

Abildgren, Kim; Hansen, Niels Lynggård; Kuchler, Andreas

Working Paper

Overoptimism and house price bubbles

Danmarks Nationalbank Working Papers, No. 109

Provided in Cooperation with:

Danmarks Nationalbank, Copenhagen

Suggested Citation: Abildgren, Kim; Hansen, Niels Lynggård; Kuchler, Andreas (2016) : Overoptimism and house price bubbles, Danmarks Nationalbank Working Papers, No. 109, Danmarks Nationalbank, Copenhagen

This Version is available at:

<https://hdl.handle.net/10419/171803>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

DANMARKS
NATIONALBANK

WORKING PAPERS

October 2016 | No. 109

OVEROPTIMISM AND HOUSE PRICE BUBBLES

Kim Abildgren, Niels Lynggård Hansen and
Andreas Kuchler
Danmarks Nationalbank



DANMARKS
NATIONALBANK

The Working Papers of Danmarks Nationalbank describe research and development, often still ongoing, as a contribution to the professional debate.

The viewpoints and conclusions stated are the responsibility of the individual contributors, and do not necessarily reflect the views of Danmarks Nationalbank.

As a general rule, Working Papers are not translated, but are available in the original language used by the contributor.

Danmarks Nationalbank's Working Papers are published in PDF format at www.nationalbanken.dk. A free electronic subscription is also available at this Web site.

The subscriber receives an e-mail notification whenever a new Working Paper is published.

Please direct any enquiries to
Danmarks Nationalbank,
Communications,
Havnegade 5,
DK-1093 Copenhagen K
Denmark
E-mail: kommunikation@nationalbanken.dk

Text may be copied from this publication provided that Danmarks Nationalbank is specifically stated as the source. Changes to or misrepresentation of the content are not permitted.

Nationalbankens Working Papers beskriver forsknings- og udviklingsarbejde, ofte af foreløbig karakter, med henblik på at bidrage til en faglig debat.

Synspunkter og konklusioner står for forfatterens regning og er derfor ikke nødvendigvis udtryk for Nationalbankens holdninger.

Working Papers vil som regel ikke blive oversat, men vil kun foreligge på det sprog, forfatterne har brugt.

Danmarks Nationalbanks Working Papers er tilgængelige på www.nationalbanken.dk i pdf-format. På hjemmesiden er det muligt at oprette et gratis elektronisk abonnement, der leverer en e-mail notifikation ved enhver udgivelse af et Working Paper.

Henvendelser kan rettes til:
Danmarks Nationalbank,
Kommunikation,
Havnegade 5,
1093 København K.
E-mail: kommunikation@nationalbanken.dk

Det er tilladt at kopiere fra Nationalbankens Working Papers forudsat, at Danmarks Nationalbank udtrykkeligt anføres som kilde. Det er ikke tilladt at ændre eller forvanske indholdet.

ISSN (online) 1602-1193

DANMARKS NATIONALBANK **WORKING PAPERS**

OVEROPTIMISM AND HOUSE PRICE BUBBLES

Contact for this working paper:

Kim Abildgren
Danmarks Nationalbank
kpa@nationalbanken.dk

Niels Lynggård Hansen
Danmarks Nationalbank
nlh@nationalbanken.dk

Andreas Kuchler
Danmarks Nationalbank
aku@nationalbanken.dk

RESUME

Overoptimisme og boligprisbobler

I papiret undersøges betydningen af overoptimisme for boligprisudviklingen i Danmark. Der findes tegn på, at den historiske boligprisudvikling delvist har været drevet af optimisme uden baggrund i fundamentale økonomiske faktorer, især i perioder med kraftige boligprisstigninger. Det understreger nødvendigheden af en stabilitetsorienteret økonomisk politik i perioder med et stramt arbejdsmarked og en høj grad af kapacitetsudnyttelse i økonomien. Analysen er baseret på data fra de danske forbrugerforventningsundersøgelser. Der anvendes såvel aggregerede data fra undersøgelserne som de underliggende mikrodata kombineret med data fra administrative registre på husholdningniveau. Der er tale om det første papir, som kombinerer anvendelsen af alle tre typer af data. I den makroøkonometriske del af papiret anvendes en almindelig strukturel VAR-model til at undersøge de historiske links mellem forbrugertillid og boligpriser. Analysen indikerer, at eksogene stød til forbrugertilliden bidrog til opgangen i boligpriserne i såvel midten af 1980'erne som i midten af 2000'erne. Resultaterne i den mikroøkonometriske del af papiret indikerer, at overoptimistiske husholdninger i 2000'erne var mere tilbøjelige til at købe fast ejendom end andre husholdninger. De valgte ligeledes en højere belåningsgrad, når de købte fast ejendom. Endelig viser analysen, at der var en særlig høj andel af overoptimistiske husholdninger, som gennemførte bolighandler under den kraftige opgang i boligpriserne i midten af 2000'erne.

ABSTRACT

Overoptimism and house price bubbles

This paper explores the significance of overoptimism on house price developments in Denmark. The results indicate that house price developments historically have been partly driven by sentiments decoupled from underlying economic fundamentals, especially during strong house price booms. This underlines the need for a prudent macroeconomic stabilisation policy in periods with tight labour markets and a high degree of capacity utilisation. The paper is based on both aggregated data from the Danish Consumer Expectations Survey as well as the underlying household-level microdata behind the survey matched with administrative register data at a household level. This is the first paper that combines the use of all these three types of data. The macroeconomic part of the paper uses a standard structural VAR model to explore the historical linkages between the consumer confidence index and house prices. The analysis suggests that exogenous sentiment shocks contributed to the house price booms in both the mid-1980s and the mid-2000s. The microeconomic part of the paper finds that overoptimistic households in the 2000s were more likely to purchase real estate compared to other households, and that they leveraged more when purchasing real estate. Finally, the share of overoptimistic households involved in real estate trades was particularly large during the strong house-price boom in the mid-2000.

KEY WORDS

Consumer sentiment; consumer confidence; house price bubbles; SVAR models; microdata.

JEL CLASSIFICATION

D10; D14; E31; E32.

ACKNOWLEDGEMENTS

The authors wish to thank Richard Curtin, University of Michigan, for valuable comments on a preliminary version of this paper. We also gratefully acknowledge comments by colleagues from Danmarks Nationalbank and by seminar participants at the Bank of England 2016 Chief Economists' Workshop, the 2016 EPRN Conference in Copenhagen and the 2016 CIRET Conference in Copenhagen.

1. INTRODUCTION

The recent international financial crisis has fuelled an active research interest in the key drivers of macroeconomic imbalances and financial instability. One of the topical issues is the significance played by consumer sentiments in relation to developments in house prices and in particular possible cases of house-price bubbles.

The idea that sentiments or confidence plays an important role in economic fluctuations and asset price formation goes a long way back. Optimism and pessimism played a dominant role in the macroeconomic business cycle models of the 1920s and 1930s. In his "Industrial Fluctuations" Pigou (1927) remarked that:

"... a significant part in building up the recorded rhythm of industry is played by the mutual generation of errors of pessimism and errors of optimism." (Pigou, 1927, Chapter XXII, p. 209).

and in his "General Theory" Keynes (1936) noted that:

"Most, probably, of our decisions to do something positive, the full consequences of which will be drawn out over many days to come, can only be taken as a result of animal spirits – of a spontaneous urge to action rather than inaction, and not as the outcome of a weighted average of quantitative benefits multiplied by quantitative probabilities." (Keynes, 1936, Chapter 12.VII, p. 161).

Shiller (2005, 2008) has more recently pointed at "animal spirits" as a factor that drives the stock markets and the real estate markets, and Akerlof and Shiller (2009) have argued that over-optimism played a key role in generating and amplifying the most recent international financial crises:

"The idea that economic crises, like the current financial and housing crisis, are mainly caused by changing thought patterns goes against standard economic thinking. But the current crisis bears witness to the role of such changes in thinking. It was caused precisely by our changing confidence, temptations, envy, resentment, and illusions – and especially by changing stories about the nature of the economy. These intangibles were the reason why people paid small fortunes for houses in cornfields; why others financed those purchases; why the Dow Jones average peaked above 14,000 and a little more than a year later fell below 7,000... " (Akerlof and Shiller, 2009, p. 4).

Following these lines of reasoning, it might be argued that consumer confidence partly reflects elements of optimism and pessimism decoupled from underlying economic fundamentals and that such behavioural and psychological factors might influence spending and investment decisions and thereby can have a causal effect on current and future economic activity (Ludvigson, 2004; Malmendier and Taylor, 2015). However, consumer confidence is also an endogenous variable that reflects current economic fundamentals and expectations about future economic fundamentals formed on the basis of news received by households. This makes it

difficult to identify the exact nature of the links between consumer sentiments and other economic variables in empirical studies.

In this paper we explore the significance of nonfundamentals-based sentiments in house price developments in Denmark using both aggregated data from the Danish Consumer Expectations Survey as well as the underlying household-level microdata behind the survey matched with administrative register data at a household level. This is the first paper that combines the use of all these three types of data.

In the macroeconometric part of our paper we explore the linkages between consumer confidence and house prices within the framework of a standard structural VAR model. The idea is to get a rough feel for the magnitude of the main correlations in the data without imposing too much structure on the model. Our model is estimated on the basis on quarterly data for the Danish economy spanning the past 40 years or so and includes real GDP, consumer prices, the short-term interest rate, house prices, share prices and consumer confidence as endogenous variables. By including share prices in the system, we make an attempt to control for news shocks regarding future economic fundamentals. We find a significant transitory effect on nominal house prices from exogenous shocks to consumer confidence. Furthermore, we find that sentiment shocks contributed to the house price booms in both the mid-1980s and the mid-2000s.

The microeconomic part of the study is based on household-level microdata from the monthly Danish Consumer Expectations Survey 2002-2013. Since Statistics Denmark knows the identity of each participating household, we are able to combine the qualitative information from the surveys with household-level information on income and other background variables drawn from a range of annual register datasets. We find that overoptimistic households were more likely to buy real estate compared to other households, particularly in the pre-crisis period. Furthermore, the share of overoptimistic households involved in real estate trades was particularly large during the house-price boom in the mid-2000. And finally, overoptimistic households may have contributed to an upward pressure on house prices by leveraging to a larger extent than other households.

Overall, our analysis indicates that house price developments in Denmark historically have been partly driven by sentiments decoupled from underlying economic fundamentals, especially during strong house price booms. This underlines the need for a prudent macroeconomic stabilisation policy in periods with tight labour markets and a high degree of capacity utilisation.

2. A BRIEF REVIEW OF RELATED LITERATURE

The literature based on macroeconomic data has been somewhat divided on the issue whether shocks to aggregate consumer confidence indices reflect "nonfundamentals-based sentiments" or "news" (Jaimovich and Rebelo, 2007). Blanchard (1993) represents a seminal contribution to the "sentiments" or "behavioural" view on confidence shocks. His paper presented a bivariate VAR model estimated on quarterly US data for the period 1959-92 with consumption of non-durable goods and services and real GDP as endogenous variables. The analysis showed that the 1990-91 recession in the US economy was the result of a negative shock to consumption that had a long-lasting effect on output. Blanchard concluded that the consumption shock at least to some extent was caused by "animal spirits". Other VAR-based papers that subscribes to the "sentiments" view on confidence shocks include Fuhrer (1993), Farmer and Guo (1994), Matsusaka and Sbordone (1995), Chauvet and Guo (2003), Golinelli and Parigi (2004) and Ling *et al.* (2015).

The "news" strand of the VAR-based macro literature includes contributions from Cochrane (1994), Doms and Morin (2004) and Barsky and Sims (2012). The latter estimates a VAR model on

quarterly US data for the period 1960-2008 with real consumption, real GDP, inflation, real interest rate and consumer confidence as endogenous variables. Barsky and Sims conclude that the empirically observed relationship between shocks to consumer confidence and future economic activity mainly reflects news shocks regarding future productivity not reflected in current economic activity rather than a causal effect of "pure sentiments" or "animal spirits" on economic activity. However, they make no attempt to control for news shocks in order to identify truly exogenous shocks to consumer confidence.

The microeconomic part of the paper relates to a growing strand of literature, which investigates behavioural implications of household expectations. A recent contribution is the study by Hyytinen and Putkuri (2012), who find that households making large optimistic forecast errors carry greater levels of debt than other households. Previous studies along the same line include Brown and Taylor (2006), Puri and Robinson (2007), Mitchell and Weale (2007), and Souleles (2004). Brown and Taylor (2006) study determinants of financial expectations as well as the subsequent impact of financial expectations on consumption and savings. They find that individual financial predictions are influenced by both the life cycle and the business cycle and in addition that more optimistic households have lower savings. Mitchell and Weale (2007) also find that rationality in expectations formation varies with the life cycle. In addition, they find that households are more optimistic about the future when they have recently seen their income rise. Puri and Robinson (2007) find, among other things, that optimists work longer, invest more in individual stocks and save more. However, they also find that moderate optimists display more reasonable financial behaviour than extreme optimists. In contrast to the wide range of outcomes studied by Puri and Robinson, Souleles (2004) focuses on households' expectations and forecast errors. He finds that there are systematic forecast errors, and that these are correlated with demographic characteristics. Furthermore, based on a matching approach between two datasets covering different sets of households, one measuring consumer sentiment and one measuring expenditure, the study finds a relation between (estimated) consumer sentiments and subsequent consumption.

Our study also builds upon the broader literature on the impact of behavioural aspects and beliefs on household financial behaviour. For a recent review, see Campbell et al. (2011). This literature, for example, documents a large variation in financial literacy (Lusardi et al., 2010), which impacts household debt market outcomes (Disney and Gathergood, 2013; Lusardi and Mitchell, 2014; Stango and Zinman, 2009). An alternative explanation for variation in household debt market outcomes is found by studies focusing on time preferences, mostly finding evidence that impatient individuals are more likely to e.g. incur higher credit card debt (Meier and Sprenger, 2010) and save less (Hastings and Mitchell, 2011). This relation is even evident for children and adolescents (Sutter *et al.*, 2013).

Finally, our study builds upon insights from economic psychology. Most relevant is Bovi (2009), who study formation of expectations and forecasts in the context of consumer confidence surveys across 10 countries. Among other conclusions, he finds that people in general are overcritical ex post and overoptimistic ex ante. In addition, he finds evidence that people systematically tend to expect that the financial situation of their own household will get better than the economic situation in general (the same result is found for backward-looking assessments). He sums up his observations in the following mantra, which seem to be guiding the response of the average participant in consumer confidence surveys: "As usual, it has got worse than I expected. Especially for the others. Nevertheless, I still think that it will get better. Especially for me." (Bovi, 2009, p. 571). To the extent that such systematic overoptimism is correlated with e.g. the business cycle and that it affects e.g. the propensity to purchase real estate, it may have a pro-cyclical aggregate impact on the real estate market.

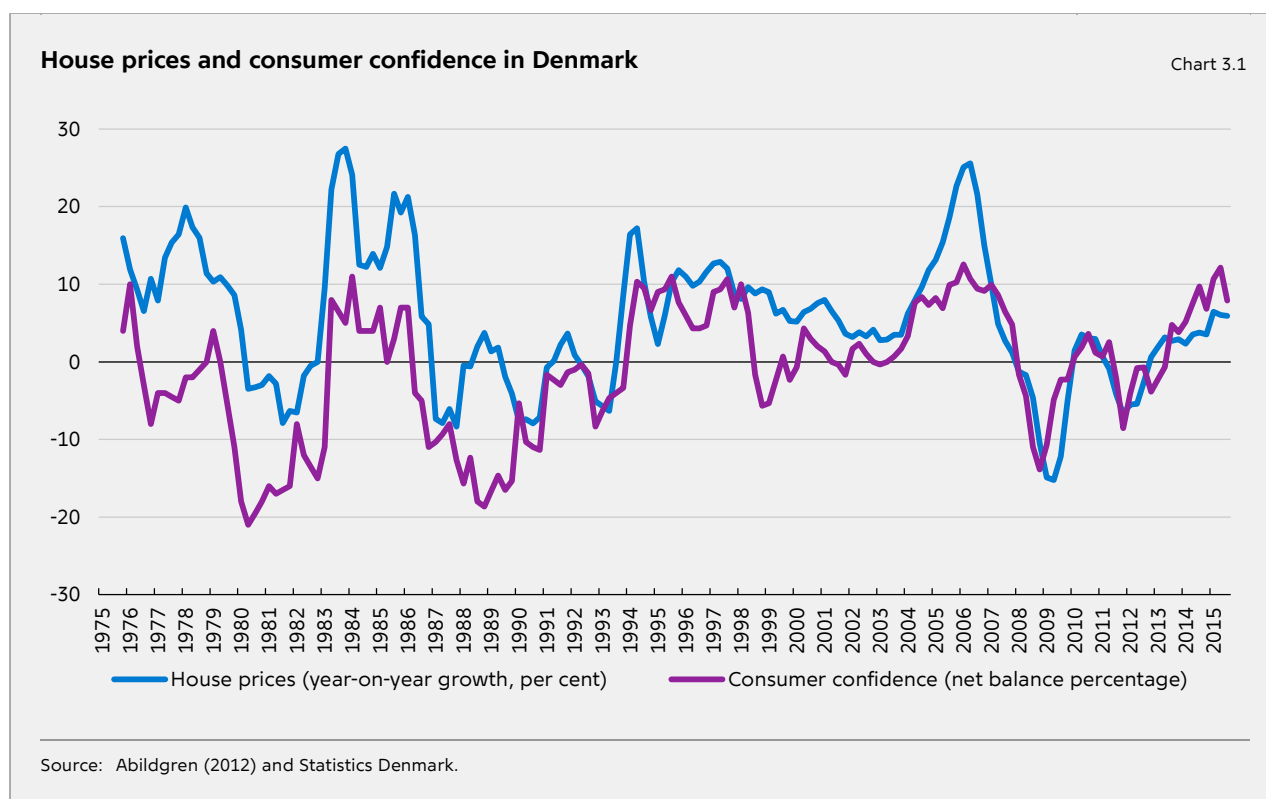
Our main contribution to the literature is that we are able to draw insights on the significance of nonfundamentals-based sentiments on house prices in Denmark using both aggregate data from the Danish Consumer Expectations Survey as well as the underlying household-level microdata behind the survey matched with administrative register data at a household level. To our knowledge this is the first paper that combines the use of all these three types of data.

Further, while earlier literature mentioned above has primarily focused on financial behaviour, this paper explores the impact of consumer sentiment on housing market outcomes at the household level. The fact that housing market decisions are relatively rare (only 3-6 per cent of households in our sample purchases real estate in a given year) implies that a large sample is needed in order to have enough observations in which households are active on the housing market. Furthermore, the sample period for our microdata covers both a period with a strong house price boom as well as a subsequent crisis period, which enables us to study the interaction between consumer sentiment and the business cycle.

Finally, our use of administrative registers to measure characteristics of households (such as income) in the sample is an advantage compared to most of the literature, which is based on survey information only. Administrative data is usually considered to have a higher quality and allow us to track households over time.

3. VAR-BASED EVIDENCE ON CONSUMER CONFIDENCE AND HOUSE PRICES

Chart 3.1 shows the development in consumer confidence and house prices in Denmark since the mid-1970s. There seems to be a strong correlation between the two series. This might, however, reflect that both house prices and consumer confidence respond to business cycle factors. In this section we wish to explore to what extent exogenous sentiment shocks contribute to movements in house prices.



Standard structural vector autoregressive (SVAR) models have previously found widespread use in studies on the links between consumer sentiments and economic activity, mainly income and consumption. In such models each endogenous variable is explained by its own lagged values and the lagged values of the other variables in the system. Combined with certain identifying restrictions, the models can be used to trace the effects on the economy of exogenous structural shocks to the endogenous variables (Stock and Watson, 2001).

Our dataset covers the period 1974q4-2015q3 and is drawn from Abildgren (2012), Statistics Denmark and Danmarks Nationalbank. The estimated SVAR model contains six endogenous variables. The first block of variables consists of the real gross domestic product (GDP), the consumer price index (CPI) and a short-term interest rate (the marginal lending rate of the central bank of Denmark). These three variables are usually found in the standard models used in the VAR-based literature on monetary transmission.

The second block of variables consists of a house price index and a share price index. Such variables are often included in VAR analyses of macro-financial linkages.

The third and last block of variables consists of the consumer confidence index only. The consumer confidence is a composite indicator that summarises the responses to the following 5 questions: (1) General economic situation in Denmark now; (2) General economic situation in Denmark 12 months from now; (3) Financial situation of the family now; (4) Financial situation of the family 12 months from now; and (5) Major purchases at the time of the interview now. The net balance percentages are calculated as the difference between the number of positive and negative answers and may vary from -100 to +100.

Guided by various information criteria as well as the wish for a parsimonious specification, we included one lag of each endogenous variable in our model as well as constant terms, seasonal dummies and linear time trends. We relied on a Cholesky factorisation of the variance-covariance matrix of the unrestricted reduced-form VAR to identify the structural shocks.

The ordering of the endogenous variables in the model was as listed above. The ordering allows asset prices to respond immediately to shocks to real GDP, CPI and the interest rate. The consumer confidence index was placed last in the ordering to ensure that the estimated effects from a sentiment shock to the widest possible extent are "cleaned" from movements in and shocks to the other variables in the system. The model thus has the most "conservative" ordering of the endogenous variables in relation to tracing effects from confidence shocks. On the other hand this implies that there is a stronger case for the existence of effects from exogenous confidence shocks if these can be traced in a model with conservative ordering.

By including share prices in the system we made an attempt to control for news shocks regarding future economic fundamentals. The underlying assumption is that news shocks regarding future economic fundamentals will be captured by structural shocks to the share price index which is ordered before consumer confidence in the model. The aim is to ensure a clearer econometric identification of truly exogenous shocks to consumer confidence, which might be interpreted as "pure sentiments" shocks.

All the endogenous variables in the models are in log-levels except the interest rate and consumer confidence which are in levels. According to Sims *et al.* (1990) the parameters describing the system dynamics and hence impulse responses will be estimated consistently in a SVAR model in levels even if some or all of the variables are non-stationary.

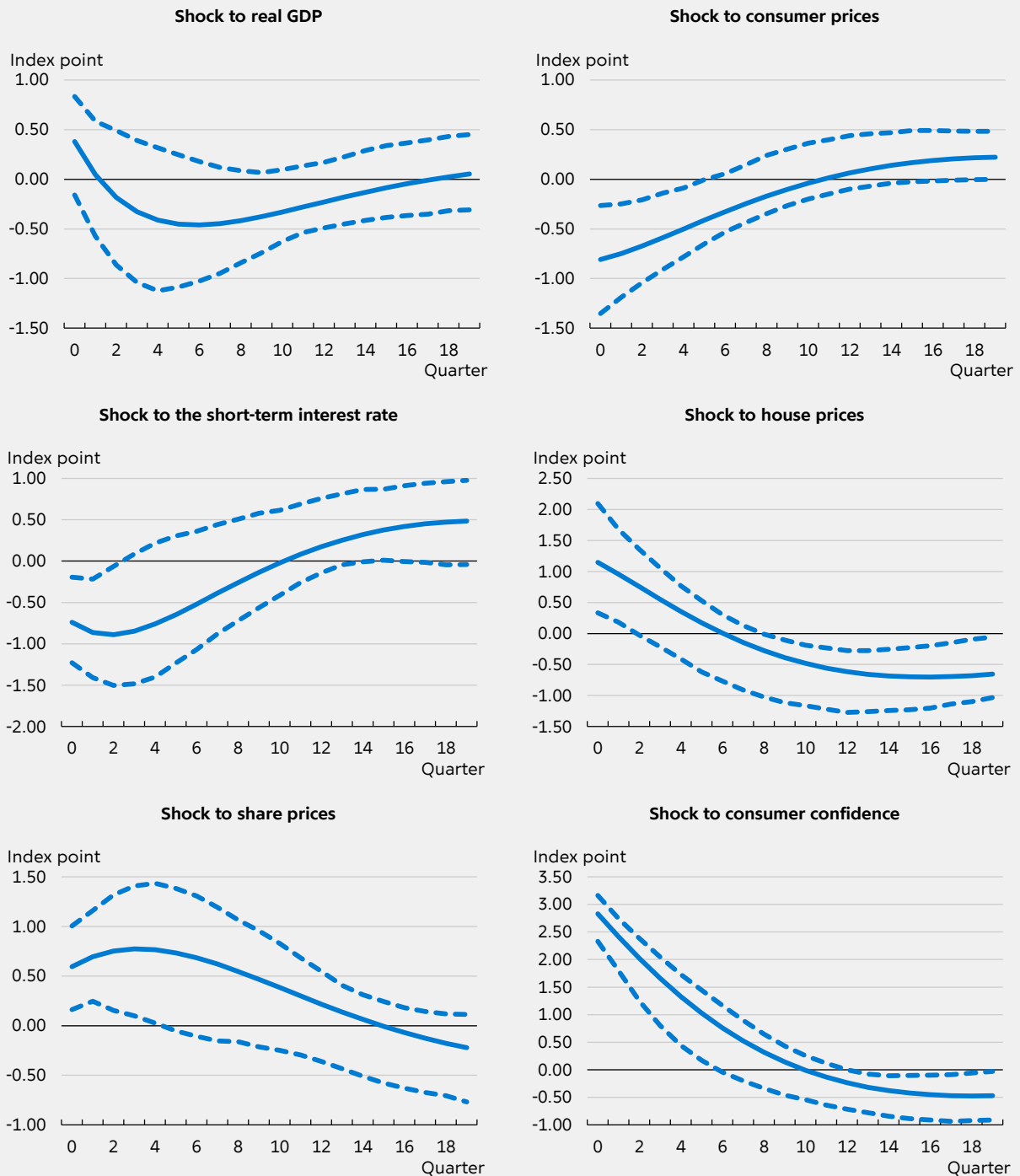
Finally, it should be mentioned that all the variables are in nominal terms except real GDP. We focus on nominal house prices since the nominal market value of a house usually serves as collateral in nominal loan contracts.

Chart 3.2 shows the response of the consumer confidence index to shocks to the other variables in the system. It clearly illustrates the endogenous nature of the variable. Consumers

become more optimistic when house prices and asset prices increase and more pessimistic when the interest rate or the CPI increase. One might further note that there also seems to be a high degree of persistence in confidence shocks: An exogenous sentiment shock will keep consumer optimism higher than the underlying baseline for around two and a half year.

Responses of consumer sentiments to a one standard error positive exogenous shock to the other variables

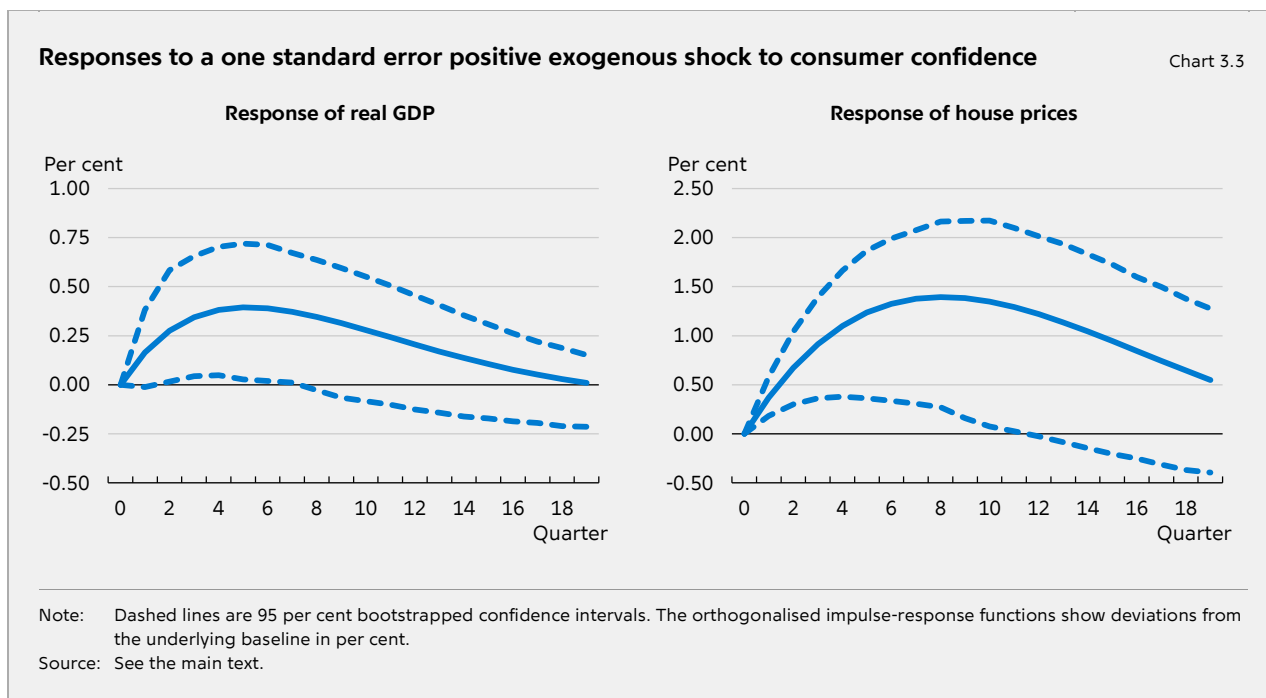
Chart 3.2



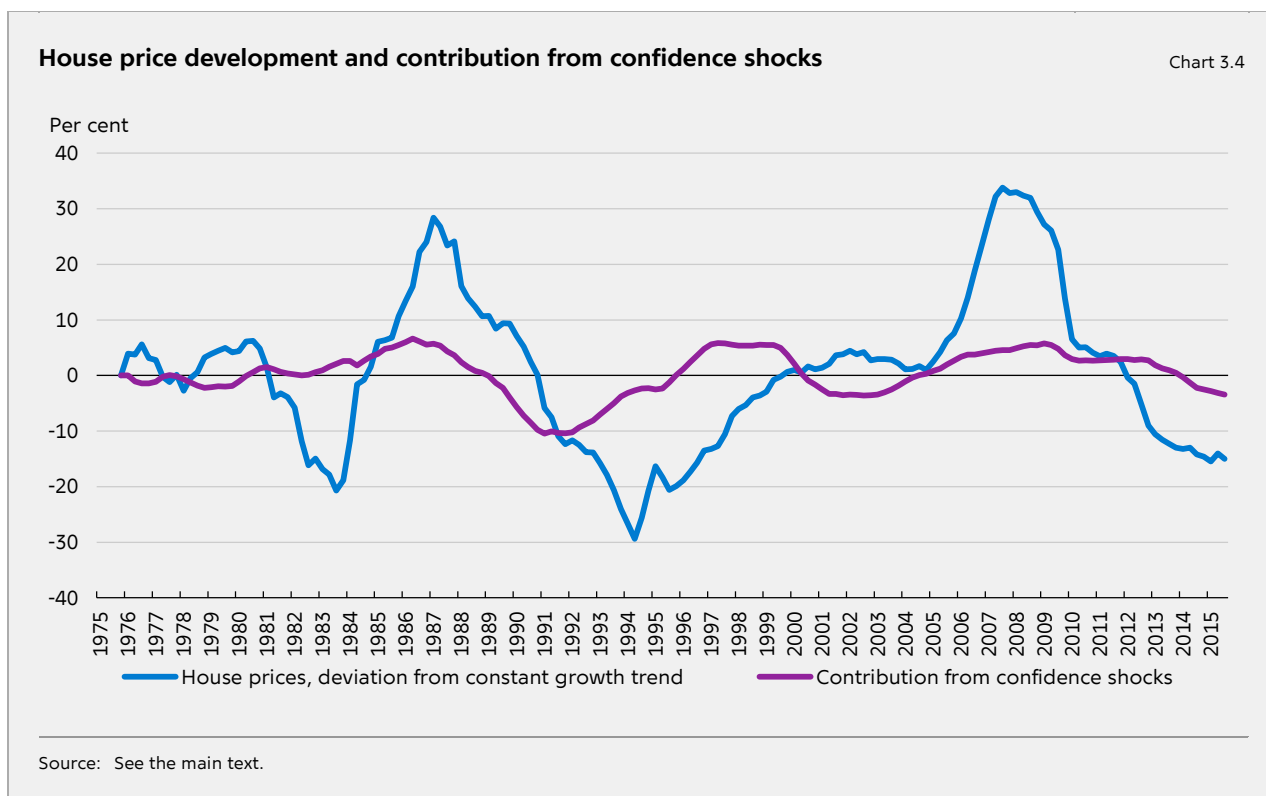
Note: Dashed lines are 95 per cent bootstrapped confidence intervals. The orthogonalised impulse-response functions show deviations from the underlying baseline in per cent, except for the interest rate and the consumer confidence index, which show deviations from the baseline in percentage points or index points.

Source: See the main text.

The estimated responses of real GDP and nominal house prices to a positive exogenous shock to consumer confidence are shown in chart 3.3. There seems to be a clear positive transitory effect on output and house prices if consumers suddenly become more optimistic.



In chart 3.4 we show the historical development in nominal house prices measured as deviation from a constant growth trend together with the contribution from confidence shocks to this development. The chart suggests that sentiment shocks at least to some degree contributed to the house price booms in both the mid-1980s and the mid-2000s.



Identification is always an issue in relation to SVAR models. We might for instance have omitted relevant variables that drive some of those shocks to consumer confidence, that are identified as exogenous. Non-linear, asymmetric or time-varying interactions between consumer confidence and other economic variables might also explain some of those exogenous sentiment shocks that are identified in our model.

4. OVEROPTIMISM AND THE REAL ESTATE MARKET: MICROECONOMETRIC EVIDENCE

We now turn to the relationship between overoptimism and the real estate market at the microeconomic level. We start by presenting the data and discussing the measure of overoptimism. Then, we proceed by characterising the relation between overoptimism and the real estate market before, during and after the crisis by a series of graphs. And finally, we test the relations in a formal econometric analysis aimed at evaluating more precisely the effect of overoptimism on the probability of being involved in a real estate trade in each year in the sample period as well as on the possible impact of overoptimism on leverage and, thereby, house prices.

Naturally, uncertainty gives rise to a certain difference between households' expectations regarding their own future financial situation and an ex post or realized measure of their future financial situation. Our empirical strategy is based on the assumption that systematic components associated with expectational errors can be used to form a measure of overoptimism. Specifically, our indicator of overoptimism is based on a comparison between households' expectations and subsequently realized outcomes.

4.1 THE DATASET

The micro dataset used in this study is based on two components, namely a survey component and a register component. The dataset covers the years 2002-2013.

The survey component consists of the micro-level data underlying the consumer confidence indicator used in section 3. The data is collected as part of the Danish Consumer Expectations Survey (CES) which follows guidelines laid out by the European Commission. The survey is based on a nationally representative sample of persons aged 16-74 years. Every month, a cross section of 1500 households is sampled by Statistics Denmark to participate in a telephone interview. The average response rate is around two-thirds. A range of questions regarding households' expectations about household level and economy-wide economic developments are covered by the survey.

The second component of the micro dataset takes advantage of the fact that Statistics Denmark knows the identity of the individuals surveyed in the CES. Therefore, through the personal identification number, Statistics Denmark is able to merge the survey responses to register-based information from a wide range of registers. To be more specific, we use administrative data from the following registers:

- Personal income register: Income, assets, debt, savings.
- Population and family registers: Age, residence, family relations.
- Register of ownership of real estate: Real estate ownership.
- Property registers: Public valuation, sales prices.
- Register of families' wealth and debt: Real estate wealth, car purchase, pension wealth.
- Integrated database for labour market research: Employment status.
- Education register: Education.

- Register of usage of hospital services: Hospital admission.
- Register of mortgage loans provided by all Danish mortgage banks: Mortgage loan characteristics such as interest rate type (fixed or floating), redemption profile (e.g. interest only, annuity loans), etc.

The register data is primarily based on third-party reporting to the tax authorities as well as public registers. Information regarding family relations from the population register allow us to aggregate the data at the family level. A family is here defined as either one or two adults plus any number of children¹. The family level is preferred, mainly because the relevant question in the CES concerns the situation of the family. In addition, for the relatively fundamental decisions considered in the analysis, such as house purchase, the relevant decision making unit will in most cases be the family.

4.2 OPTIMISM AND OVEROPTIMISM

A central challenge in the behavioural microeconomic literature using consumer expectations surveys or their likes is the measurement of expectations and the extent to which they are met. Mainly two approaches have been used by the studies surveyed in section 2. The first approach builds on the deviation between survey-based measures of a concept and some form of more objective measure of the same concept. For example, Puri and Robinson (2007) use the deviation between subjective life expectancy and statistical life tables to form a measure of optimism. The second approach is to use the deviation between survey-based information on expectations and subsequent survey based information on self-assessed realised outcomes (e.g. Hyytinen and Putkuri, 2012). We combine these approaches in our definition of overoptimism, since we have survey based data on expectations and register based data on subsequent realisations.

Optimistic households are defined as those who answer 'improve somewhat' or 'improve considerably' to the question 'How do you think the financial situation of your family will be in a year compared with today?' in the CES, and correspondingly for pessimistic families.

Overoptimistic households are defined as those who are *ex ante* optimistic about the financial situation of the household, but nonetheless experience a reduction in real income over the subsequent three years.² Even though the survey question refers to a time horizon of one year, we choose to compare with the actual development over three years in order to make sure that families with only a temporary drop in income in one year are not labelled as overoptimistic. Our definition does indeed capture a group of families, which despite being optimistic experience a substantially weaker development in income and liquid assets during the following years compared to other families, cf. chart 4.1 and 4.2.

This definition of overoptimism may be criticised. For example, if a family is hit by an unexpected shock, such as illness or unemployment, the initial optimism may have been justified

¹ A family is defined as either one or two adults and any number of children living at home. Two adults are regarded as members of the same family, if they are living together and a) are married to each other or have entered into a registered partnership, b) have at least one common child registered in the Civil Registration System or, c) are of opposite sex and have an age difference of 15 years or less, are not closely related and live in a household with no other adults. Adults living at the same address but not meeting one of the three criteria are regarded as single families. Children living with their parents are regarded as members of their parents' family if they are under 25 years old, have never been married or entered into a registered partnership and do not themselves have children who are registered in the CPR. A family meeting these criteria can consist of only two generations. If three or more generations live at the same address, the two younger generations are considered one family, while the members of the eldest generation constitute a separate family.

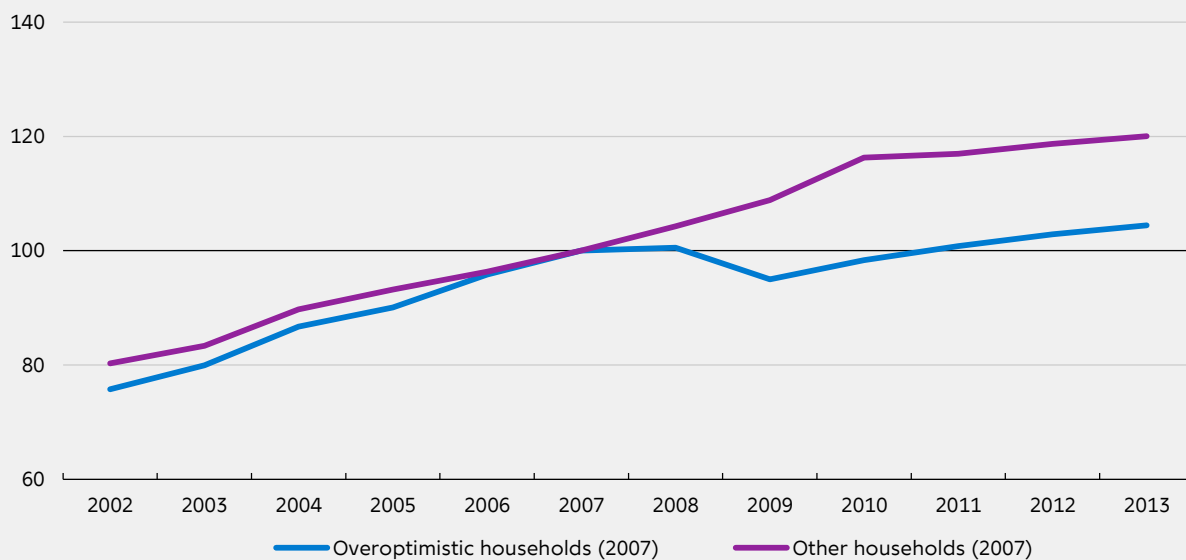
² A threshold of 0.1 per cent has been applied when considering the decline in real income in order to avoid classifying families as overoptimistic based on e.g. rounding errors. We exclude households with students and self employed members since their income development is particularly volatile and, for the self employed, an imprecise measure of actual household income. We also exclude households with retired members since their income is likely to fall without this necessarily meaning that their financial situation is worsened. Since the CES is conducted in every month of the year, with questions covering a time horizon of one year, and given that we only have information on income in each calendar year, we use the following rule in comparing realised and expected outcomes: For CES-interviews conducted in the months January-June in a given year, the actual income growth is measured as the growth from t-1 (i.e. the previous year) to t+2, whereas interviews conducted in the months July-December are compared with income growth from t to t+3. While not perfect, this definition ensures that more than half of the year, to which the interview questions refer, is covered in the corresponding realisation period. The timing issue is a possible error source, although timing is exogenous and unsystematic, and we will assume that the effect will average out over the sample period and in the cross section.

by all available information and the reduction in income may be fully ascribed to the shock. On the other hand, overoptimistic households may systematically underestimate the risk of becoming unemployed, meaning that households having been exposed to unemployment might not be excluded from being labelled overoptimistic. It could also be argued that the development in income only provides a partial view of the realised 'financial situation of the household', although the use of income is justified by previous research (e.g. Mitchell and Weale (2007), who find a positive relation between income and assessments of realized outcomes). For example, the development in liquid assets might also matter, in particular for households having a large share of their assets in stocks or bonds. Further, to circumvent the influence of forecast errors, one may use the fundamentals (e.g. income) of the household at the time of the survey rather than the future realization. Finally, it could be argued that an income decline should be larger than a certain threshold in order to be interpreted as a deterioration of the financial situation of the household. To make sure that our results are not driven by the chosen definition of overoptimism, we conduct extensive robustness checks, cf. Appendix A. Using 12 alternative definitions of overoptimism, which among others take into account the above mentioned criticisms, we find that results are robust to the definition of overoptimism.

Median income growth, overoptimistic households and other households surveyed in 2007

Chart 4.1

Nominal household income, median of index, 2007 = 100

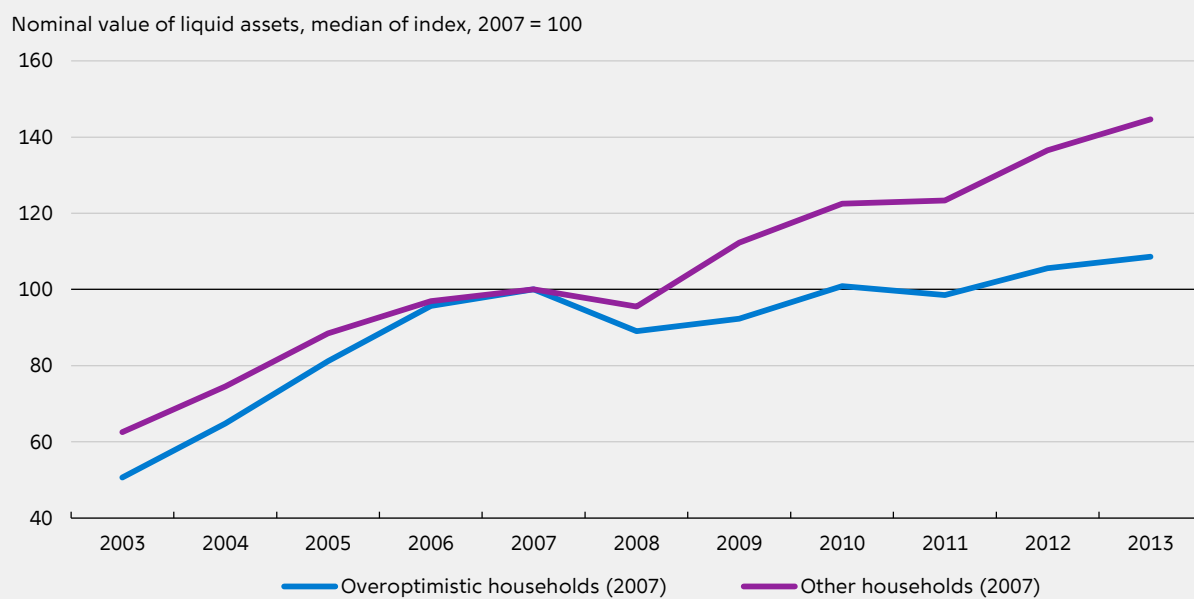


Note: The chart shows the median of an index constructed at the household level as the ratio of the household's (nominal) income to the same household's income in 2007.

Source: Own calculations based on micro data from the consumer expectations survey and register data from Statistics Denmark.

Median growth in liquid assets, overoptimistic households and other households surveyed in 2007

Chart 4.2



Note: The chart shows the median of an index constructed at the household level as the ratio of the household's (nominal) value of liquid assets to the same household's value of liquid assets in 2007.

Source: Own calculations based on micro data from the consumer expectations survey and register data from Statistics Denmark.

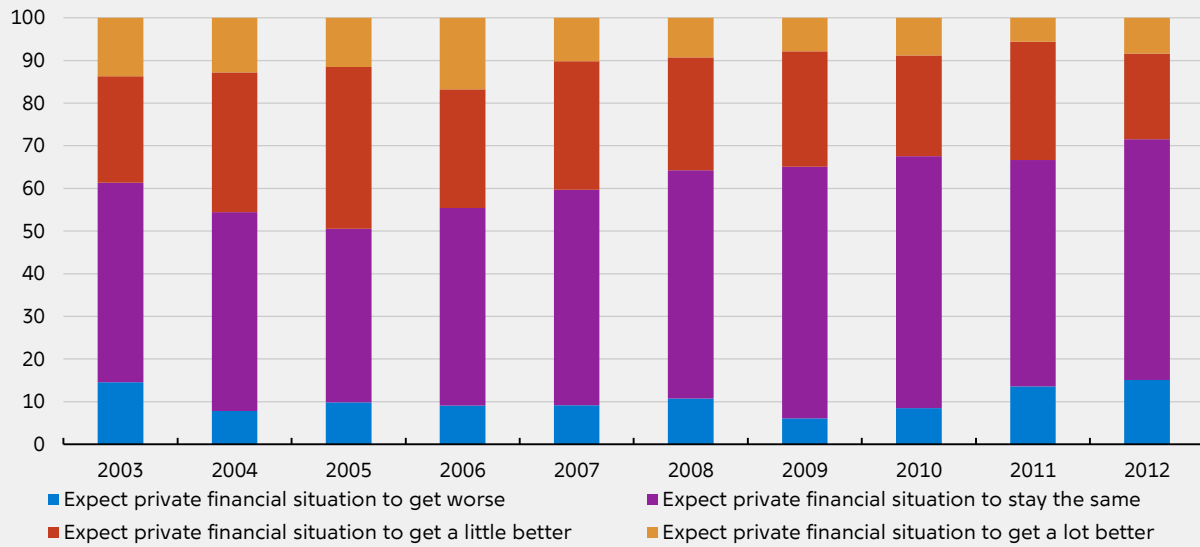
4.3 OPTIMISM AND THE REAL ESTATE MARKET

Before considering the role of overoptimism for the real estate market, this section focuses on the role of optimism. We start our analysis of optimism and the real estate market by dividing the sample of households according to their expectations regarding the future financial situation of the household. In the pre-crisis years, families being optimistic about their future financial situation were involved in a larger share of the real estate purchases than during and after the crisis, cf. chart 4.3. To rule out the possibility that this is just a consequence of a larger share of households being optimistic before the crisis than in the subsequent period, chart 4.4 depicts the share of households in each category, which purchased real estate. Before the crisis, 8.1 per cent of households, which expected their future financial situation to improve substantially, purchased real estate, whereas the corresponding share for households, which expected their financial situation to deteriorate, was 4.6 per cent. A similar pattern was found during and after the crisis. As long as expectations are realistic and justified by fundamental factors, such a pattern is natural, since families with positive economic prospects have a larger tendency to demand housing than families with more negative prospects.

Households involved in a real estate trade distributed according to expectations

Chart 4.3

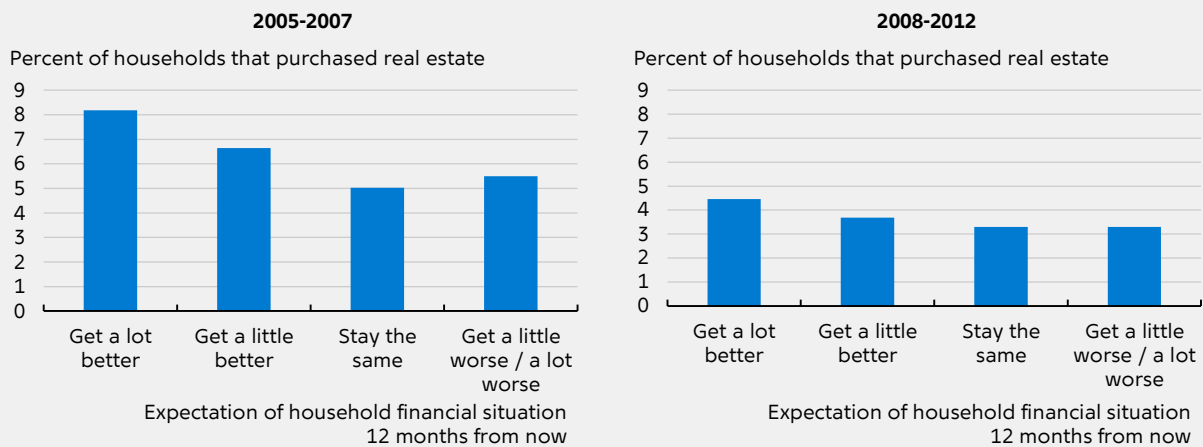
Per cent of households that purchased real estate



Source: Own calculations based on micro data from the consumer expectations survey and register data from Statistics Denmark.

Expectations and the real estate market

Chart 4.4

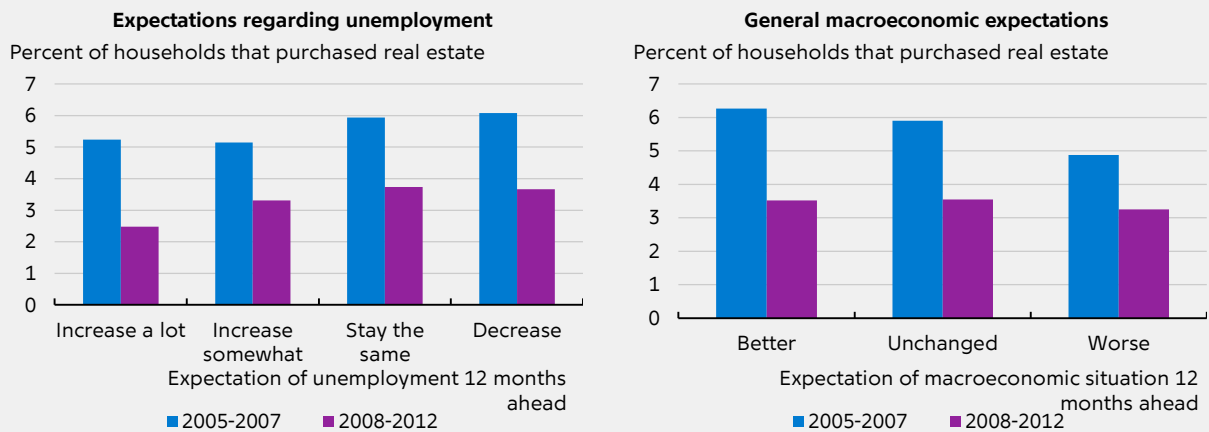


Note: The chart shows the share of households in each response category, which purchased real estate in the survey year.
 Source: Own calculations based on micro data from the consumer expectations survey and register data from Statistics Denmark.

A similar pattern is found when considering macroeconomic expectations instead of expectations to the households' own financial situation. Before the crisis, households which expected the macroeconomic situation to improve were more likely to purchase real estate than households which expected the situation to worsen, cf. chart 4.5. Similarly, households which expected unemployment to decrease or stay unchanged were more likely to purchase real estate than households which expected unemployment to increase. The latter relation can be found both before and during the crisis period. This indicates that also more general sentiments than those relating specifically to the household's own financial situation influence decisions of individual households on the real estate market. It may also indicate that for example unemployment risk is taken into account when making such decisions.

Macroeconomic expectations and real estate purchases

Chart 4.5



Source: Own calculations based on micro data from the consumer expectations survey and register data from Statistics Denmark.

4.4 OVEROPTIMISM AND THE REAL ESTATE MARKET

If a substantial number of the optimistic households, which purchased real estate in the period before the crisis, were too optimistic regarding their forecasted future financial situation, these overoptimistic households may have contributed to the house price bubble through their demand being higher than justified by fundamentals.

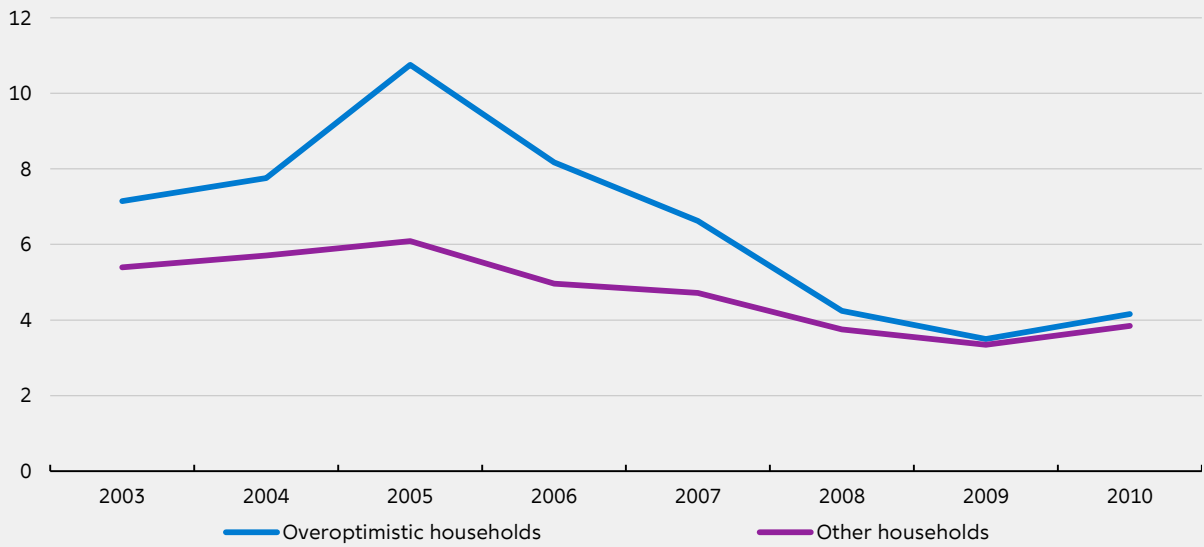
Compared to other households, a larger share of overoptimistic households purchased real estate, in particular in the pre-crisis period, cf. chart 4.6. This was also the case when comparing overoptimistic households to two other, more carefully selected control groups based on our definition of overoptimism, cf. chart 4.7. Recall that the definition of an overoptimistic household requires that a household is 1) optimistic, and 2) realise a negative growth in real income over the subsequent 3 years. To see whether results are mostly driven by one of these two conditions, we define two relevant comparison groups as follows. The first group is 'justified' optimists, i.e. households which were 1) optimistic, and 2) realised a non-negative growth in real income over the subsequent 3 years. And the second group is 'justified' non-optimists, i.e. households which were 1) non-optimistic (i.e. neutral or pessimistic) and 2) realised a negative growth in real income over the subsequent 3 years. In 2005 and 2006, overoptimistic households were more likely to purchase real estate, also in comparison to those two groups, cf. chart 4.7.

As demonstrated in chart 4.6, the share of overoptimistic households that purchased real estate was almost twice as large as the share of other households in 2005. In addition, there were more overoptimistic households in the pre-crisis period. This implies that a larger share of the real estate purchases which took place in 2005-07 involved an overoptimistic household compared to the period before and after, cf. chart 4.8. The increased activity by overoptimistic households on the real estate market can mainly be ascribed to existing homeowners, which purchased more expensive real estate. The share of overoptimistic first-time buyers has been more stable over time.

Overoptimism and real estate purchase

Chart 4.6

Share of households, which purchased real estate, per cent

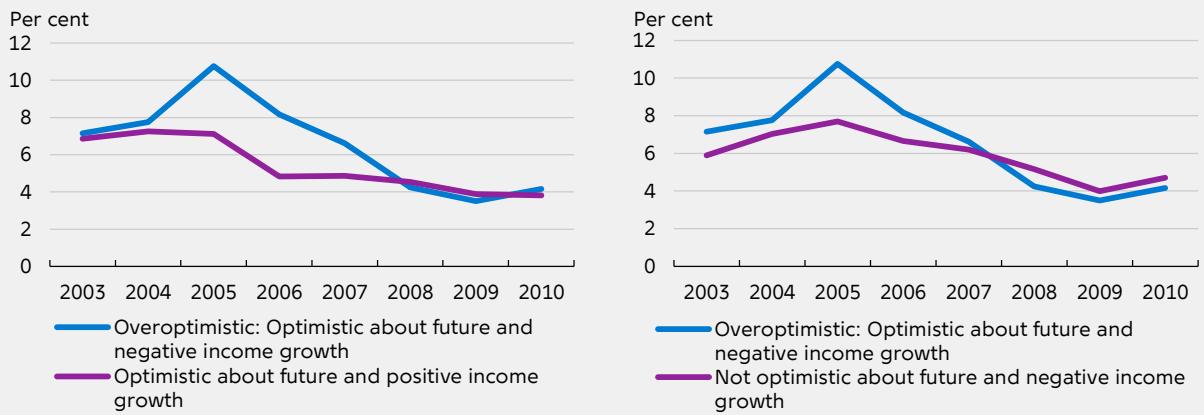


Note: The chart shows the share of households in each of the two categories, which during the year purchased real estate.

Source: Own calculations based on micro data from the consumer expectations survey and register data from Statistics Denmark.

Overoptimism and real estate purchase – selected comparison groups

Chart 4.7



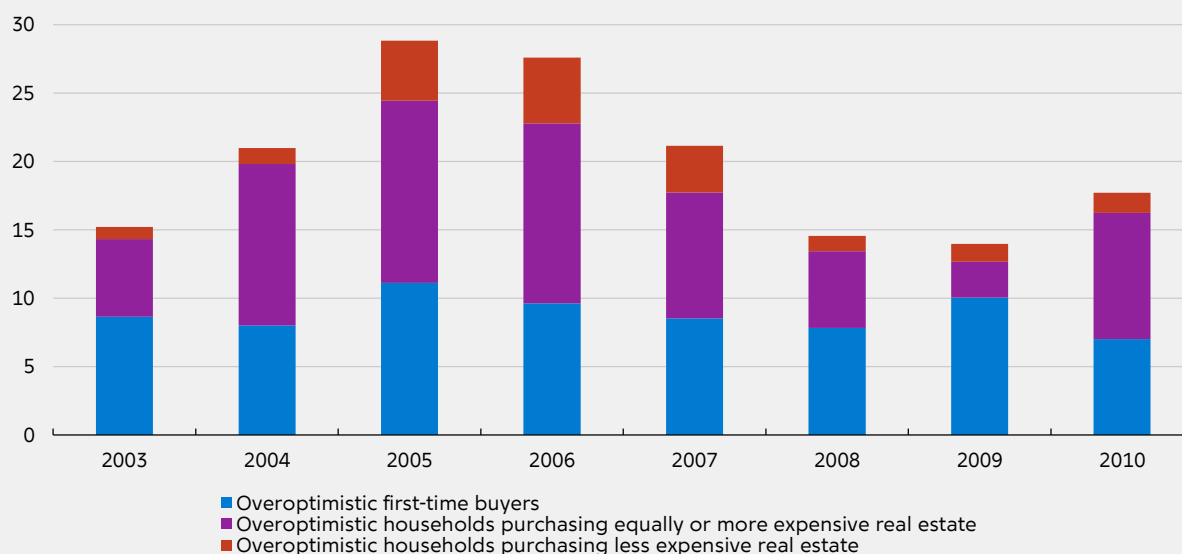
Note: Income growth is measured as growth in real income over the subsequent three years.

Source: Own calculations based on micro data from the consumer expectations survey and register data from Statistics Denmark.

Overoptimistic households and the real estate market

Chart 4.8

Per cent of real estate purchases



Note: First-time buyers are defined as those households that did not own any real estate at the end of the previous year. Households purchasing equally or more expensive real estate is defined as those households, which purchase real estate with an equivalent or higher public valuation than the previously owned real estate. The public valuation of the previously owned real estate is estimated as the public valuation at the end of year t-1 adjusted by the median change in all public valuations from t-1 to t.

Source: Own calculations based on micro data from the consumer expectations survey and register data from Statistics Denmark.

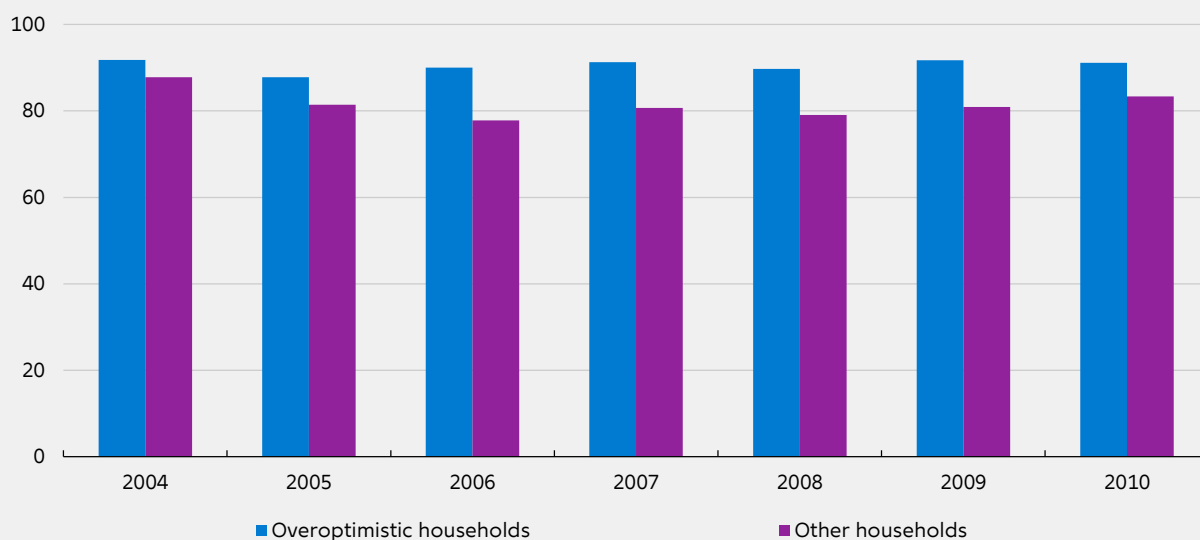
Overoptimism may also more directly have affected house prices. Both before and during the crisis, overoptimistic households had higher median loan-to-value (LTV) ratios in the year in which they purchased real estate than other households, cf. chart 4.9. The implication of these results is twofold. First, overoptimistic households may have contributed to a house price bubble by putting an upward pressure on the number of real estate trades. And second, they may also have contributed to an upward pressure on house prices by leveraging more when purchasing real estate (and possibly thereby purchasing more expensive real estate than similar households which were not overoptimistic).

On the other hand, there is no evidence that overoptimistic households contributed to the increasing house prices by purchasing overvalued real estate compared to other households, cf. chart 4.10 (left). Also, the development in house prices during and after the crisis was broadly similar for overoptimistic households and other households which purchased real estate before the crisis, cf. chart 4.10 (right).

Median loan-to-value ratio, households which purchased real estate

Chart 4.9

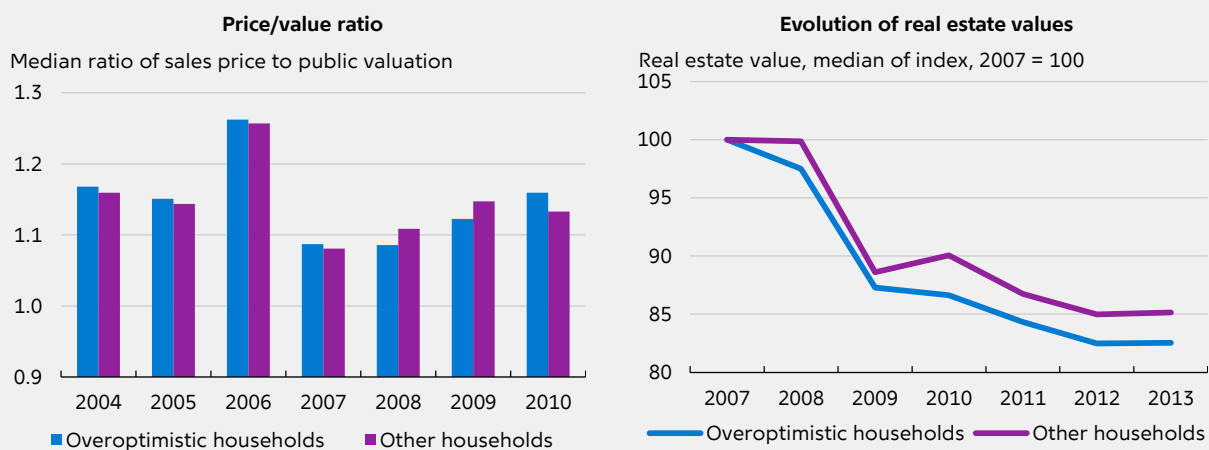
Median loan-to-value ratio, per cent



Note: Only households, which purchased real estate in the given year, are included. For the calculation of the loan to value ratio, all debt, also debt which is not secured by real estate, is included in the nominator. Only value of real estate is included in the denominator.
Source: Own calculations based on micro data from the consumer expectations survey and register data from Statistics Denmark.

Price-value ratio and evolution of real estate values for households which purchased real estate in 2005-2007

Chart 4.10



Note: Left chart: All households, which purchased real estate in the given year, are included. Right chart: The chart is based on households which purchased real estate in the years 2005-2007 and did not purchase or sell real estate in the years 2008-2013. The chart is constructed by first indexing each household's real estate value to the same household's real estate value in 2007, and subsequently finding the median for each year. The real estate value is estimated by Statistics Denmark based on the public valuation corrected by a factor defined as the ratio of actual sales prices to the public valuation for similar estate categories in the same postal code, municipality or region, as detailed as the number of sales permit.
Source: Own calculations based on micro data from the consumer expectations survey and register data from Statistics Denmark.

In terms of background characteristics (of all households and not only those which purchased real estate), we find that overoptimistic households had higher leverage and slightly higher income in the pre-crisis period than other households as well as a higher likelihood of choosing interest only mortgages and variable rate mortgages in the period after the beginning of the

crisis³, cf. table 4.1 and chart 4.9. The difference in leverage between overoptimistic households and other households is sizeable. In other words, not only did overoptimistic households, which purchased real estate, leverage more at the time of purchasing real estate, but overoptimistic households, which did not purchase real estate, were also more highly leveraged than other households.

The above results suggest that overoptimism is a quite fundamental trait, giving rise to relatively persistent differences in behaviour between overoptimistic households and other households. This is further underlined by considering behavioural differences in other areas than the housing market. For example, overoptimistic households had a higher consumption-to-income ratio in 2006-2009 as well as a larger propensity to purchase a car throughout the sample period, cf. chart 4.11. The differences between overoptimistic households and other households illustrate the importance of considering background characteristics when analysing the impacts of overoptimism on the housing market. Therefore, in the next section, we more formally take into account the heterogeneity of households by testing the implications of overoptimism on housing market developments in a regression framework.

Characteristics of overoptimistic and other households

Table 4.1

	2002-2004		2005-2007		2008-2010	
	Over-optimistic	Other	Over-optimistic	Other	Over-optimistic	Other
Disposable income, 1000 kr. (median)	295.5	311.4	334.5	346.5	328.8	391.6
Age of oldest family member (median)	41	46	44	47	44	48
Real estate value, 1000 kr. (median)	914.9	1090.1	1217.0	1425.7	987.5	1557.9
Ratio of gross debt to disposable income, per cent (median)	162.0	190.7	201.6	208.6	171.1	223.7
Ratio of pension assets to disposable income, per cent (median)	62.3	93.3	89.7	116.3	78.1	121.7
Loan to value ratio, per cent (median)	75.5	69.9	67.9	58.7	76.6	67.0
Share of families with members with higher education, per cent	21.9	34.1	40.3	44.5	38.0	48.4
Share of homeowner families with interest only mortgages, per cent	-	-	-	-	45.0	38.9
Share of homeowner families with variable rate mortgages, per cent	-	-	-	-	59.8	56.3
No. of observations	3,950	14,175	4,337	16,983	3,589	18,383

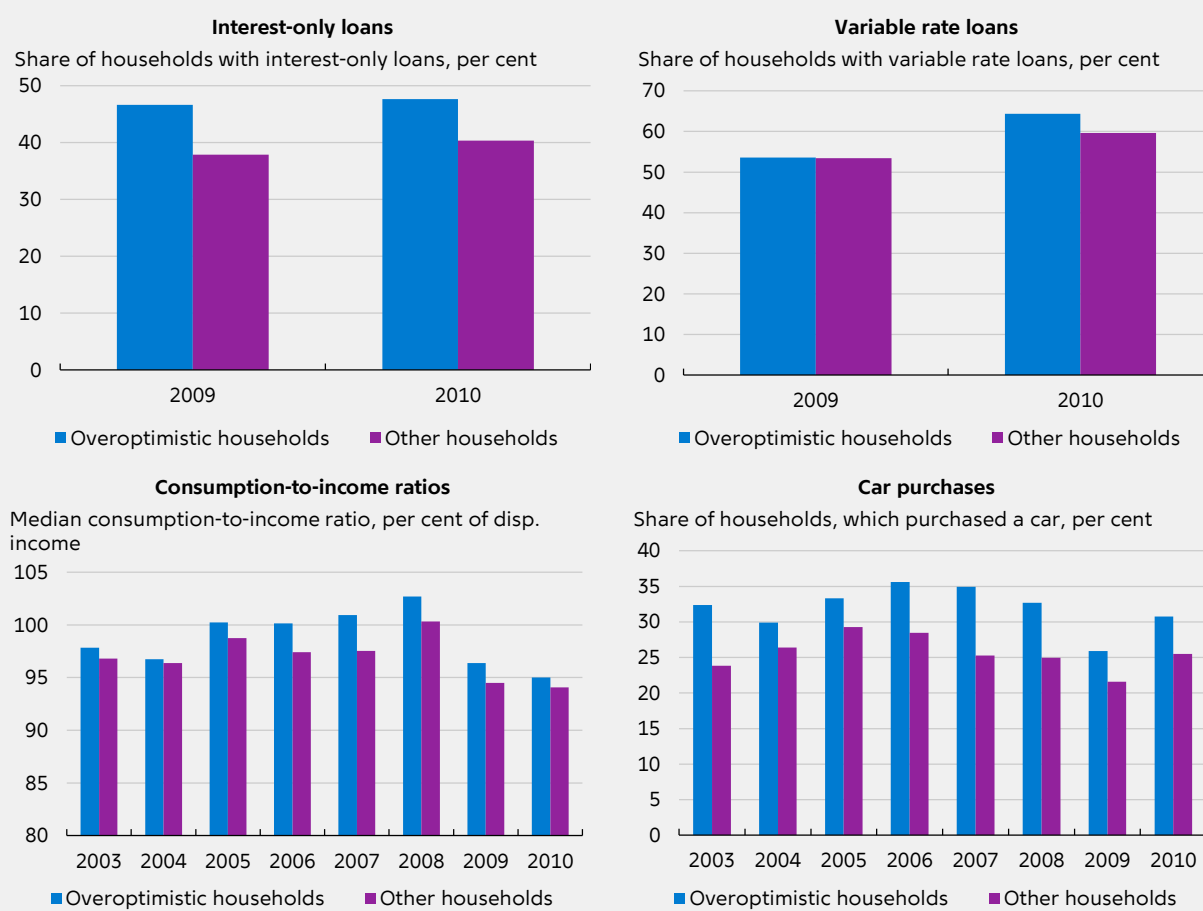
Note: Information about interest only loans and variable rate loans is only available from 2009 and onwards.

Source: Own calculations based on micro data from the consumer expectations survey and register data from Statistics Denmark.

³ Information on loan types is only available from 2009 and onwards. However, Kuchler (2015) shows that Danish families with interest only loans on average have lower savings rates and higher LTV and LTI ratios following house purchase, also before the crisis. Overoptimistic families also had these characteristics. It is therefore very likely that the finding that overoptimistic households to a larger extent than other households chose interest only mortgages in the years 2009-2013 also is valid in the pre-crisis period. This points to a conclusion that the introduction of interest only loans in 2003 contributed to increasing house prices in the pre-crisis period by enabling (in particular) overoptimistic households to borrow more without increasing their immediate (first year) debt service payments.

Mortgage loan characteristics, consumption-to-income ratios and car purchases

Chart 4.11



Note: For the calculation of the share of households with interest-only and variable rate loans, all households having an outstanding mortgage loan have been included in the denominator. Consumption is defined and measured as in Andersen et al. (2016).
Source: Own calculations based on micro data from the consumer expectations survey and register data from Statistics Denmark.

4.5 MODEL SPECIFICATION AND RESULTS

To summarise and quantify the effect of overoptimism on the probability of house purchase and on LTV, we estimate the following relation

$$Y_{it} = \gamma_1 O_{it} + \gamma_2 O_{it} * P_t + \gamma_3 P_t + \beta x_{it} \quad (1)$$

where O_{it} is an indicator of household i being overoptimistic at time t , P_t is an indicator of the pre-crisis period, here defined as the years 2004-2007⁴ and x_{it} is a vector of control variables including the logarithm of household disposable income, age, age squared, net wealth and family size indicators. The dependent variable, Y_{it} , is either house purchase or LTV.⁵ For LTV, the models are based only on households which have purchased real estate in the given year. As an example of the interpretation, in the model for house purchase, γ_1 indicates the difference in the probabilities of house purchase between overoptimistic households and other households and γ_2 indicates the additional effect of overoptimism in the pre-crisis years over and above the time effect (which is captured by inclusion of the pre-crisis dummy).

⁴ The model is estimated using data from 2004 to 2013.

⁵ Models for real estate purchase are linear probability models. Probit specifications yield comparable results.

Regression results: Effects of overoptimism

Table 4.2

Dependent variable	Purchased	LTV
Overoptimism (O)	0.0021 (0.0043)	2.0506 (2.9690)
Overoptimism*Pre-crisis (O*P)	0.0224*** (0.0055)	2.8019 (3.4130)
Pre-crisis (P)	0.0196*** (0.0022)	-3.1618** (1.3837)
F-test for joint significance of O and O*P (p-value)	0.000***	0.013**
Control variables included	Yes	Yes
Sample	All	Purchased
Observations	48,308	2,643
R ²	0.0149	0.2198

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. In the row 'sample', 'purchased' means households, which have purchased real estate in the given year. For the calculation of the loan to value ratio (LTV), all debt, also debt which is not secured by real estate, is included in the nominator. Only value of real estate is included in the denominator. To avoid extreme values driving the results, the estimation sample for the LTV regression exclude values of LTV above the 9th decile. Control variables include income, age, age squared, net wealth and family size indicators.

Source: Own calculations based on micro data from the consumer expectations survey and register data from Statistics Denmark.

Overoptimistic households were significantly more likely to purchase real estate during the period before the financial crisis, even after controlling for other characteristics, which may influence the probability of purchasing a house, cf. table 4.2. In the years 2004-2007, the (average) probability that an overoptimistic household purchased real estate was around 2 percentage points higher than the probability of a similar household, which was not overoptimistic. The probability of real estate purchase was around 5 per cent during these years for households which were not overoptimistic.

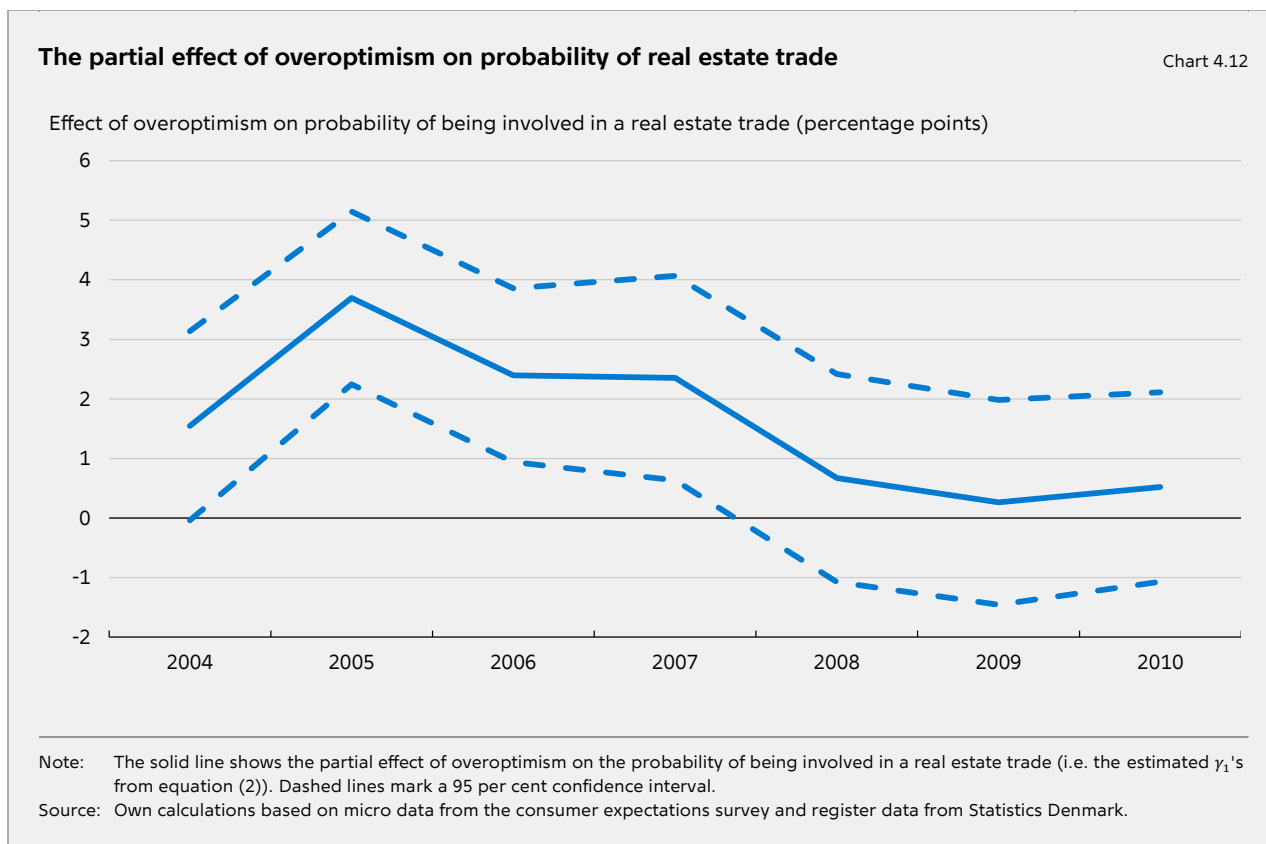
Overoptimistic households which purchased real estate in the pre-crisis period had significantly higher LTV ratios than other households purchasing real estate, cf. the last column of table 4.2. To be more specific, in the pre-crisis period (2004-2007) overoptimistic households which purchased real estate had on average an LTV-ratio which was 5 percentage points larger than similar households, which were not overoptimistic. During the crisis/post-crisis, results also indicate that overoptimistic households which purchased real estate had higher leverage than other households, but the difference is not statistically significant.

As noted, there is a stronger effect of overoptimism on the probability of purchasing real estate in the pre-crisis period than during the crisis. To shed further light on this channel, we utilize the relatively large number of observations to estimate a more granular model with year specific effects of optimism, namely

$$Y_{it} = \gamma_1 O_{it} * T_t + \gamma_2 T_t + \beta x_{it} \quad (2)$$

where Y_{it} is an indicator signalling that the family has been involved in a real estate trade in year t . In this specification, the effect of overoptimism is allowed to vary over the years, and year fixed effects have been included to take into account that the (baseline) probability of being involved in a real estate trade was larger before the crisis than during the crisis, as also found above. The γ_1 coefficients therefore provide an estimate of the additional effect of overoptimism on the probability of being involved in a real estate trade in each of the years, over and above the year effect. We expect γ_1 to be positive in all years and larger in the pre-crisis years than during and

after the crisis. Results from estimation of equation (2) underline that overoptimism played a significant role for the volume of real estate trades in the pre-crisis period, cf. chart 4.12. As mentioned, only 3-6 per cent of households in our sample purchases real estate in a given year.



5. FINAL REMARKS

This paper has explored the significance of nonfundamentals-based sentiments in house price developments in Denmark using both aggregated data from the Consumer Expectations Survey as well as the underlying household-level microdata behind the survey matched with administrative register data at a household level. This is the first paper that combines the use of all these three types of data. The macroeconometric part of the study used a structural VAR model to explore the historical linkages between consumer confidence and house prices. We found that exogenous sentiment shocks contributed to the house price booms in both the mid-1980s and the mid-2000s. The microeconometric part of the study showed that overoptimistic households were more likely to purchase real estate compared to other households, and that they leveraged themselves more when purchasing real estate. Furthermore, the share of overoptimistic households involved in real estate trades was particularly large during the strong house-price boom in the mid-2000. The results presented in the paper are robust to using various alternative definitions of overoptimistic households.

Hence, the analysis indicates that house price developments in Denmark have partly been driven by sentiments decoupled from underlying economic fundamentals, especially during strong house price booms. This underlines the need for a prudent macroeconomic stabilisation policy in periods with tight labour markets and a high degree of capacity utilisation. It should be

underlined that nonfundamentals-based sentiments are not the most important driver of house prices but they do play a certain role.

We consider these findings to be in line with Keynes' own assessment of the significance of "animal spirits":

"We should not conclude from this that everything depends on waves of irrational psychology. ... We are merely reminding ourselves that human decisions affecting the future, whether personal or political or economic, cannot depend on strict mathematical expectation, since the basis for making such calculations does not exist; and that it is our innate urge to activity which makes the wheels go round, our rational selves choosing between the alternatives as best we are able, calculating where we can, but often falling back for our motive on whim or sentiment or chance." (Keynes, 1936, Chapter 12.VII, p. 162-163).

REFERENCES

- Abildgren, Kim (2012), Business Cycles and Shocks to Financial Stability - Empirical evidence from a new set of Danish quarterly national accounts 1948-2010, *Scandinavian Economic History Review*, Vol. 60(1), pp. 50-78.
- Akerlof, George A. and Robert J. Shiller (2009), *Animal Spirits*, Princeton, NJ: Princeton University Press.
- Andersen, Asger Lau, Charlotte Duus and Thais Lærkholm Jensen (2016), Household debt and spending during the financial crisis: Evidence from Danish micro data, *European Economic Review*, Vol. 89, pp. 96-115.
- Barsky, Robert B. and Eric R. Sims (2012), Information, Animal Spirits, and the Meaning of Innovations in Consumer Confidence, *American Economic Review*, Vol. 102(4), pp. 1343-1377.
- Blanchard, Olivier (1993), Consumption and the Recession of 1990-1991, *American Economic Review*, Vol. 83(2), pp. 270-274.
- Bovi, Maurizio (2009), Economic versus psychological forecasting. Evidence from consumer confidence surveys, *Journal of Economic Psychology*, Vol. 30, pp. 563-574.
- Brown, Sarah and Karl Taylor (2006), Financial Expectations, Consumption and Saving: A Microeconomic Analysis, *Fiscal Studies*, Vol. 27(3), pp. 313-338.
- Campbell, John Y., Howell E. Jackson, Brigitte C. Madrian and Peter Tufano (2011), Consumer Financial Protection, *Journal of Economic Perspectives*, Vol. 25 (1), pp. 91-114.
- Chauvet, Marcelle and Jang-Ting Guo (2003), Sunspots, Animal Spirits, and Economic Fluctuations, *Macroeconomic Dynamics*, Vol. 7, pp- 140-1, 69.
- Cochrane, John H. (1994), Shocks, *Carnegie-Rochester Conference Series on Public Policy*, Vol. 41, pp. 295-364.
- Disney, Richard and John Gathergood (2013), Financial Literacy and Consumer Credit Portfolios, *Journal of Banking and Finance*, Vol. 37 (7), pp. 2246-2254.
- Doms, Mark and Norman Morin (2004), Consumer Sentiment, the Economy, and the News Media, *FRBSF Working Paper*, No. 9, June.
- Farmer, Roger E. A. and Jang-Ting Guo (1994), Real Business Cycles and the Animal Spirits Hypothesis, *Journal of Economic Theory*, Vol. 63, pp. 42-72.
- Fuhrer, Jeffrey C. (1993), What Role Does Consumer Sentiment Play in the US Macroeconomy, *New England Economic Review*, January/February, pp. 32-44.
- Golinelli, Roberto and Giuseppe Parigi (2004), Consumer Sentiment and Economic Activity: A Cross Country Comparison, *Journal of Business Cycle Measurement and Analysis*, Vol. 1(2), pp. 147-170.
- Hastings, Justine S. and Olivia S. Mitchell (2011), How Financial Literacy and Impatience Shape Retirement Wealth and Investment Behaviors, *NBER Working Paper*, no. 16740, January.
- Hyytinen, Ari and Hanna Putkuri (2012), Household optimism and borrowing, *Bank of Finland Research Discussion Papers*, No. 21, May.
- Jaimovich, Nir and Sergio Rebelo (2007), Behavioral Theories of the Business Cycle, *Journal of the European Economic Association*, Vol. 5(2-3), pp. 361-368.
- Keynes, John Maynard (1936) [1986], *The General Theory of Employment, Interest and Money*, London: MacMillan.

- Kuchler, Andreas (2015), Loan types, leverage, and savings behaviour of Danish households, *Danmarks Nationalbank Working Paper*, no. 97, September.
- Ling, David C., Joseph T. L. Ooi and Thao T. T. Le (2015), Explaining House Price Dynamics: Isolating the Role of Nonfundamentals, *Journal of Money, Credit and Banking*, Vol. 47(1), pp. 88-125.
- Ludvigson, Sydney C. (2004), Consumer Confidence and Consumer Spending, *Journal of Economic Perspectives*, Vol. 18(2), pp 29-50.
- Lusardi, Annamaria and Olivia S. Mitchell (2014), The Economic Importance of Financial Literacy: Theory and Evidence, *Journal of Economic Literature*, Vol. 52 (1), pp. 5-44.
- Lusardi, Annamaria, Olivia S. Mitchell and Vilsa Curto (2010), Financial Literacy among the Young, *Journal of Consumer Affairs*, Vol 44 (2), pp. 358-380.
- Malmendier, Ulrike and Timothy Taylor (2015), On the Verges of Overconfidence, *Journal of Economic Perspectives*, Vol. 29(4), pp. 3-8.
- Matusaka, John D. and Argia M. Sbordon (1995), Consumer Confidence and Economic Fluctuations, *Economic Inquiry*, Vol. 33(2), pp. 296-318.
- Meier, Stephan and Charles Sprenger (2010), Present-Biased Preferences and Credit Card Borrowing, *American Economic Journal: Applied Economics*, Vol. 2 (1), pp. 193-210.
- Mitchell, James and Martin Weale (2007), The rationality and reliability of expectations reported by British households: micro evidence from the British household panel survey, *Deutsche Bundesbank Discussion Paper*, Series 1, No. 19, July.
- Pigou, Arthur Cecil (1927), *Industrial Fluctuations*, London: MacMillan.
- Puri, Manju and David T. Robinson (2007), Optimism and economic choice, *Journal of Financial Economics*, Vol. 86, pp. 71-99.
- Shiller, Robert J. (2005), *Irrational Exuberance*, Second Edition, Princeton NJ: Princeton University Press.
- Shiller, Robert J. (2008), *The Subprime Solution*, Princeton NJ: Princeton University Press.
- Sims, Christopher A., James H. Stock and Mark W. Watson (1990), Inference in Linear Time Series Models with some Unit Roots, *Econometrica*, Vol. 58(1), pp. 113-144.
- Stango, Victor and Jonathan Zinman (2009), Exponential Growth Bias and Household Finance, *Journal of Finance*, Vol. 64, pp. 2807-2849.
- Stock, James H. and Mark W. Watson (2001), Vector Autoregressions, *Journal of Economic Perspectives*, Vol. 15(4), pp. 101-115.
- Souleles, Nicholas S. (2004), Expectations, heterogeneous forecast errors and consumption: Micro evidence from the Michigan Consumer Sentiment Surveys, *Journal of Money, Credit, and Banking*, Vol. 36(1), pp. 39-72.
- Sutter, Matthias, Martin G. Kocher, Daniela Glätzle-Rützler and Stefan T. Trautmann (2013), Impatience and Uncertainty: Experimental Decisions Predict Adolescents' Field Behavior, *American Economic Review*, Vol. 103 (1), pp. 510-531.

APPENDIX A: ROBUSTNESS OF THE MICROECONOMETRIC RESULTS

The definition of overoptimism used in section 4 is not the only possible definition. While we have a household-level survey based measure of optimism, we do not have an *ex post* measure of the same household's assessment of the realised development. In the definition used, we identify households as overoptimistic if they were *ex ante* optimistic and over the subsequent three years experience a reduction in real income. In this appendix, we demonstrate that this definition is not crucial to our results.

A number of alternative definitions of overoptimism has been considered. We focus on various income measures as well as liquid assets as a measure of the realised development. Since liquid assets include both bank deposits and bond and stock holdings, a change in liquid assets may come from either saving/dissaving, revaluations, or both. While relevant for the overall assessment of a household's financial situation, the growth in real estate value is not considered in these alternative definitions, mainly because the growth in house prices on a three-year horizon is not likely to be assigned a large weight in the households' assessment of their financial situation

compared to one year ago. For each alternative definition, we reestimate each of the regression models from table 4.2. The alternative definitions as well as the significance of overoptimism in each of these regressions are shown in table A.1. Results regarding the importance of overoptimism for the probability of purchasing real estate before the crisis are robust to all the various specifications of overoptimism. Results regarding LTV are robust in most, but not all, specifications. This should be interpreted in light of the substantially lower number of observations used in some specifications, since these regressions are only based on households, which purchased real estate in the given period.

Robustness: Significance of various overoptimism specifications on different outcome variables

Table A.1

Definition	Description	Share ¹	Pre-crisis (2004-2007)		Crisis / post-crisis (2008-2010)	
			Purchased	LTV	Purchased	LTV
Baseline	Households which are optimistic about the financial situation of the household one year ahead and experience a reduction in real income over the subsequent three years.	18.1	***	**	-	-
A	Households which are optimistic about the financial situation of the household one year ahead and experience a reduction in real income over <i>the subsequent year</i> .	14.8	***	***	***	*
B	Households which are optimistic about the financial situation of the household one year ahead and experience a reduction in real income over the three subsequent years, <i>no members unemployed or hospitalised, no split of household or death</i> .	16.1	***	**	-	-
C	Households which are optimistic about the financial situation of the household one year ahead and experience a reduction in real income <i>of 10 per cent or more</i> over the subsequent three years.	13.3	***	**	-	-
D	Households which are optimistic about the financial situation of the household one year ahead and experience a reduction in <i>nominal</i> income over the subsequent year.	12.6	***	***	***	**
E	Households which are optimistic about the financial situation of the household one year ahead and experience a reduction in real gross <i>wage</i> income over the subsequent year.	16.9	**	-	-	***
F	Households which are optimistic about the financial situation of the household one year ahead and have experienced a reduction in real income over the <i>past</i> three years.	29.8	***	**	***	**
G	Households which are <i>very</i> optimistic about the financial situation of the household one year ahead and experience a reduction in real income over the subsequent three years.	4.8	***	-	-	-
H	Households which are optimistic <i>or neutral</i> about the financial situation of the household one year ahead and experience a reduction in real income over the subsequent three years.	43.0	***	-	***	-
I	Households which are optimistic about the financial situation of the household one year ahead and experience a reduction in <i>liquid assets</i> deflated by the CPI over the subsequent three years.	20.9	***	***	-	***
J	Households which are optimistic about the financial situation of the household one year ahead and experience a reduction in <i>liquid assets</i> deflated by the CPI of <i>10 per cent or more</i> over the subsequent three years.	19.4	***	***	-	**
K	Households which are optimistic about the financial situation of the household one year ahead and experience a reduction in <i>liquid assets</i> deflated by the CPI <i>over the subsequent year</i> .	18.6	***	-	-	**
L	Households which are optimistic about the financial situation of the household one year ahead and experience a reduction in <i>both real income and liquid assets</i> deflated by the CPI over the subsequent three years.	13.0	***	***	-	*

Note: Liquid assets include bank deposits and value of stocks, bonds and mortgage deeds in safe custody. Significance (and positive sign) of overoptimism in separate regressions using the model specified in equation (1) and each of the specified definitions of overoptimism is denoted by *** p<0.01, ** p<0.05, * p<0.1.

Source: Own calculations based on micro data from the consumer expectations survey and register data from Statistics Denmark.

¹ Per cent of households, which are classified as overoptimistic (average over the sample period).