imputation. We discuss the implications of measurement error for obtaining a consistent estimate of π_5 in section 5.

To implement (1), we need to estimate processes for income and house prices; our methods are outlined in the next two subsections.

The house price process

In order to distinguish between expected and unexpected house price changes, we investigate the time series characteristics of house prices. Households form their expectations about house prices in period t based on their observation of house prices in the past in their municipality. We assume that house prices follow a first-order autoregressive (AR1) model with unobserved effects and serially uncorrelated disturbances[5]:

$$p_{it} = \alpha p_{it-1} + (1-\alpha)\eta_i + \beta x_{it} + v_{it} + m_{it}^{p} - \alpha m_{it-1}^{p}, \quad i = 1,...,N, \;\; t = 2,...,T \qquad (2)$$

p_{it} is the natural log of the average house price in the municipality where household i lives, η_i captures unobserved heterogeneity in house prices, x_{it} contains information about average observed characteristics of houses in the municipality where household i lives (the average area of houses and the average number of rooms). Note that we do not include time dummies so that aggregate price changes are included in the error term, v_{it}. The terms m_{it}^{p} and m_{it-1}^{p} are errors relating to the measurement of house prices. As we will discuss in more detail later, we observe average sales values among traded houses, and this creates a sampling error because the averages are calculated over different numbers of house sales. Our estimation will

[5] Disney et al. (2010) and Campbell and Cocco (2007) also estimate house price regressions to separate expected from unexpected innovations to house prices. Campbell and Cocco (2007) states that the change of log house price is regressed on the second lag of the change in log house prices (and other variables). Disney et al (2010) estimate an AR(2) model for county level house prices including county fixed effects and year dummies. However, neither of these studies report the results from estimating these processes, and it is therefore not clear whether the house prices follow a stationary or an integrated process. As previously argued, this is important evidence for understanding if there is a potential for a wealth effect.

address the potential influence of such errors by explicitly including measurement error in the specification and applying estimation methods that take these in to account.

Household expectations to the development of local house prices are formed by $E[\Delta p_{it}] = E[p_{it}] - p_{i,t-1}$. The innovation (surprise) in average municipality level house prices experienced by household i in period t is then $\hat{\theta}_{it}^{p} = p_{it} - E[p_{it}]$.

Hence, we assume that households base their expectations about the price development of their own house on the expected price development in their municipality.[6] Estimation of the house price process is crucial for distinguishing between unexpected and expected changes in house prices at the household level. Details on the model and the estimation of it are relegated to Appendix 1.

The income process

Estimation of the model of consumption changes over time in (2) requires that we distinguish between expected and unexpected innovations to disposable income. To do this, we specify a model for household formation of expectations about their disposable income. The literature on earnings processes of individuals and households has proposed various dynamic models. In this paper, the main focus is on the consumption equation, and we adopt a somewhat simpler formulation for the income process. Specifically, we assume an autoregressive income process where household log disposable income in period t is related to lagged log disposable income. We control for household characteristics: the presence of children, age of oldest spouse in the household (captured by z), and year dummies (captured by κ_t). u_{it} is an independent error term and m_{it}^{y}, m_{it-1}^{y} are measurement errors pertaining to the income that we measure:

$$y_{it} = \gamma y_{it-1} + (1-\gamma)\mu_i + \phi z_{it} + \kappa_t + u_{it} + m_{it}^{y} - \alpha m_{it-1}^{y} \quad , i = 1,...,N, \ t = 2,...,T \qquad (3)$$

[6] For renters we assume that they form expectations about house prices in their local area according to the same estimated house price process

At time *t*, $E(y_{it-1}) = y_{it-1}$. This specification implies that the difference between realized income changes and expected price changes - the predicted surprise term, $\hat{\theta}_{it}^{y}$ - can be calculated as $\hat{\theta}_{it}^{y} = y_{it} - E\left[y_{it}\right]$ More details and estimation results can be found in Appendix 2.

Inference

Equation (1) includes generated regressors, and conventional asymptotic standard errors are therefore potentially biased. The calculation of correct asymptotic standard errors is not standard, and we therefore use bootstrapped errors. In constructing the bootstrap, we note that the sampling scheme is based on sampling individual households; that is, household level time series. The bootstrap procedure accommodates this, so that the data used for estimating the income process, the house price process and the consumption equation are re-sampled in exactly the same way. Specifically, we have constructed one big data set containing all the price, income and consumption information for each household. For the consumption and income information this is straightforward as they are already individual specific. For the house prices we have allocated a municipal house price to each observation implying that the house prices for a particular municipality enter the data set as many times as there are inhabitants from that municipality in our data set. This procedure effectively gives different weights to different municipalities, depending on the fraction of the sample living in a particular municipality when estimating the house price process. Similarly for the income process which is estimated on the incomes of the households in the sample. We then block-bootstrap entire municipalities, i.e. when a municipality is re-sampled then all household specific time series within that municipalities are included, to accommodate that house prices vary only across municipalities. For each bootstrap sample, we re-estimate all three equations.

4. Data

The data used in this paper are based on Danish public administrative registers for a random sample of 10% of the Danish population aged 16+ who are followed in the period 1987-1996. Due to the collection of a wealth tax in this period, the administrative registers contain detailed information about wealth along with income and a number of personal and household characteristics.[7]

The Expenditure Imputation

One of the advantages of having access to longitudinal information on wealth in combination with income is the possibility of deriving an imputed expenditure measure at the household level over time. Browning and Leth-Petersen (2003)[8] develop and test a number of different imputation methods for total expenditure. Their preferred – and also simplest - approach to derive an expression for total household expenditure is based on an accounting identity where total expenditure in a period is calculated as total disposable income in the period minus the change in total net wealth from the previous period to the present period:

$$c_{it} = y_{it} - \Delta W_{it} \qquad (4)$$

where c_{it} is total expenditure of household *i* in period *t*, y_{it} is disposable income of household *i* in period *t*, and ΔW_{it} is the change in household *i*'s total net financial wealth (savings) from period *t-1* to period *t*. All figures have been deflated with relevant price indices to reflect real terms (1990 price levels). Household disposable income is defined as the sum of gross income including interest income and dividends from share capital; from this sum we deduct taxes on income, taxes on shares, imputed rent (used for taxing house owners) and tax-exempted

[7] The wealth tax was abandoned in 1997, and major breaks in the data appear at this point. We therefore limit the analysis to the period where the wealth tax was in operation and where we are confident that the wealth data are collected consistently.

[8] Browning and Leth-Petersen (2003) examine the quality of the imputation using data drawn from the Danish Family Expenditure Survey (DES) for the years 1994-1996. The DES gives diary and interview based information on expenditure on all goods and services, which can then be aggregated to give total expenditure in a sub-period within the calendar year for each household in the survey. The households in the DES can be linked to their administrative income/wealth tax records for the years around their survey year, making it possible to directly check the reliability of the imputation against the self-reported total expenditure measure at the household level. Browning and Leth-Petersen (2003) find that the imputation provides a measure that performs quite well in terms of matching individual households' self-reported total expenditure.

interest rate expenses. Household net wealth is defined as assets minus liabilities. Assets include the market value of share capital, bank deposits, the market value of bonds and securities. The tax-register data give information about the value of the assets. Hence, if a household adjusts its portfolio by purchasing, say, one share (holding other assets and liabilities constant), this will appear as a savings decision. If, however, the portfolio is held constant, but the price of one share in the portfolio goes up, a capital gain on the share, then this will erroneously appear as savings as well. Correcting for the influence of capital gains is only possible if the quantities are known. This is only the case for housing. In the analysis, housing assets are simply left out of the imputation. Given that we have detailed data on financial wealth for 1987-1996, we end up with a panel of imputed expenditure levels for 1988-1996.

Figure 1 plots average consumption against age of the oldest household member. The plot shows the familiar pattern with an increase from early ages to about the late-40's and then a decline as children leave home.

[Figure 1 about here; see end of paper]

House prices

For estimating the house price process, we use data on average sales prices for traded single-family houses at the municipality level for the period 1985-2001. These data are constructed by the Danish tax authorities from data for all individual house transaction (we do not have access to the individual house price information). Each time a house is traded the price of the house is recorded in a public register of house sales and mortgages and the tax authorities use these data to construct the average price. In the period analyzed, there were 275 municipalities in Denmark. House prices vary across municipalities. Figure 2a below shows the log of real house prices for six different municipalities which are, respectively, at the 10^{th}, the 25^{th}, the median, the 75^{th}, the 90^{th} and the 95^{th} position in the percentile distribution in 1985. It appears that house prices in different municipalities move in tandem, suggesting that aggregate movements are a large part of the total variation. The figure shows that prices were generally declining in the period 1985-1993 and increasing hereafter. The price changes were most extreme in the area close to the capital throughout the period, but the spatial distribution of the price changes was much more heterogeneous before 1993 than after with dramatic price declines also appearing in more thinly populated areas before 1993. In the analysis we exploit these differences in changes across municipalities. Figure 2b shows first differences of log house prices for the same municipalities as in figure 2a. Figure 2b shows that not all the variation in house price changes across municipalities is common. In fact, when looking across all municipalities for all years in the period observed (not reported), house prices are increasing in some municipalities while decreasing in others.

[Figure 2 about here; see end of paper]

Figure 2b, however, also reveals year-to-year negative autocorrelation. We believe this is related to the way the price data are constructed. Because the within municipal average prices are calculated over different number of house sales, prices will vary across municipalities not only because of real differences but also because of differences in the number of house sales used for calculating the averages. In the data, house prices series will tend to be more volatile for small municipalities with few house sales than for large municipalities with many sales. Figure 2b shows this very clearly. For example, the 25th and the 50th percentile happen to be small municipalities with few sales each year whereas the 90th and the 95th percentile happen to be large municipalities. As noted after equation (2) above, we take explicit account of this relationship between measurement error and the size of the municipality in the calculation of standard errors. Effectively our bootstrap procedure down-weights small municipalities.

House Prices, Expenditure and Debt

Most previous papers have found that house prices and total expenditure are correlated. Our empirical analysis looks into the relationship between house price changes and changes in expenditure at the household level. Figure 3 shows the relationship between average annual changes in log expenditure and log house prices in our sample.

[Figure 3 about here; see end of paper]

A regression of the first-difference of log total expenditure on a constant and the first-difference of log house prices yields a parameter estimate of 0.08; this parameter estimate is highly significant. This confirms that, in Denmark just as elsewhere, the evolution of total expenditure and house prices are indeed correlated.

Table 2 shows how the average house values and debt levels in the periods 1989-1992 and 1993-1996. The first period was a period where prices were declining and the latter period was a period were house prices were increasing. The table presents values separately for young and older households. We define the young households to be households where the oldest person was 23-40 years old in 1987 and the old households to be households where the oldest person was 41-55 years in 1987. If a wealth effect is at play and households take out equity to finance consumption we should expect to see that young people decrease their debt by more than old households. Table 2 shows that young households are more leveraged than old households but also that they on average reduced their debt level by more than the old households even though the young group experiences a larger average increase in house values. Obviously, the heterogeneity is massive as witnessed by the size of the standard deviations and these numbers presumably mask the underlying heterogeneity that we will exploit in more detail in the analysis.

[Table 2 about here; see end of paper]

Sample Selection

The analysis of the consumption equation necessitates that we make some sample selections. In order to avoid complications related to household formation we limit the sample to include only couples. Specifically, we focus on "stable" couples which are defined as couples who stayed together through the period observed. Our analysis focuses on households in which the oldest spouse was between 22 and 55 years old in 1987. Households where the oldest spouse is older than 55 years are excluded in order to avoid interference with the retirement decision.[9] We include couples that are either house owners or renters throughout the sample period. We deselect around 1,000 observations with negative values of imputed total

[9] We perform sensitivity tests to check whether our results change substantially if we include households aged 55-65 years. The de-selection of households above 55 years has no effect on the overall conclusions inferred from the results in section 5.

expenditure and households for whom we lack information on changes in disposable income, debt etc. The consumption estimation is based on the sample of couples over the period 1989-96 with observations on predictions and innovations in house prices and incomes. The final sample for the consumption regression is an unbalanced panel with almost 89,000 households and almost 394,000 observations.

5. Results

The empirical analysis consists of three parts. First, we estimate house price and income processes. Second, based on the estimation results from the house price and income processes, we derive predictions of expected and unexpected house price and income changes. Third, we use these predictions in the total expenditure equation.

Estimation of the house price process

The data consists of annual observations on average sales prices of single-family houses in 275 Danish municipalities during the period 1985-2001. However, the unit of the analysis is the individual household. We therefore assign a price to each household in the sample for a given year, thereby effectively giving more weight to house prices in municipalities with more inhabitants/observations.

A first step towards understanding the potential for a house price wealth effect is to understand if house prices follow a stationary or nonstationary process. We test the hypothesis that the house process has a unit root: $\alpha = 1$, using three different test statistics. In all cases the hypothesis of a unit root is rejected. Details are given in appendix 1. As we have emphasized, the rejection of a unit root already suggest limits to how strong the direct wealth effect can be.

Given the rejection of a unit root, we estimate the parameters of the stationary process using the system GMM estimator proposed by Arellano & Bover (1995), Ahn & Schmidt (1995) and Blundell & Bond (1998). This estimator produces consistent and efficient estimates when the process modelled is persistent but stationary. In estimating the price process we assume that common shocks to the house price process are part of the unanticipated changes in house prices.[10] We assume that individual households base their expectations on the price development of their own house on the average price change in the municipality. This represents an approximation since certain neighbourhoods in a municipality may experience a different house price development over time than other neighbourhoods. This variation may be due to, for example, investments in infrastructure, quality improvements in certain schools, the establishment of new local firms, shopping opportunities etc. Unfortunately, we do not have information on local house prices in smaller districts than the municipality. Moreover, we neither catch idiosyncratic depreciation nor improvements due to renovation, reconstruction and modernization. These neighbourhood and individual house characteristics are captured by the error term.

The estimation results yield an autoregressive parameter of 0.82. This implies that a shock to house prices maintains more than 35% of its original value after 5 years, but less than 15% after 10 years. Thus, a house price shock is potentially able to deliver significant wealth effects for households close to exiting the housing market but less so for households who are young and still have to remain in the housing market for a long time. In addition, there is a moderating effect for young house owners. Young house owners who plan to remain owners for many years also face increasing costs of housing following a positive house price shock and are therefore not likely to increase consumption following a shock to the house price process.

Using the parameter estimates from the house price process, we calculate the expected house price increases $E\left[\Delta p_{it}\right] = \hat{p}_{it} - p_{i,t-1}$ and the unexpected house price innovations $\hat{\theta}_{it}^{p}$.

Estimation of the income process

A number of studies of income processes focus on earnings for male workers. By contrast, our study focuses on household disposable income: the after-tax income from both labour income and social transfers, and we work with two-adult households where one or both of the partners may be unemployed or out of the labour force.

The income process is estimated for four education groups separately, the group of households where none of the partners have an education beyond primary school, households where the maximum educational level among the partners is a vocational education,

[10] We also did the entire analysis assuming that county-time specific shocks in the price process were anticipated. This did not change the results substantially.

households where the highest education is high school or a short further education and the group of households where at least one of the partners has a medium-long or longer education. Log disposable income is the dependent variable, and explanatory variables include the lag of disposable income, log age (of the oldest spouse), log age squared, and number of children. Furthermore, we control for year specific common shocks. Since households belonging to different cohorts are assumed to react differently to common national shocks, we also include an interaction variable of the year dummies and log age. The test of a unit root in the AR(1) income process is rejected for all education groups, see details in Appendix 2. The estimation results for the estimation of (4) are shown in Appendix 2. Overall, we find the autoregressive parameter estimates to be around 0.7-0.8.

The expenditure regression

In this section we estimate the parameters of model (1). Our primary interest lies in examining if changes in household consumption expenditures are related to changes in anticipated/unanticipated local house prices when we control for anticipated/unanticipated income changes and other standard control variables.

We start out by presenting in table 3 a set of baseline regressions where we do not distinguish between anticipated and unanticipated price and income effects.

[table 3 about here]

Column (1) in table 3 presents the result from a regression of first-difference of log total expenditure on first-difference of log house prices. The estimated coefficient is 0.08 indicating that a 1% house price increase is associated with a 0.08% increase in expenditure. In order to convert this elasticity into a marginal propensity to consume out of housing wealth, note that the average house value was 500,000 DKK in 1993 and the average expenditure level was 180,000 DKK, so that an increase in the house value of 1% amounts to 5,000 DKK and a 0.08% increase in expenditure amounts to an increase of 144DKK corresponding to about 3% of the house value increase. Obviously, this estimate cannot be interpreted as a housing wealth effect as house prices may co-vary not only with expenditure but also with incomes as in the “productivity hypothesis” proposed by King (1990), Pagano

(1990), Attanasio and Weber (1994) and Attanasio *et al* (2009). Introducing the first difference of log-income as a regressor (column (2) of table 3), the estimated house price coefficient is lowered to less than half the size.[11]

The wealth effect hypothesis and the productivity effect hypothesis both suggest that effects may vary depending on the life stage position of the household. In column (3) we allow for different effects for young and old households. The estimated price parameters are now generally smaller but the largest effects are for the old sample. However, standard errors are relatively large and none of the parameters are significant. Finally, in column (4) we introduce interactions allowing parameters to vary between two sub-periods: 1988-1992 and 1993-1996. The motivation for this split is that collateralized loans were available in the period 1993-96 but not before. All the price parameters are insignificant, except for the parameter for prices for young households before 1993 which is negative, but only significant at the 10% level. We therefore conclude that no clear pattern emerges when comparing periods and age groups.

The results presented in table 3 confound anticipated and unanticipated effects. The next step is to estimate equation (1) with house price and income changes split into anticipated and unanticipated components based on the price and income models estimated in the previous sections. When doing so, we have to take explicit account of the measurement error, Δm_{it}^{c}, for the estimation of π_5. When estimating equation (1), $E\left[\Delta y_{it}\right]$ and θ_{it}^{y} will be replaced by their estimated counterparts, $\widehat{\Delta y}_{it}$ and $\hat{\theta}_{it}^{y}$. The measurement error is likely to be positively correlated with these variables: $p\lim\left(\widehat{\Delta y_{it}}\,\Delta m_{it}^{c}\right)>0$ and $p\lim\left(\hat{\theta}_{it}^{y}\,\Delta m_{it}^{c}\right)>0$, because of the prominent role of income in the expenditure imputation. This implies that the estimated parameters of the income variables are likely upward biased. Similarly, $E\left[\Delta p_{it}\right]$ and θ_{it}^{p} are replaced by their estimated counterparts, $\widehat{\Delta p}_{it}$ and $\hat{\theta}_{it}^{p}$. Given the imputation method and the sample selection, the measurement error is, however, *not* likely to be correlated with these price variables: $p\lim\left(\widehat{\Delta p_{it}}\,\Delta m_{it}^{c}\right)=0$ and $p\lim\left(\hat{\theta}_{it}^{p}\,\Delta m_{it}^{c}\right)=0$. As noted in section 4, the imputation is susceptible to capital gains on assets held by the households to the extent that we observe the value but not the quantities of the assets held by each household. One exception to this is the housing assets where we observe the quantity. We control for capital

[11] Here and below, we do not show the income coefficients since, due to the imputation method, they do not have any structural interpretation. This is explained in more detail below.

gains on this particular asset by simply leaving out housing assets from the imputation. As a consequence the house price variables are likely to be uncorrelated with the measurement error in (1). Finally, for being able to interpret the π_5, the parameter of $\hat{\theta}_{it}^{p}$, as a causal effect we also require $p\lim\left(\widehat{\Delta y_{it}}\,\hat{\theta}_{it}^{p}\right)=0$ and $p\lim\left(\hat{\theta}_{it}^{y}\,\hat{\theta}_{it}^{p}\right)=0$; income changes should be uncorrelated with our estimate of unanticipated house price changes.[12] In summary, we believe that the parameters of the price variables are consistently estimated while the parameters of the income variables reflect both true income and measurement error. As a result, we do not give these estimates a structural interpretation as the expenditure response to unanticipated income growth. In spite of the potential bias induced on the estimated income parameters we include the income variables because of their role in controlling for expectations of future incomes.

The results from estimating (1) are listed in table 4. Compared to the estimations presented in table 3, we also add a set of additional control variables: age of oldest person in the household a dummy for children, the educational level of the person in the household with the maximum level of education, and county specific year dummies. Column 1 shows results for all owners.

[table 4 about here]

In the pooled regression reported in column (1) all parameter estimates for house price variables, both anticipated and unanticipated, are insignificant. The specification in column (1) can be thought of as a differences-in-differences specification where the growth rate of total expenditure of young and old households are compared. In the bottom panel of table 4, we report a test for differences in growth rates between young and old households, but the test reveals no difference.

Column (2) shows results from a regression where all parameters are interacted with dummies indicating if the household held high and low levels of liquid assets at the beginning of the year respectively. Low liquid asset households are defined as households with liquid asset holdings equal to less than 1½ months of disposable income in year *t-1*, and high liquid asset

[12] This is verifiable in the data: for our preferred specification (from which we have reported results in table 4) we have regressed $\hat{\theta}_{it}^{p}$ on $\hat{\theta}_{it}^{y}$, $\widehat{\Delta y_{it}}$ and all the other explanatory variables to confirm that $\hat{\theta}_{it}^{p}$ is indeed uncorrelated with $\hat{\theta}_{it}^{y}$ and $\widehat{\Delta y_{it}}$.

households are households holding liquid assets corresponding to more than 1½ months of disposable income in year *t-1*. The idea behind estimating specific parameters for households holding low levels of liquid assets is that it separates out a group that is more likely to be affected by constraints in the credit market.

When focusing on low- and high-liquidity households, we find that only young households with low levels of liquidity are significantly sensitive to changes in *un*anticipated changes after 1992. The test for differences in growth rates between young and old households reported in column (2) in the bottom panel of the table also confirms that the before/after growth rate of young low liquid asset households differ from the growth rate of old low liquid asset households.

As discussed in section 2, the credit reform implemented in mid-1992 enabled homeowners to raise mortgage loans using their housing equity as collateral and use the proceeds for non-housing consumption. In the post- reform period the collateral explanation can therefore be at play along with the productivity and the wealth explanation. The fact that young low liquid asset households appear to respond to unanticipated house price innovations suggests that these households respond to a wealth effect. We interpret the result as evidence of lifting credit constraints for this group. Our procedure may not allow us to cleanly separate borrowing constraints from wealth effects because households receiving a positive wealth shock may also be relieved from their credit constraint at the same time. The fact that the results appears for low liquid asset households but not for high liquid asset households is consistent with the lifting of constraints, and the fact that it appears for young households and not for old households corroborates this interpretation. For a given increase in housing wealth it would be expected that old households respond more than young households if consumption is influenced by wealth directly. This is because a positive house price shock increases not only housing wealth but also housing costs, and young households have to bear the consequences of the increased housing costs for more years than old households, Sinai and Souleles (2005). Our finding is also consistent with the results in Leth-Petersen (2010) who investigates the response to the credit market reform and finds evidence in favour of constraints affecting some young house owners. The estimated house price elasticity of 0.12 and the fact that the average expenditure level for this group is 208,000 DKK and the average house value is 525,000 suggest that the average MPC out of housing wealth increase is 5%.

The same exercise has been performed for renters, and results are displayed in the appendix. We think of this exercise as a check that our model specification is not driving the results.

Long term renters should not respond to changing house prices as they hold no housing wealth. The results suggest that no wealth effect is at play for renters as would be expected. However, standard errors are large for renters, and we do not believe that much can be learned from the sample of renters.

The results from this study are most directly comparable to the results of Campbell and Cocco (2007) (henceforth CC) and Disney *et al* (2010), both studies based on UK data for the period 1988-2000 and 1994-2003 respectively.

CC estimate a model in which the growth rate of expenditure is regressed on the growth rate of house prices, income, the log real interest rate, the growth rate of real mortgage payments, and demographic controls. CC find a simple elasticity of house prices to consumption of 1.56 (table 3) corresponding to a marginal propensity to consume out of housing wealth of about 10%. These estimates are much larger than ours. However, the estimated parameters of the unanticipated components in CC (reported in table 7 and 8) suffer from the same problem as our estimates, namely that standard errors are large. Generally, the effects of unanticipated shocks are smaller than anticipated effects, and the point estimates based on regional variation in house prices (reported in their table 7) are only borderline significant and indicative of small consumption effects.[13]

Disney *et al.* (2010) use the British Household Panel Survey 1994-2003 and county-level price data to estimate the effect of a surprise change in house prices on active savings. This study is in some respects closer to ours than CC in that they use micro panel data and estimate a dynamic model for house prices. However, we use a much finer geographical unit for estimating the house price process. Disney *et al.* (2010) find a marginal propensity to consume out of surprise innovations to housing wealth of maximally 0.01, but do not find different effects for young and old. This is similar to our findings in the sense that the effects are found to be small.

Robustness checks

We have performed a number of robustness checks to check if the results presented here are artefacts of our specification.[14] We have allowed for asymmetric responses to positive and negative surprise changes in house prices. This has previously been attempted by Disney et al.

[13] This problem may even be worse than it appears from CC since they do not report standard errors taking in to account the fact that they are using generated regressors.

[14] Results from these robustness checks are available on request.

(2010). In another specification, we have allowed for size effects where responses to small innovations are allowed to differ from responses to large innovations. The idea is that small changes may not trigger a response while large innovations may. Next, we have attempted alternative age splits so as to make sure that results were not driven by our arbitrary age split, and we investigated if responses differed for families with children to check for the importance of demographic characteristics. None of these alternative gave different results.

Our setup relies on the total expenditure imputation being valid. Browning and Leth-Petersen (2003) have shown that the measure may be potentially unreliable when large unobserved capital gains exist. The potential for this is large among stock owners. We therefore also re-estimated the model on a sample of households not holding stocks; the results were unaffected.

In our main estimation results presented in table 4 the sample is split based on the level of liquid assets at the beginning of the year. We split the sample at a level corresponding to 1½ months of disposable income. This is arbitrary, and to check for the sensitivity of the cut-off point we have re-estimated the model using two alternative splits where low liquid asset households are defined to hold liquid assets corresponding to ½ and 3 months of disposable income. The first split left the parameter of the surprise change in house prices for young low liquid asset households after the reform insignificant. This is because the number of households categorized as low liquid asset households is reduced and the standard error becomes larger. The other split left this parameter significant at the 10% level. In neither of the two alternative splits was there any indication that old households respond.

As a final check we have investigated the robustness of the results to the exclusion of observations with a negatively imputed value of total expenditure. Equation (2) is specified in terms of the natural log of imputed total expenditure and since the natural log cannot address negative values such observations are simply discarded. To investigate the importance of this we have applied the inverse hyperbolic sine function proposed by Burbidge *et al* (1988). This transformation down weights large values but can be applied to positive and negative numbers as well as zero and does not impose constant elasticities. We compared results from applying this transformation to imputed total expenditure for the sample used above and for a larger sample where observations with negatively imputed total expenditure were not discarded. The inclusion of these observations did not affect the results. In some of these robustness checks we find responses for young low liquid asset households before the reform, but the only results that comes through in all specifications is that young low liquid asset households respond to unanticipated house prices after the credit reform. In particular, we do not find evidence that old households respond to unanticipated house price changes, and we therefore find it reasonable to conclude that in all specifications that we have attempted we find little evidence of wealth effects.

Caveats

Before closing we comment on potential pitfalls associated with our analysis. One objection relates to a potentially relevant omitted variable. Attanasio and Weber (1994) and Disney *et al* (2010) argue that changing financial expectations may be an omitted variable. This could, for example, be the case if returns to non housing assets are correlated with (expectations to) house prices. We do not think this presents a serious objection to our results. If house prices co-vary with returns to other assets then this should create an upward bias in the estimated house price effect. Disney *et al* control for this by including a measure of financial expectations and find exactly this, although the quantitative effect was not large. In our case we find little evidence of any wealth effect, and including a measure of financial expectations is therefore not likely to change our results towards finding a house price wealth effect.
An important caveat of our analysis is that our measure of total expenditure is noisy. Consequently, standard errors on the key parameters are large. Hence, while we conclude that there is not much evidence of significant wealth effects, the standard errors are so large that confidence intervals cover what would be perceived as significant wealth effects.

Another and related caveat applying to our analysis is that we consider a large number of subgroup results and we may be facing a multiple testing problem, This suggests that significance levels should be interpreted even more conservatively than we have already done. On the other hand, the cuts we consider (young/old, constrained/unconstrained and pre/post reform) are all conventional cuts that would have been considered before the analysis was conducted.

Finally, while there appears to be rich price variation in the data, the period covered by our sample does not include events where house prices increase as dramatically as was the case in the years leading up to the current crises where prices in some places increased by more than 10% per year, and we cannot be sure that our results have external validity to such events.

Keeping these reservations in mind, we conclude that the results from estimating our consumption growth equation indicate that house prices are not likely to have caused consumption expenditure to change because of the changes in wealth brought about by house price changes in the period considered. Instead we find some indication that when credit conditions were eased in the period 1993-1996, spending increased for some households who were likely to have been credit constrained.

6. Summary and conclusion

This paper investigates the empirical relationship between house prices and consumption. Many studies have found that the evolution of consumption and house prices is correlated, but there are several competing explanations for the cause of this link. The life cycle hypothesis augmented with rational expectations suggests that house owners should only respond to changes to wealth when these innovations are unanticipated. This forms the basic structure for our analysis. We analyze a Danish panel dataset with information on house prices and wealth at the household level to investigate the importance of the wealth explanation. These data are used to impute of total expenditure at the household level for 1988-1996. Furthermore, we model the process of house prices on a panel of municipality level average sales prices for 1985-2001. Estimates from this process are used to divide changes in house prices into an expected component and a surprise/innovation component. Changes in household consumption (based on our panel of imputed expenditure) are then regressed on expected as well as unexpected innovations to house prices.

Overall, we find little support for the wealth explanation. A first piece of evidence comes from estimating the house price process. We find that the house price process is persistent but stationary. This implies that shocks to house prices do not have lasting effects; that is, there are no permanent wealth effects from changing house prices except for households who are about to exit the housing market. We take this as evidence that the wealth effect is likely to be small if present at all.

Moving on to the expenditure growth regressions we find no significant relationship between house prices and consumption before 1993, when institutional restrictions permit us to rule out some of the competing explanations. After 1992, we find no evidence that older home-owners react to house price changes. This indicates that the wealth effect is not a likely explanation for the correlation between house price changes and the expenditure growth rate. We do find a positive and significant relationship between unanticipated house price innovations and the expenditure growth rate only for young households who are likely to be constrained. This is interpreted as evidence that constraints have been lifted for this group consistent with the 1992 reform

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Figures to be inserted in the text

Figure 1. Average expenditure and age of oldest spouse

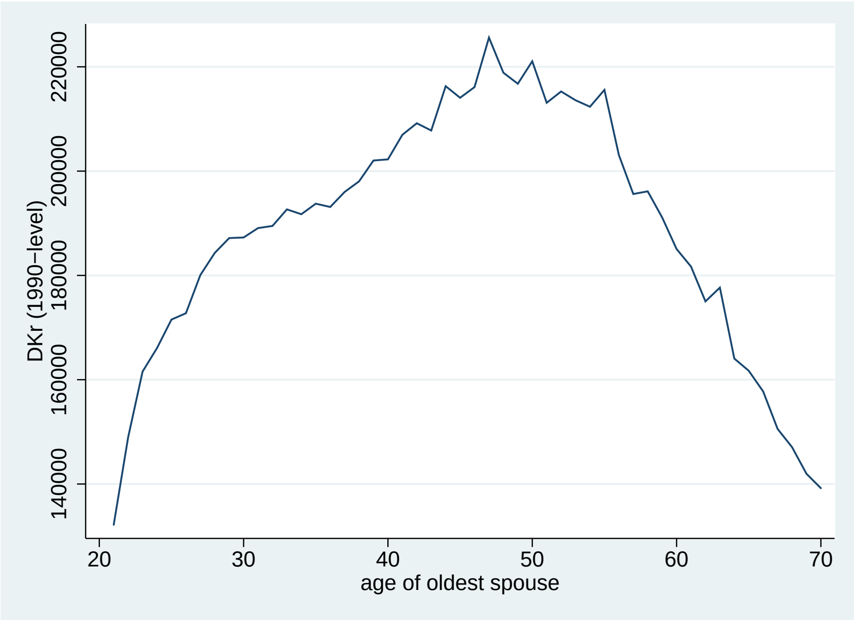


Figure 2a. Regional trends in house prices at different percentiles of the 1985 distribution

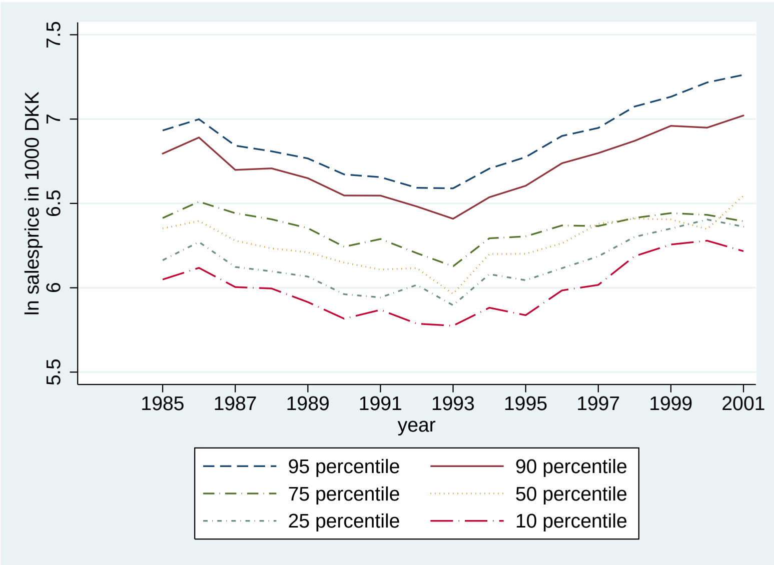
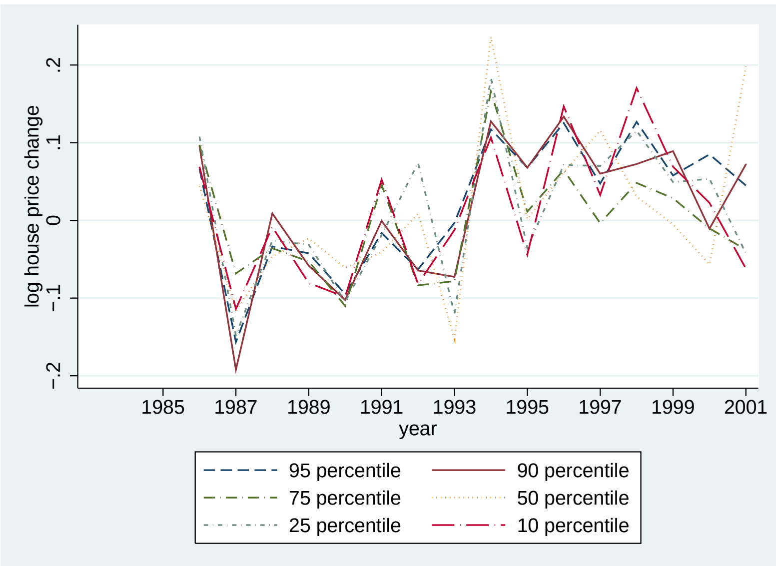
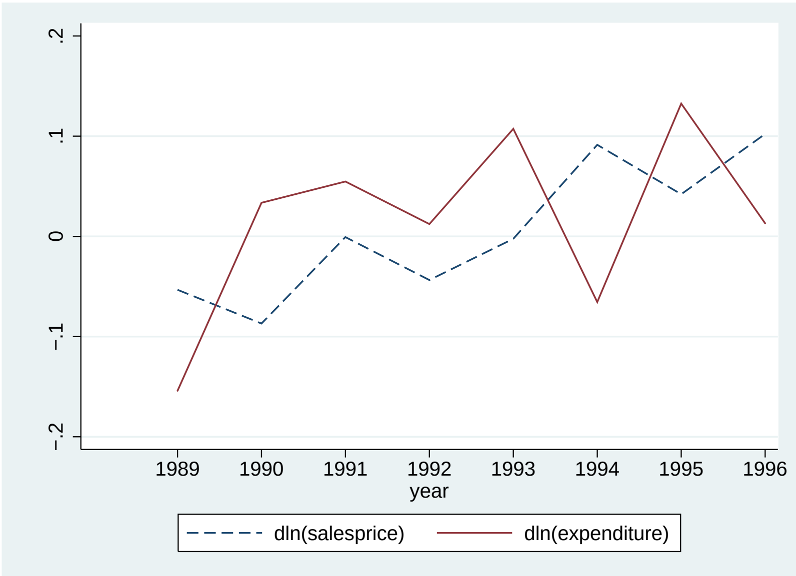


Figure 2b. The evolution of Changes in log of municipal average sales prices, plotted at different percentiles of the 1985 distribution



Source: Sales prices based on traded houses by municipality. Statistics Denmark and publications from Danish tax authorities (Skat).

Figure 3. Average changes in ln(expenditure) and ln(price) of traded houses



Tables to be inserted in the text

Table 1. Institutional setup in the mortgage market before and after 1993

1987-1992	1993-1996
20 year repayment period	30 year repayment period
Fixed interest rate	Fixed interest rate
Refinancing not allowed	Refinancing allowed
No use of equity as collateral	Equity can be used as collateral

Table 2. Average house prices and debt before and after 1993

	1989-1992		1993-1996		% change	
	House value[1]	Debt[2]	House value[1]	Debt[2]	House value	Debt
Young households	539,298 (231,020)	502,148 (251,992)	581,206 (279,705)	488,619 (258,260)	7.77	-2.69
Older households	602,245 (272,020)	366,210 256,709	630,293 (307,425)	364,589 (262,725)	4.66	-0.44

Notes: 1) House value is an imputed sales prices based on the tax value of the house scaled by the relationship between annual municipality-specific sales prices over annual municipality-specific tax values.
2) Debt is defined as mortgage debt and bank debt.
Values in 1990-DKK. Standard deviations in parentheses.

Table 3. Baseline regressions

	(1) Param.		(2) Param.	(3) Param.	(4) Param.
Δp_{it}	0.079	***	0.034		
	(0.028)		(0.028)		
Δp_{it}, young				0.004	
				(0.038)	
Δp_{it}, old				0.024	
				(0.045)	
Δp_{it}, young, <1993					-0.066
					(0.043)
Δp_{it}, old, <1993					0.025
					(0.055)
Δp_{it}, young, $\geq$1993					0.043
					(0.052)
Δp_{it}, old, $\geq$1993					0.003
					(0.078)

Note: Standard errors in parentheses * indicate significance at 10% level. ** indicate significance at 5% level. *** indicate significance at 1% level. The number of observations in all regressions is 328,809. The regression in column (2) also includes a control for the change in income. The regression reported in column (3) includes controls for the change in income with separate parameters for young and old as well as a dummy for old and controls for the real rate of interest, the level of education and for the arrival and exit of children. The regression reported in (4)) includes controls for the change in income, with separate parameters for young and old and before and after 1993, as well as a dummy for old, a dummy for the observation pertaining to an after-reform period and their interaction. Also controls for the real rate of interest, the level of education and for the arrival and exit of children are included.

Table 4. Estimation results, anticipated and unanticipated effects, owner

	(1) All Param. (s.e.)		(2) High/low-liquidity Param. (s.e.)
		High level of Liquid assets:	
$\widehat{E(\Delta p)_{it}}$, young, <1993	-0.044 (0.046)	$\widehat{E(\Delta p)_{it}}$, young, <1993	-0.060 (0.066)
$\widehat{E(\Delta p_{it})}$, old, <1993	0.039 (0.058)	$\widehat{E(\Delta p_{it})}$, old, <1993	0.028 (0.071)
$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	-0.009 (0.059)	$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	-0.059 (0.072)
$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	-0.003 (0.089)	$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	0.049 (0.110)
$\widehat{\theta_{it}^{p}}$, young, <1993	-0.067 (0.043)	$\widehat{\theta_{it}^{p}}$, young, <1993	-0.093 (0.063)
$\widehat{\theta_{it}^{p}}$, old, <1993	0.020 (0.056)	$\widehat{\theta_{it}^{p}}$, old, <1993	-0.020 (0.068)
$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	0.041 (0.051)	$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	-0.052 (0.064)
$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	0.004 (0.082)	$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	0.037 (0.100)
		Low level of Liquid assets:	
		$\widehat{E(\Delta p)_{it}}$, young, <1993	-0.035 (0.062)
		$\widehat{E(\Delta p_{it})}$, old, <1993	0.048 (0.089)
		$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	0.034 (0.073)
		$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	-0.094 (0.129)
		$\widehat{\theta_{it}^{p}}$, young, <1993	-0.052 (0.054)
		$\widehat{\theta_{it}^{p}}$, old, <1993	0.051 (0.087)
		$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	0.131 ** (0.063)
		$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	-0.053 (0.122)
Wald test, θ^{P}			
$\left(\theta_{\geq 1993}^{Old}-\theta_{<1993}^{Old}\right)-\left(\theta_{\geq 1993}^{Young}-\theta_{<1993}^{Young}\right)=0$	0.251		
$\left(\theta_{\geq 1993}^{Old}-\theta_{<1993}^{Old}\right)-\left(\theta_{\geq 1993}^{Young}-\theta_{<1993}^{Young}\right)=0, High$			0.939
$\left(\theta_{\geq 1993}^{Old}-\theta_{<1993}^{Old}\right)-\left(\theta_{\geq 1993}^{Young}-\theta_{<1993}^{Young}\right)=0, Low$			0.050
$\left(\theta_{\geq 1993}^{Young,High}-\theta_{<1993}^{Young,High}\right)-\left(\theta_{\geq 1993}^{Young,Low}-\theta_{<1993}^{Young,Low}\right)=0$			0.203
$\left(\theta_{\geq 1993}^{Old,High}-\theta_{<1993}^{Old,High}\right)-\left(\theta_{\geq 1993}^{Young,Low}-\theta_{<1993}^{Young,Low}\right)=0$			0.323
N	328,809		328,809

Note: Standard errors in parentheses. * indicate significance at 10% level. ** indicate significance at 5% level. *** indicate significance at 1% level. Regressions include dummies for old, for observations pertaining to periods after the reform and their interaction. Moreover regressions include controls for the real rate of interest, controls for education, the arrival and exit of children, year and region dummies and year-region interactions. In both regressions anticipated and unanticipated income are included with a full set of interactions corresponding to those used for the price parameters. Additionally, the regression reported in column (2) includes a dummy for holding low levels of liquid assets and its interaction with the dummy variables for being old and for observations pertaining to the after reform period.

Appendices for

Housing Wealth and Consumption: A Micro Panel Study

By

Martin Browning, Mette Gørtz and Søren Leth-Petersen

Appendix 1. The house price process

In order to distinguish between expected and unexpected house price changes, we investigate the time series characteristics of house prices. Households form expectations about house prices in period *t* based on their observation on house prices in the past in their municipality. We hypothesize that each household forms its expectations about the future development of the price of its house based on information about traded houses in the local area. We assume that house prices follow a first-order autoregressive (AR1) model with unobserved individual-specific effects and serially uncorrelated disturbances:

$$p_{it} = \alpha p_{it-1} + (1-\alpha)\eta_i + \beta x_{it} + v_{it} + m_{it}^p - \alpha m_{it-1}^p, \quad i = 1,...,N, \;\; t = 2,...,T \quad \text{(A1.1)}$$

p_{it} is the natural log of the average price of houses sold in the municipality where household *i* lives, η_i captures unobserved heterogeneity in house prices, x_{it} symbolises observed characteristics of houses in the municipality where household *i* lives (the average size of houses in the municipality measured by the number of square meters and the number of rooms of an average house in the municipality). v_{it} is an independent error term and m_{it}^p and m_{it-1}^p are measurement errors relating to the measurement of house prices. The observations are independent across individuals and we assume that the unobserved components satisfy:

$$E(\eta_i) = E(v_{it}) = E(m_{it}^p) = 0 \; for \;\; i = 1,...,N \;\; and \;\; t = 2,...,T$$

There are two sources of persistence in the model. One source of persistence stems from the autoregressive mechanism described by the AR parameter, α, which is constant across individuals. Another source of persistence comes from unobserved heterogeneity, η_i. A higher AR parameter generally means that more persistence is ascribed to the common autoregressive mechanism and less to unobserved municipality specific effects. In the extreme case of an AR parameter of unity, all persistence in the time series stems from the autoregressive mechanism.

Household expectations on the development of local house prices are formed by $E(\Delta p_{it}) = E(p_{it}) - p_{it-1}$. The unexpected innovation to house prices in period *t* is then:

$$\hat{\theta}_{it}^p = \Delta p_{it} - E[\Delta p_{it}] = p_{it} - p_{i,t-1} - (E[p_{it}] - p_{i,t-1}) = p_{it} - E[p_{it}]$$

Under the assumption that households understand the house price generating process in model (A2.1), expectations on the house price are found by $E(p_{it}) = \hat{p}_{it}$. Thus, estimation of the price process is crucial when distinguishing between unexpected and expected changes in house prices.

Data

The parameters of the house price process in (A1.1) are estimated on a panel data set with information about the average price of traded houses across all municipalities in Denmark collected by the Danish tax authorities and Statistics Denmark. Specifically, the data consists of annual observations on average sales prices of single-family houses in 275 Danish municipalities during the period 1985-2001 (i.e. 275 municipalities observed over 17 years). To each household in the sample we allocate a municipal house price average thereby assuming that households form their expectations based on local (municipality) house prices. We focus on the development in single-family houses, which is by far the most widespread type of owner-occupied housing. Summary statistics are shown in table A1.1 below.

Table A1.1. Summary statistics, house price data

	N	Mean	Std.	Minimum	Maximum
Avg. house price, 1000 Dkr	1150397	684.6	276.8	186.1	2587.6
Avg. square meters	1150397	136.7	10.0	104.8	165.9
Avg. # of rooms	1150397	4.67	0.26	3.9	5.7

Test for nonstationarity of the house price process

In order to establish if unanticipated house price shocks have a lasting effect it is necessary to establish whether the AR1 process is stationary or non-stationary. If the process is nonstationary and carries a unit root the model reduces to a random walk, i.e. $\alpha = 1$. In this case a shock to the price process has a permanent effect on house prices. We are therefore interested in testing the null hypothesis that $\alpha = 1$ against the alternative that $\alpha < 1$.

Bond, Nauges and Windmeijer (2005) suggest combining the insights we get from performing tests of the null based on estimation results from three different estimators:

1. OLS – a t-test of $\alpha = 1$
2. BM: A modified OLS-estimator due to Breitung and Meyer (1994) – a t-test of $\alpha = 1$

3. AHS: A test for the validity of the moment conditions applied when estimating model (A1.1) using Arellano and Bonds (1991) estimator. This test is proposed by Arellano-Hansen-Sentana (1999).

According to Bond, Nauges and Windmeijer (2005), the simple test based on OLS in the levels equation (test no. 1 above) is sensitive to the relationship between the variance of the unobserved heterogeneity and the variance of v_{kt}, i.e. σ_η^2/σ_v^2. To take this problem into account, Breitung and Meyer proposed test no. 2 above which uses OLS estimates on a transformation of model (A1.1), i.e.:

$$\begin{aligned} &p_{it} - p_{i1} = \alpha(p_{i,t-1} - p_{i1}) + \ldots + \varepsilon_{it}, \quad t = 3,\ldots,T \\ &\text{where } \varepsilon_{it} = v_{it} - (1-\alpha)(p_{i1} - \eta_i) \end{aligned} \tag{A1.2}$$

This estimator is upwards biased when $\alpha < 1$, but the power of a test of $\alpha = 1$ is not affected by σ_η^2/σ_v^2. Bond, Nauges and Windmeijer (2005) also suggest testing for a unit root by applying a test for the validity of the moment conditions proposed by Arellano, Hansen and Sentana (AHS, 1999). This is test no. 3 above. The point made by Bond, Nauges and Windmeijer is that when $\alpha = 1$, the rank condition is not satisfied as the instruments are uncorrelated with the endogenous variable, and therefore α is not identified. Thus, the Sargan statistic for overidentifying restrictions has an asymptotic χ^2distribution with T(T-1)/2 degrees of freedom when the model is underidentified. When the Sargan test rejects, the model is not underidentified. For the AR(1) model, a test for identification is equivalent to a unit root test.

The results from the estimation of (A2.1) by OLS, the Breitung-Meyer (BM) estimator and the Arellano and Bond (AB) estimator are shown in the table A1.2. Estimation by OLS gives an estimate of α of 0.977, Breitung-Meyer estimation produces a somewhat smaller estimate of α of 0.94, and estimation using the Arellano-Bond estimator gives an estimate of 0.883. In all three cases, the null hypothesis of $\alpha = 1$ is rejected implying rejection of the unit root hypothesis. Furthermore, the AHS-test based on the Sargan test calculated after estimating the AB-model rejects the null. The results from these three tests lead us to reject the hypothesis of a unit root in the house price process.

Table A1.2. Unit root tests

	Test 1: OLS Coef.		Test 2: Breitung-Meyer Coef.		Test 3: AHS-test Coef.	
p_{kt-1}	0.977	***	0.922	***	0.870	***
	(0.006)		(0.006)		(0.007)	
$\ln\left(\mathrm{m}^2\right)$	0.095	**	0.249	***	-0.276	
	(0.043)		(0.058)		(0.419)	
$\ln(\#\ \mathrm{rooms})$	0.107	*	0.111		-0.087	
	(0.061)		(0.083)		(0.709)	
Constant	-0.514	***	-1.443	***	1.926	*
	(0.150)		(0.218)		(1.079)	
N	835,429		538,808		645,023	
R2	0.93		0.80			
test H0: $\alpha = 1^{\Delta}$, p-value	0.000		0.000		0.000	
Sargan-test, p-value					0.000	

Δ) One-sided alternative, $\alpha < 1$. Note: regressions include county dummies. Standard-errors in parentheses.
* indicate significance at 10% level. ** indicate significance at 5% level. *** indicate significance at 1% level.

Estimation of the house price process

Having established that the house price process is stationary, we apply the estimator for linear dynamic panel data models proposed by Arellano and Bover (1995) Ahn-Schmidt (1995) and Blundell and Bond (1998). This estimator is consistent and efficient for stationary and persistent processes. Results from estimating the house price process are presented in table A1.3.

Table A1.3. Estimation results, house price process

	Coef.	
p_{kt-1}	0.819	***
	(0.021)	
$\ln\left(\mathrm{m}^2\right)$	3.358	***
	(1.052)	
$\ln(\#\ \mathrm{rooms})$	-1.435	
	(1.473)	
N	835,469	
Sargan-test	p=0.000	
Arellano-Bond test of 3rd order autocorrelation	p=0.000	

Note: regressions also include county dummies and a constant. Standard errors in parentheses. *** indicate significance at 1% level.

The relevant instrument set for estimating the parameters of (A1.1) includes lagged levels dated t-3 or earlier as instruments in the differenced equation and lagged first-differences dated t-2 or earlier as instruments in the levels equation, as suggested in Bond (2002). The Arellano-Bond test for no 3rd order autocorrelation was rejected.

Based on the estimation results in table A3.1, we calculate a set of predictions for unexpected house price innovations $\hat{\theta}_{it}^{p} = p_{it} - E(p_{it}) = p_{it} - \hat{p}_{it}$ and expected house price changes $E(\Delta p_{it}) = \hat{p}_{it} - p_{it-1}$.

Appendix 2. The income process

Households' individual expectations to future incomes are assumed to be based on their information about household income in the past. More specifically, we assume an income process where individual income in period *t* is related to income in period *t-1*.

$$y_{it} = \gamma y_{it-1} + (1-\gamma)\mu_i + \phi z_{it} + \kappa_t + u_{it} + m_{it}^y - \alpha m_{it-1}^y \qquad \text{(A2.1)}$$

Where $\boldsymbol{z_{it}}$ is a vector of household characteristics, the presence of children, and age of oldest spouse in the household, μ_i is an individual specific fixed effect and κ_t contains year dummies. u_{it} is an independent error term and m_{it}^y and m_{it-1}^y are measurement errors relating to the measurement of income. The observations are independent across individuals and the unobserved components satisfy:

$$E(\mu_i) = E(u_{it}) = E(m_{it}^y) = 0 \quad \text{for } i = 1,\ldots,N \text{ and } t = 3,\ldots,T$$

As for the house price process the objective is to divide innovations to income in to expected and unexpected innovations. The expected income growth is given by $E(\Delta y_{it}) = \hat{y}_{it} - y_{it-1}$ and the unexpected income growth is $\hat{\theta}_{it}^y = \Delta y_{it} - E(\Delta y_{it}) = y_{it} - E(y_{it}) = y_{it} - \hat{y}_{it}$

Estimation of the income process

The income process is estimated for four education groups separately, the group of households where none of the partners have an education beyond primary school, households where the maximum educational level among the partners is a vocational education, households where the highest education is high school or a short further education, and the group of households where at least one of the partners has a medium-long or longer education. Households are classified according to maximum educational level in the period. Thus, households who shift from being without education to having a short or medium/high education within the period studied are classified according to the educational level that they attain during the period.

The natural log disposable income is the dependent variable. Explanatory variables is the lag of disposable income, $\ln(age)$ (of the oldest spouse) and $\ln(age)^2$, and number of children. Furthermore, we control for year-specific common shocks. Since households belonging to different cohorts are assumed to react differently to common national shocks, we also include an interaction variable of the time dummies and log age.

In order to verify that the income process is stationary it is fist estimated in levels OLS. The OLS estimates of γ in the AR(1) process in (A2.1) are around 0.82 for all four education groups (not reported). Based on the simple t-test on OLS estimates of the AR(1) version of (A2.1), we can reject the hypothesis of a unit root in the income process.

We proceed assuming that the income process is stationary an estimate its parameters employing Arellano and Bovers (1995) estimator as we did for the house price process. The results are shown in table A2.1 below. Overall, we find the autoregressive parameter estimate to be around 0.7-0.8 across educational groups. Based on the estimated parameters we calculate innovations to disposable income as explained above.

Table A2.1 Estimation results, process for disposable income

	Primary school	Vocational education	High school or short further education	Medium or long further education
	Coeff.	Coeff.	Coeff.	Coeff.
y_{it-1}	0.713 ***	0.666 ***	0.636 ***	0. 721 ***
	(0.023)	(0.015)	(0.039)	(0.027)
Number of children	0.015 ***	0.007 ***	0.002	0.007
	(0.003)	(0.001)	(0.003)	(0.002)
age	-0.011 ***	0.014 ***	0.026 ***	0.026 ***
	(0.003)	(0.002)	(0.004)	(0.004)
$\text{age}^2/100$	0.014 ***	-0.011 **	-0.023 **	-0.022 ***
	(0.003)	(0.002)	(0.005)	(0.004)
N	142,850	413,074	60,478	219,027
Sargan test$^{\Delta}$	P=0.000	P=0.000	P=0.000	P=0.000
Arellano-Bond-test$^{\Delta\Delta}$	P=0.227	P=0.429	P=0.677	P=0.441

Note: Year dummies and interactions between year dummies and age are included in the regressions, but results are not reported. * indicate significance at 10% level. ** indicate significance at 5% level. *** indicate significance at 1% level. Standard errors in parentheses.
Δ) Sargan test of overidentifying restrictions
ΔΔ) Arellano-Bond test of 3rd order autocorrelation in residuals

Appendix 3: Estimation results for renters

Table A3.1: anticipated and unanticipated effects. Results for renters

	(1) All Param. (s.e.)		(2) High/low-liquidity Param. (s.e.)
		High level of Liquid assets:	
$\widehat{E(\Delta p)_{it}}$, young , <1993	-0.081 (0.074)	$\widehat{E(\Delta p)_{it}}$, young , <1993	0.005 (0.126)
$\widehat{E(\Delta p_{it})}$, old, <1993	0.033 (0.109)	$\widehat{E(\Delta p_{it})}$, old, <1993	-0.029 (0.208)
$\widehat{E(\Delta p_{it})}$, young, $\geq$1993	0.026 (0.026)	$\widehat{E(\Delta p_{it})}$, young, $\geq$1993	-0.006 (0.067)
$\widehat{E(\Delta p_{it})}$, old, $\geq$1993	0.127 (0.157)	$\widehat{E(\Delta p_{it})}$, old, $\geq$1993	0.168 (0.307)
$\widehat{\theta_{it}^{p}}$, young, <1993	-0.084 (0.073)	$\widehat{\theta_{it}^{p}}$, young, <1993	-0.005 (0.109)
$\widehat{\theta_{it}^{p}}$, old, <1993	0.036 (0.113)	$\widehat{\theta_{it}^{p}}$, old, <1993	-0.086 (0.193)
$\widehat{\theta_{it}^{p}}$, young, $\geq$1993	0.024 (0.024)	$\widehat{\theta_{it}^{p}}$, young, $\geq$1993	0.040 (0.068)
$\widehat{\theta_{it}^{p}}$, old, $\geq$1993	0.112 (0.148)	$\widehat{\theta_{it}^{p}}$, old, $\geq$1993	0.110 (0.292)
		Low level of Liquid assets:	
		$\widehat{E(\Delta p)_{it}}$, young , <1993	-0.100 (0.083)
		$\widehat{E(\Delta p_{it})}$, old, <1993	0.031 (0.130)
		$\widehat{E(\Delta p_{it})}$, young, $\geq$1993	0.034 (0.030)
		$\widehat{E(\Delta p_{it})}$, old, $\geq$1993	0.112 (0.156)
		$\widehat{\theta_{it}^{p}}$, young, <1993	-0.106 (0.088)
		$\widehat{\theta_{it}^{p}}$, old, <1993	0.060 (0.133)
		$\widehat{\theta_{it}^{p}}$, young, $\geq$1993	0.021 (0.024)
		$\widehat{\theta_{it}^{p}}$, old, $\geq$1993	0.103 (0.145)
Wald test, θ^{p}			
$\left(\theta_{\geq 1993}^{Old}-\theta_{<1993}^{Old}\right)-\left(\theta_{\geq 1993}^{Young}-\theta_{<1993}^{Young}\right)=0$	0.900		
$\left(\theta_{\geq 1993}^{Old}-\theta_{<1993}^{Old}\right)-\left(\theta_{\geq 1993}^{Young}-\theta_{<1993}^{Young}\right)=0, High$			0.709
$\left(\theta_{\geq 1993}^{Old}-\theta_{<1993}^{Old}\right)-\left(\theta_{\geq 1993}^{Young}-\theta_{<1993}^{Young}\right)=0, Low$			0.738
$\left(\theta_{\geq 1993}^{Young,High}-\theta_{<1993}^{Young,High}\right)-\left(\theta_{\geq 1993}^{Young,Low}-\theta_{<1993}^{Young,Low}\right)=0$			0.608
$\left(\theta_{\geq 1993}^{Old,High}-\theta_{<1993}^{Old,High}\right)-\left(\theta_{\geq 1993}^{Young,Low}-\theta_{<1993}^{Young,Low}\right)=0$			0.736
N	65,022		65,022

Note: * indicate significance at 10% level. ** indicate significance at 5% level. *** indicate significance at 1% level. Regressions include dummies for old, for observations pertaining to periods after the reform and their interaction. Moreover regressions include controls for the real rate of interest, controls for education, the arrival and exit of children, year and region dummies and year-region interactions. In both regressions anticipated and unanticipated income are included with a full set of interactions corresponding to those used for the price parameters. Additionally, the regression reported in column (2) includes a dummy for holding low levels of liquid assets and its interaction with the dummy variables for being old and for observations pertaining to the after reform period.

Appendix 4: Robustness analyses

Table A4.1: Anticipated and unanticipated effects for owners. Positive versus negative effects.

	(1) All Param. (s.e.)		(2) High/low-liquidity Param. (s.e.)
		High level of Liquid assets:	
$\widehat{E(\Delta p)_{it}}$, young , <1993	-0.049 (0.046)	$\widehat{E(\Delta p)_{it}}$, young , <1993	-0.060 (0.067)
$\widehat{E(\Delta p_{it})}$, old, <1993	0.037 (0.060)	$\widehat{E(\Delta p_{it})}$, old, <1993	0.027 (0.073)
$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	-0.012 (0.059)	$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	-0.062 (0.071)
$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	-0.000 (0.089)	$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	0.051 (0.110)
$\widehat{\theta_{it}^{p}}$, young, <1993, pos	-0.033 (0.057)	$\widehat{\theta_{it}^{p}}$, young, <1993, pos	-0.083 (0.081)
$\widehat{\theta_{it}^{p}}$, old, <1993, pos	0.043 (0.064)	$\widehat{\theta_{it}^{p}}$, old, <1993, pos	0.011 (0.083)
$\widehat{\theta_{it}^{p}}$, young, ≥ 1993, pos	0.059 (0.061)	$\widehat{\theta_{it}^{p}}$, young, ≥ 1993, pos	-0.027 (0.074)
$\widehat{\theta_{it}^{p}}$, old, ≥ 1993, pos	-0.008 (0.092)	$\widehat{\theta_{it}^{p}}$, old, ≥ 1993, pos	0.020 (0.115)
$\widehat{\theta_{it}^{p}}$, young, <1993, neg	-0.086 (0.052)	$\widehat{\theta_{it}^{p}}$, young, <1993, neg	-0.091 (0.077)
$\widehat{\theta_{it}^{p}}$, old, <1993, neg	0.016 (0.066)	$\widehat{\theta_{it}^{p}}$, old, <1993, neg	-0.016 (0.081)
$\widehat{\theta_{it}^{p}}$, young, ≥ 1993, neg	0.024 (0.055)	$\widehat{\theta_{it}^{p}}$, young, ≥ 1993, neg	-0.076 (0.073)
$\widehat{\theta_{it}^{p}}$, old, ≥ 1993, neg	0.017 (0.086)	$\widehat{\theta_{it}^{p}}$, old, ≥ 1993, neg	0.043 (0.106)
		Low level of Liquid assets:	
		$\widehat{E(\Delta p)_{it}}$, young , <1993	-0.040 (0.062)
		$\widehat{E(\Delta p_{it})}$, old, <1993	0.047 (0.091)
		$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	0.033 (0.073)
		$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	-0.090 (0.123)
		$\widehat{\theta_{it}^{p}}$, young, <1993, pos	-0.005 (0.078)
		$\widehat{\theta_{it}^{p}}$, old, <1993, pos	0.051 (0.103)
		$\widehat{\theta_{it}^{p}}$, young, ≥ 1993, pos	0.138 * (0.076)
		$\widehat{\theta_{it}^{p}}$, old, ≥ 1993, pos	-0.062 (0.139)
		$\widehat{\theta_{it}^{p}}$, young, <1993, neg	-0.091 (0.066)
		$\widehat{\theta_{it}^{p}}$, old, <1993, neg	0.044 (0.101)
		$\widehat{\theta_{it}^{p}}$, young, ≥ 1993, neg	0.126 (0.073)
		$\widehat{\theta_{it}^{p}}$, old, ≥ 1993, neg	-0.027 (0.138)

Note: * indicate significance at 10% level. ** indicate significance at 5% level. *** indicate significance at 1% level. Variables for house price shocks have been interacted with dummies indicating whether the shock was positive or negative for the year in question. Regressions include dummies for old, for observations pertaining to periods after the reform and their interaction. Moreover regressions include controls for the real rate of interest, controls for education, the arrival and exit of children, year and region dummies and year-region interactions. In both regressions anticipated and unanticipated income are included with a full set of interactions corresponding to those used for the price parameters. Additionally, the regression reported in column (2) includes a dummy for holding low levels of liquid assets and its interaction with the dummy variables for being old and for observations pertaining to the after reform period.

Table A4.2: Anticipated and unanticipated effects for owners. Inclusion of squared effects.

	(1) All Param. (s.e.)			(2) High/low-liquidity Param. (s.e.)	
			High level of Liquid assets:		
$\widehat{E(\Delta p)}_{it}$, young , <1993	-0.036		$\widehat{E(\Delta p)}_{it}$, young , <1993	-0.053	
	(0.046)			(0.066)	
$\widehat{E(\Delta p_{it})}$, old, <1993	0.057		$\widehat{E(\Delta p_{it})}$, old, <1993	0.044	
	(0.058)			(0.074)	
$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	-0.009		$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	-0.061	
	(0.062)			(0.075)	
$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	-0.049		$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	-0.003	
	(0.092)			(0.117)	
$\widehat{E(\Delta p)}_{it}$, young , <1993, squared	-0.188	*	$\widehat{E(\Delta p)}_{it}$, young , <1993, squared	-0.079	
	(0.109)			(0.064)	
$\widehat{E(\Delta p_{it})}$, old, <1993, squared	-0.271	**	$\widehat{E(\Delta p_{it})}$, old, <1993, squared	0.006	
	(0.132)			(0.069)	
$\widehat{E(\Delta p_{it})}$, young, ≥ 1993, squared	-0.024		$\widehat{E(\Delta p_{it})}$, young, ≥ 1993, squared	-0.055	
	(0.119)			(0.064)	
$\widehat{E(\Delta p_{it})}$, old, ≥ 1993, squared	0.330	*	$\widehat{E(\Delta p_{it})}$, old, ≥ 1993, squared	0.031	
	(0.172)			(0.100)	
$\widehat{\theta_{it}^{p}}$, young, <1993	-0.378	***	$\widehat{\theta_{it}^{p}}$, young, <1993	-0.287	
	(0.045)			(0.193)	
$\widehat{\theta_{it}^{p}}$, old, <1993	0.053		$\widehat{\theta_{it}^{p}}$, old, <1993	0.181	
	(0.055)			(0.186)	
$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	0.040		$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	-0.210	
	(0.051)			(0.164)	
$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	0.001		$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	0.194	
	(0.081)			(0.269)	
$\widehat{\theta_{it}^{p}}$, young, <1993, squared	0.192	*	$\widehat{\theta_{it}^{p}}$, young, <1993, squared	0.149	***
	(0.104)			(0.043)	
$\widehat{\theta_{it}^{p}}$, old, <1993, squared	0.218	*	$\widehat{\theta_{it}^{p}}$, old, <1993, squared	0.018	
	(0.123)			(0.041)	
$\widehat{\theta_{it}^{p}}$, young, ≥ 1993, squared	0.062		$\widehat{\theta_{it}^{p}}$, young, ≥ 1993, squared	0.098	
	(0.117)			(0.033)	
$\widehat{\theta_{it}^{p}}$, old, ≥ 1993, squared	-0.258		$\widehat{\theta_{it}^{p}}$, old, ≥ 1993, squared	0.185	***
	(0.163)			(0.056)	
			Low level of Liquid assets:		
			$\widehat{E(\Delta p)}_{it}$, young , <1993	-0.019	
				(0.064)	
			$\widehat{E(\Delta p_{it})}$, old, <1993	0.074	
				(0.089)	
			$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	0.038	
				(0.078)	
			$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	-0.135	
				(0.133)	
			$\widehat{E(\Delta p)}_{it}$, young , <1993, squared	-0.280	*
				(0.161)	
			$\widehat{E(\Delta p_{it})}$, old, <1993, squared	-0.286	
				(0.209)	
			$\widehat{E(\Delta p_{it})}$, young, ≥ 1993, squared	-0.037	
				(0.153)	
			$\widehat{E(\Delta p_{it})}$, old, ≥ 1993, squared	0.356	
				(0.286)	
			$\widehat{\theta_{it}^{p}}$, young, <1993	-0.005	
				(0.060)	
			$\widehat{\theta_{it}^{p}}$, old, <1993	0.096	
				(0.087)	
			$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	0.131	**
				(0.063)	
			$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	-0.055	
				(0.123)	

		$\widehat{\theta_{it}^{p}}$, young, <1993, squared	0.298 ** (0.140)
		$\widehat{\theta_{it}^{p}}$, old, <1993, squared	0.243 (0.198)
		$\widehat{\theta_{it}^{p}}$, young, $\geq$1993, squared	0.047 (0.146)
		$\widehat{\theta_{it}^{p}}$, old, $\geq$1993, squared	-0.296 (0.271)

Note: * indicate significance at 10% level. ** indicate significance at 5% level. *** indicate significance at 1% level. The regression includes squares of all variables for predicted house price changes and house price shocks. Regressions include dummies for old, for observations pertaining to periods after the reform and their interaction. Moreover regressions include controls for the real rate of interest, controls for education, the arrival and exit of children, year and region dummies and year-region interactions. In both regressions anticipated and unanticipated income are included with a full set of interactions corresponding to those used for the price parameters. Additionally, the regression reported in column (2) includes a dummy for holding low levels of liquid assets and its interaction with the dummy variables for being old and for observations pertaining to the after reform period.

Table A4.3: Anticipated and unanticipated effects for owners. Sample not holding stocks.

	(1) All Param. (s.e.)		(2) High/low-liquidity Param. (s.e.)
		High level of Liquid assets:	
$\widehat{E(\Delta p)}_{it}$, young , <1993	-0.057 (0.047)	$\widehat{E(\Delta p)}_{it}$, young , <1993	-0.076 (0.066)
$\widehat{E(\Delta p_{it})}$, old, <1993	0.043 (0.071)	$\widehat{E(\Delta p_{it})}$, old, <1993	0.039 (0.086)
$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	-0.020 (0.065)	$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	-0.093 (0.081)
$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	0.019 (0.093)	$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	0.040 (0.115)
$\widehat{\theta_{it}^{p}}$, young, <1993	-0.063 (0.044)	$\widehat{\theta_{it}^{p}}$, young, <1993	-0.079 (0.064)
$\widehat{\theta_{it}^{p}}$, old, <1993	0.042 (0.069)	$\widehat{\theta_{it}^{p}}$, old, <1993	0.026 (0.082)
$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	0.032 (0.054)	$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	-0.080 (0.069)
$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	0.053 (0.086)	$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	0.063 (0.108)
		Low level of Liquid assets:	
		$\widehat{E(\Delta p)}_{it}$, young , <1993	-0.044 (0.065)
		$\widehat{E(\Delta p_{it})}$, old, <1993	0.051 (0.111)
		$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	0.043 (0.077)
		$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	-0.005 (0.143)
		$\widehat{\theta_{it}^{p}}$, young, <1993	-0.061 (0.058)
		$\widehat{\theta_{it}^{p}}$, old, <1993	0.037 (0.103)
		$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	0.133 ** (0.065)
		$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	0.043 (0.132)

Note: * indicate significance at 10% level. ** indicate significance at 5% level. *** indicate significance at 1% level. The regression is performed on a subsample not holding stocks (almost ¾ of the standard sample). Regressions include dummies for old, for observations pertaining to periods after the reform and their interaction. Moreover regressions include controls for the real rate of interest, controls for education, the arrival and exit of children, year and region dummies and year-region interactions. In both regressions anticipated and unanticipated income are included with a full set of interactions corresponding to those used for the price parameters. Additionally, the regression reported in column (2) includes a dummy for holding low levels of liquid assets and its interaction with the dummy variables for being old and for observations pertaining to the after reform period.

Table A4.4: Anticipated and unanticipated effects for owners. Specification for three age groups.

	(1) All Param. (s.e.)			(2) High/low-liquidity Param. (s.e.)	
			High level of Liquid assets:		
$\widehat{E(\Delta p)}_{it}$, ageg 1,<1993	-0.132 (0.082)		$\widehat{E(\Delta p)}_{it}$, ageg 1,<1993	-0.204 (0.119)	
$\widehat{E(\Delta p)}_{it}$, ageg2,<1993	0.000 (0.050)		$\widehat{E(\Delta p)}_{it}$, ageg2,<1993	0.018 (0.072)	
$\widehat{E(\Delta p)}_{it}$, ageg3 ,<1993	0.040 (0.058)		$\widehat{E(\Delta p)}_{it}$, ageg3 ,<1993	0.028 (0.071)	
$\widehat{E(\Delta p_{it})}$, ageg1, ≥ 1993	-0.029 (0.094)		$\widehat{E(\Delta p_{it})}$, ageg1, ≥ 1993	-0.124 (0.122)	
$\widehat{E(\Delta p_{it})}$, ageg2, ≥ 1993	-0.002 (0.061)		$\widehat{E(\Delta p_{it})}$, ageg2, ≥ 1993	-0.027 (0.080)	
$\widehat{E(\Delta p_{it})}$, ageg3, ≥ 1993	-0.002 (0.089)		$\widehat{E(\Delta p_{it})}$, ageg3, ≥ 1993	0.050 (0.110)	
$\widehat{\theta_{it}^{p}}$, ageg1,<1993	-0.167 (0.080)	**	$\widehat{\theta_{it}^{p}}$, ageg1,<1993	-0.240 (0.111)	**
$\widehat{\theta_{it}^{p}}$, ageg2,<1993	-0.015 (0.047)		$\widehat{\theta_{it}^{p}}$, ageg2,<1993	-0.018 (0.069)	
$\widehat{\theta_{it}^{p}}$, ageg3,<1993	0.020 (0.056)		$\widehat{\theta_{it}^{p}}$, ageg3,<1993	-0.020 (0.068)	
$\widehat{\theta_{it}^{p}}$, ageg1, ≥ 1993	0.039 (0.079)		$\widehat{\theta_{it}^{p}}$, ageg1, ≥ 1993	-0.092 (0.108)	
$\widehat{\theta_{it}^{p}}$, ageg2, ≥ 1993	0.036 (0.055)		$\widehat{\theta_{it}^{p}}$, ageg2, ≥ 1993	-0.034 (0.075)	
$\widehat{\theta_{it}^{p}}$, ageg3, ≥ 1993	0.004 (0.082)		$\widehat{\theta_{it}^{p}}$, ageg3, ≥ 1993	0.037 (0.100)	
			Low level of Liquid assets:		
			$\widehat{E(\Delta p)}_{it}$, ageg 1,<1993	-0.060 (0.119)	
			$\widehat{E(\Delta p)}_{it}$, ageg2,<1993	-0.018 (0.066)	
			$\widehat{E(\Delta p)}_{it}$, ageg3 ,<1993	0.049 (0.089)	
			$\widehat{E(\Delta p_{it})}$, ageg1, ≥ 1993	0.056 (0.112)	
			$\widehat{E(\Delta p_{it})}$, ageg2, ≥ 1993	0.016 (0.079)	
			$\widehat{E(\Delta p_{it})}$, ageg3, ≥ 1993	-0.093 (0.129)	
			$\widehat{\theta_{it}^{p}}$, ageg1,<1993	-0.090 (0.103)	
			$\widehat{\theta_{it}^{p}}$, ageg2,<1993	-0.028 (0.061)	
			$\widehat{\theta_{it}^{p}}$, ageg3,<1993	0.051 (0.087)	
			$\widehat{\theta_{it}^{p}}$, ageg1, ≥ 1993	0.161 (0.090)	*
			$\widehat{\theta_{it}^{p}}$, ageg2, ≥ 1993	0.109 (0.071)	
			$\widehat{\theta_{it}^{p}}$, ageg3, ≥ 1993	-0.053 (0.122)	

Note: * indicate significance at 10% level. ** indicate significance at 5% level. *** indicate significance at 1% level. Regressions include dummies for old, for observations pertaining to periods after the reform and their interaction. Moreover regressions include controls for the real rate of interest, controls for education, the arrival and exit of children, year and region dummies and year-region interactions. In both regressions anticipated and unanticipated income are included with a full set of interactions corresponding to those used for the price parameters. Additionally, the regression reported in column (2) includes a dummy for holding low levels of liquid assets and its interaction with the dummy variables for being old and for observations pertaining to the after reform period.

Age groups are defined in the following way.
ageg1: Age group 1 – households with oldest spouse younger than 34 in 1989.
ageg2: Age group 2 - households with oldest spouse 35-44 in 1989.
ageg3: Age group 3 - households with oldest spouse older than 45 in 1989.

Table A4.5: Anticipated and unanticipated effects for owners. Sample of young families with children

	(1) All Param. (s.e.)		(2) High/low-liquidity Param. (s.e.)
		High level of Liquid assets:	
$\widehat{E(\Delta p)_{it}}$, <1993	0.007 (0.056)	$\widehat{E(\Delta p)_{it}}$, <1993	0.036 (0.085)
$\widehat{\theta_{it}^{p}}$, <1993	-0.018 (0.050)	$\widehat{\theta_{it}^{p}}$, <1993	-0.024 (0.111)
$\widehat{E(\Delta p_{it})}$, ≥1993	0.033 (0.082)	$\widehat{E(\Delta p_{it})}$, ≥1993	0.007 (0.076)
$\widehat{\theta_{it}^{p}}$, ≥1993	0.090 (0.070)	$\widehat{\theta_{it}^{p}}$, ≥1993	-0.018 (0.100)
		Low level of Liquid assets:	
		$\widehat{E(\Delta p)_{it}}$, <1993	-0.020 (0.073)
		$\widehat{\theta_{it}^{p}}$, <1993	0.072 (0.102)
		$\widehat{E(\Delta p_{it})}$, ≥1993	-0.051 (0.067)
		$\widehat{\theta_{it}^{p}}$, ≥1993	0.178 ** (0.087)

Note: * indicate significance at 10% level. ** indicate significance at 5% level. *** indicate significance at 1% level. Regressions include dummies for old, for observations pertaining to periods after the reform and their interaction. Moreover regressions include controls for the real rate of interest, controls for education, the arrival and exit of children, year and region dummies and year-region interactions. In both regressions anticipated and unanticipated income are included with a full set of interactions corresponding to those used for the price parameters. Additionally, the regression reported in column (2) includes a dummy for holding low levels of liquid assets and its interaction with the dummy variables for being old and for observations pertaining to the after reform period. Young families are families where the oldest spouse is below 44 and who have children below 17 years living at home.

Table A4.6. Anticipated and unanticipated effects for owners based on alternative house price process including year dummies. Year effects included in prediction.

	(1) All Param. (s.e.)		(2) High/low-liquidity Param. (s.e.)
		High level of Liquid assets:	
$\widehat{E(\Delta p)_{it}}$, young , <1993	0.001 (0.056)	$\widehat{E(\Delta p)_{it}}$, young , <1993	0.024 (0.080)
$\widehat{E(\Delta p_{it})}$, old, <1993	0.059 (0.068)	$\widehat{E(\Delta p_{it})}$, old, <1993	0.065 (0.091)
$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	-0.058 (0.074)	$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	-0.052 (0.090)
$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	-0.096 (0.089)	$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	-0.059 (0.125)
$\widehat{\theta_{it}^{p}}$, young, <1993	-0.068 (0.043)	$\widehat{\theta_{it}^{p}}$, young, <1993	-0.096 (0.063)
$\widehat{\theta_{it}^{p}}$, old, <1993	0.020 (0.056)	$\widehat{\theta_{it}^{p}}$, old, <1993	-0.020 (0.068)
$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	0.043 (0.050)	$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	-0.051 (0.064)
$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	0.003 (0.081)	$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	0.033 (0.100)
		Low level of Liquid assets:	
		$\widehat{E(\Delta p)_{it}}$, young , <1993	-0.003 (0.081)
		$\widehat{E(\Delta p_{it})}$, old, <1993	0.088 (0.112)
		$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	-0.073 (0.095)
		$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	-0.091 (0.155)
		$\widehat{\theta_{it}^{p}}$, young, <1993	-0.053 (0.054)
		$\widehat{\theta_{it}^{p}}$, old, <1993	0.050 (0.087)
		$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	0.136 ** (0.063)
		$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	-0.051 (0.122)

Note: * indicate significance at 10% level. ** indicate significance at 5% level. *** indicate significance at 1% level. Regressions include dummies for old, for observations pertaining to periods after the reform and their interaction. Moreover regressions include controls for the real rate of interest, controls for education, the arrival and exit of children, year and region dummies and year-region interactions. In both regressions anticipated and unanticipated income are included with a full set of interactions corresponding to those used for the price parameters. Additionally, the regression reported in column (2) includes a dummy for holding low levels of liquid assets and its interaction with the dummy variables for being old and for observations pertaining to the after reform period.

Table A4.7: Anticipated and unanticipated effects for owners. Inverse hyperbolic sine

	(1) All Param. (s.e.)		(2) High/low-liquidity Param. (s.e.)
		High level of Liquid assets:	
$\widehat{E(\Delta p)_{it}}$, young , <1993	-0.042 (0.044)	$\widehat{E(\Delta p)_{it}}$, young , <1993	-0.059 (0.061)
$\widehat{E(\Delta p_{it})}$, old, <1993	0.041 (0.061)	$\widehat{E(\Delta p_{it})}$, old, <1993	0.029 (0.071)
$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	-0.013 (0.051)	$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	-0.062 (0.064)
$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	-0.004 (0.086)	$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	0.048 (0.109)
$\widehat{\theta_{it}^{p}}$, young, <1993	-0.064 (0.041)	$\widehat{\theta_{it}^{p}}$, young, <1993	-0.091 (0.057)
$\widehat{\theta_{it}^{p}}$, old, <1993	0.021 (0.058)	$\widehat{\theta_{it}^{p}}$, old, <1993	-0.019 (0.070)
$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	0.038 (0.044)	$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	-0.053 (0.059)
$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	0.003 (0.768)	$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	0.037 (0.097)
		Low level of Liquid assets:	
		$\widehat{E(\Delta p)_{it}}$, young , <1993	-0.031 (0.064)
		$\widehat{E(\Delta p_{it})}$, old, <1993	0.050 (0.093)
		$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	0.030 (0.072)
		$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	-0.093 (0.125)
		$\widehat{\theta_{it}^{p}}$, young, <1993	-0.049 (0.057)
		$\widehat{\theta_{it}^{p}}$, old, <1993	0.051 (0.090)
		$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	0.128 ** (0.064)
		$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	-0.055 (0.117)

Note: * indicate significance at 10% level. ** indicate significance at 5% level. *** indicate significance at 1% level. Regressions include dummies for old, for observations pertaining to periods after the reform and their interaction. Moreover regressions include controls for the real rate of interest, controls for education, the arrival and exit of children, year and region dummies and year-region interactions. In both regressions anticipated and unanticipated income are included with a full set of interactions corresponding to those used for the price parameters. Additionally, the regression reported in column (2) includes a dummy for holding low levels of liquid assets and its interaction with the dummy variables for being old and for observations pertaining to the after reform period.

Table A4.8: Anticipated and unanticipated effects for owners. Liquidity constrained if assets less than 0.5 months of disposable income

	High/low-liquidity parameter (se)
High level of Liquid assets:	
$\widehat{E(\Delta p)_{it}}$, young , <1993	-0.052 (0.048)
$\widehat{E(\Delta p_{it})}$, old, <1993	0.021 (0.068)
$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	-0.002 (0.057)
$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	0.022 (0.093)
$\widehat{\theta_{it}^{p}}$, young, <1993	-0.087 * (0.045)
$\widehat{\theta_{it}^{p}}$, old, <1993	-0.014 (0.065)
$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	0.036 (0.050)
$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	0.020 (0.083)
Low level of Liquid assets:	
$\widehat{E(\Delta p)_{it}}$, young , <1993	-0.017 (0.107)
$\widehat{E(\Delta p_{it})}$, old, <1993	0.123 (0.134)
$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	-0.054 (0.092)
$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	-0.093 (0.221)
$\widehat{\theta_{it}^{p}}$, young, <1993	-0.001 (0.090)
$\widehat{\theta_{it}^{p}}$, old, <1993	0.150 (0.134)
$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	0.053 (0.082)
$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	-0.043 (0.208)

Note: * indicate significance at 10% level. ** indicate significance at 5% level. *** indicate significance at 1% level. Regressions include dummies for old, for observations pertaining to periods after the reform and their interaction. Moreover regressions include controls for the real rate of interest, controls for education, the arrival and exit of children, year and region dummies and year-region interactions. In both regressions anticipated and unanticipated income are included with a full set of interactions corresponding to those used for the price parameters. Additionally, the regression reported in column (2) includes a dummy for holding low levels of liquid assets and its interaction with the dummy variables for being old and for observations pertaining to the after reform period.

Table A4.9: Anticipated and unanticipated effects for owners. Liquidity constrained if assets less than 3 months of disposable income

	High/low-liquidity parameter (se)
High level of Liquid assets:	
$\widehat{E(\Delta p)_{it}}$, young , <1993	-0.043 (0.088)
$\widehat{E(\Delta p_{it})}$, old, <1993	0.101 (0.086)
$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	-0.067 (0.085)
$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	0.059 (0.134)
$\widehat{\theta_{it}^{p}}$, young, <1993	-0.095 (0.082)
$\widehat{\theta_{it}^{p}}$, old, <1993	-0.015 (0.086)
$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	-0.087 (0.079)
$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	0.065 (0.115)
Low level of Liquid assets:	
$\widehat{E(\Delta p)_{it}}$, young , <1993	-0.046 (0.054)
$\widehat{E(\Delta p_{it})}$, old, <1993	-0.006 (0.078)
$\widehat{E(\Delta p_{it})}$, young, ≥ 1993	0.007 (0.060)
$\widehat{E(\Delta p_{it})}$, old, ≥ 1993	-0.062 (0.101)
$\widehat{\theta_{it}^{p}}$, young, <1993	-0.056 (0.049)
$\widehat{\theta_{it}^{p}}$, old, <1993	0.010 (0.074)
$\widehat{\theta_{it}^{p}}$, young, ≥ 1993	0.088 * (0.052)
$\widehat{\theta_{it}^{p}}$, old, ≥ 1993	-0.053 (0.092)

Note: * indicate significance at 10% level. ** indicate significance at 5% level. *** indicate significance at 1% level. Regressions include dummies for old, for observations pertaining to periods after the reform and their interaction. Moreover regressions include controls for the real rate of interest, controls for education, the arrival and exit of children, year and region dummies and year-region interactions. In both regressions anticipated and unanticipated income are included with a full set of interactions corresponding to those used for the price parameters. Additionally, the regression reported in column (2) includes a dummy for holding low levels of liquid assets and its interaction with the dummy variables for being old and for observations pertaining to the after reform period.