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Abstract

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JEL classification: D14; G11; R21

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1 Introduction

Housing is the single most important asset for the majority of households. The salient features of housing are that it is difficult to diversify, highly leveraged, and costly to adjust. Before buying a house, households need to accumulate liquid wealth for a down payment.[1] After buying a house, a household faces expenditure risk due to committed mortgage payments and house price risk. As a result, households usually plan well ahead before buying a house. These features suggest that a house purchase could be closely linked to the accumulation of liquid wealth and the portfolio choice of liquid wealth.

This paper estimates the development of households' liquid wealth, equity market participation (the extensive margin), and the conditional risky asset share of liquid wealth (the intensive margin) through the period from 3 years before to 3 years after a house purchase using unique administrative panel data from Denmark. Ultimately, we attempt to document the temporal patterns of liquid wealth accumulation and households' investment in risky financial assets over a 7-year period around a house purchase.

Previous studies have attempted to examine the effects of mortgage debt and home equity on household portfolio choice. These studies relied mostly on analyzing cross-sectional data and did not find a systematic relation between housing and portfolio choice of liquid wealth. For example, Fratantoni (1998) finds that the elasticity of the risky asset share (the stock share) with respect to mortgage debt is negative, and Yamashita (2003) finds that households with a high house-to-net-worth ratio hold a lower proportion in stocks. However, Heaton and Lucas (2000) and Cocco (2005) show that in cross-sectional ordinary least squares (OLS) regressions in which property value is included as a covariate, the risky asset share is positively associated with mortgage debt. In a recent paper, Chetty, Sándor, and Szeidl (2017) isolate a plausibly exogenous variation in home equity and mortgages. They find that for homeowners, an increase in mortgage debt reduces the share of liquid wealth held in stocks, while an increase in home equity raises the risky asset share of liquid wealth with CRRA preferences. They implement a cross-sectional instrument variable (IV) strategy using microdata from the Survey of Income and Program Participation (SIPP). They also make use of the panel feature of the SIPP to test whether individuals who buy larger houses reduce their risky asset share of liquid wealth more than those who buy smaller houses. Given that the SIPP is a short panel, the authors can observe household portfolios only 1 year before and 1 year after a

[1] Liquid wealth in this paper refers to non-pension financial assets. It is defined as the sum of the market value of stocks and risky mutual fund investments, the market value of bond, and bank deposits. In the literature, some also use the term financial asset to refer to the same concept.

house purchase for a small sample, which diminishes much of the benefit of a panel data set.

In this paper, we exploit a rich administrative panel data set from Denmark that contains the entire Danish population and spans 11 years from 2002 to 2012. The data include detailed household demographics, income, as well as asset and debt holdings. Based on these administrative data, we construct our main sample composed of households that bought houses in one of the years 2005—2009. The panel structure of the data ensures that observed and unobserved time-invariant household characteristics and the calendar-year fixed effect that presents uniformly to all households will not bias the results. Thus, we provide new and more reliable evidence for the relation between house purchases and households' portfolio choice of liquid wealth.

We find a considerable increase in liquid wealth before the purchase of a house.[2] On average Danish households hold about DKK 205,000 (about USD 37,000 or EUR 28,000) in liquid wealth 3 years before purchasing a house purchase.[3] The average household liquid wealth increases to DKK 295,000 (about USD 53,000 or EUR 40,000) 1 year before a house purchase, an increase of 44%. In the year of a house purchase, households' liquid wealth falls by 61% as household convert most of their liquid wealth into down payments. After a house purchase, households' liquid wealth remains low for 2 years and starts to increase after 3 years.

Portfolio theories predict that the equity market participation rate drops before a house purchase. As households face borrowing constraints, they become more risk averse before buying a house (Paxson, 1990; Grossman and Vila, 1992; Teplá, 2000). When information and/or other types of participation costs (e.g., set-up fees, monitoring costs, etc.) are associated with a risky asset investment, higher risk aversion leads to a lower equity market participation rate. For the sample households, we find that the equity market participation rate decreases 2 percentage points in the year of a house purchase, which is a 6.2% decline relative to the participation rate 1 year before the house purchase (32.2%) and statistically significant at the 1% level. For households with wealth above the median level, the decline in the equity market participation rate is even larger. Thus, the results provide strong evidence that housing investments induce households to withdraw funds from the risky asset market. We also find that from 3 years before to 1 year

[2]In Denmark, there is a tax penalty for withdrawing pension savings before retirement. Thus, it is unlikely that the increase in liquid wealth before buying a house is due to withdrawals from pension savings.

[3]This is equivalent to 7.23 times the average monthly household labor income in Denmark after tax and deductions.

before a house purchase, the equity market participation rate increases slightly by about 1 percentage point. This overall gain in the participation rate comes from households with wealth below the median level, reflecting that some of these households might be taking on more risk by participating in the stock market in the hope of earning higher returns so that they can buy a house.

After a house purchase, the overall equity market participation rate continues to fall slightly for 2 years, and it does not start to increase until 3 years after the house purchase. As households have low liquid wealth immediately after a house purchase, they benefit less from participating in the equity market. Therefore, the equity market participation rate is low after a house purchase if certain costs are associated with participation.

Conditional on participation, the risky asset share of liquid wealth decreases in a few years before a house purchase, and the share reaches the lowest point (24%) 1 year before the purchase of a house. Overall, the conditional risky asset share falls 2 percentage points from 3 years before to 1 year before a house purchase. This is likely due to the increased risk aversion before the house purchase.

Regarding the conditional risky asset share of liquid wealth after a house purchase, there are three theoretical arguments in the literature: the diversification effect (Yao and Zhang, 2005), the debt retirement channel (Becker and Shabani, 2010), and the liquidity demand hypothesis (Fratantoni, 2001; Hu, 2005).[4] The first two suggest that the conditional risky asset share of liquid wealth increases immediately following a house purchase, while the third argues for the opposite. We find that conditional on participation, the risky asset share jumps immediately in the year of the house purchase. The risky asset share continues to increase in the next 2 years following the house purchase. As a result, the conditional risky asset share of liquid wealth is 3.3 percentage points higher 2 years after the house purchase than 1 year before the house purchase (a 13.8% increase). Overall, the results suggest that the diversification effect and the debt retirement channel have a dominant effect over the liquidity concern.

Our findings in Denmark, an economy with a relatively low minimum down payment

[4]More details on these three theoretical arguments are provided in the following section.

requirement,[5] convenient and low-cost mortgage refinancing and prepayment terms,[6]as well as a mature stock market, indicate that there could be an even stronger link between house purchases and households' portfolio choice of liquid wealth in countries and economies where households face stricter borrowing constraints and stock markets are more volatile.

The rest of the paper is organized as follows. Section 2 presents theories and predictions for how house purchases can affect the household portfolio choice of liquid wealth before and after the purchase. Section 3 describes the data. Section 4 explains our empirical strategies, and Section 5 presents the results. Section 6 concludes.

2 Theoretical Considerations

A rich theoretical and empirical literature has studied household portfolio choices along the extensive participation margin (the decision to hold a certain type of liquid wealth) and the intensive allocation margin (the share of financial wealth held in a given asset); see Guiso, Haliassos, and Jappelli (2002), Campbell (2006), and Guiso and Sodini (2013), among others.[7] Household portfolio choices are found to be affected by various factors, including risk preferences, financial characteristics, demographic characteristics,

[5]In Denmark, for owner-occupied housing, households can borrow up to 80% of property value as a mortgage loan, according to the Act on Mortgages and Mortgage Bonds § 5 by the Danish FSA (Finanstilsynet). The remaining 20% can be borrowed as a bank loan from commercial banks. During the sample period, there is no legal minimum down payment requirement, although most households make down payments when buying a house. Since November 1, 2015, every household has been required to have at least a 5% down payment when buying a house. For more details, see "Lov om realkreditlån og realkreditobligationer m.v." (in Danish): https://www.finanstilsynet.dk/AttachedFiles/%7B07a5ca67-9613-4ac2-a9ed-df786a2f5e7b%7D.%7Ba2fd5696-0b38-407b-9429-954fc7ace0e4%7D.lov-454-af-10062003-realkreditlaen.pdf.

[6]A standard Danish mortgage contract allows households to borrow long-term (up to 30 years) at fixed rates with an option to make a prepayment. The prepayment can be made by either buying back the underlying covered bonds at the market price (i.e., exercise the delivery option) or at par (i.e., exercise the call option). Borrowers typically exercise the delivery option if the underlying bond is priced below par (when the interest rate increases) and are charged a trading fee of 0.10-0.30% depending on the size of the loan. This debt restructuring environment also allows borrowers in Denmark to benefit from a decline in interest rates, to avoid the lock-in effect from a potential increase in the market value of the debt, and to enjoy a tax deduction on the mortgage interest payment. In addition, deregulation and mortgage banks' adoption of new technologies in the 1990s gave rise to a wide range of loan types for borrowers to choose from. Borrowers can refinance their mortgages to reduce their interest rate and extend the loan's maturity without cashing out, even when the borrowers have negative home equity. For more details on the supply side of Danish mortgages, see the Danish Mortgage Banks' Federation, Frankel, Gyntelberg, Kjeldsen, and Persson (2004), Willemann and Svenstrup (2006), and Rasmussen, Madsen, and Poulsen (2014).

[7]Some studies have focused on the role of housing in influencing households' portfolio choices. See Cocco (2005) and Yao and Zhang (2005).

background risk, information and participation costs, etc. The literature has provided theoretical guidance for our empirical investigations.

In this paper, we are interested in the temporal patterns of household portfolio choices of liquid wealth around the time of a house purchase. Buying a house is the most important financial decision for the majority of households. We expect that households likely form expectations about their upcoming house purchase and accumulate more liquid wealth to pay for down payments.

Regarding households' portfolio choice of liquid wealth before a house purchase, our empirical model builds on the theoretical contributions of Paxson (1990), Grossman and Vila (1992), and Teplá (2000). These studies show that when facing a borrowing constraint, households become more risk averse in anticipation of the possibility that the constraint might be binding in the near future. If information costs and other participation costs are associated with stock investments, higher risk aversion leads to lower participation in the equity market.[8] Thus, we expect that the equity market participation rate will fall before a house purchase. Moreover, before a house purchase and conditional on equity market participation, households are likely to rebalance their liquid wealth portfolios from risky to safe assets due to a reduced willingness to take on risk. We expect that the impact is stronger closer to the time of the house purchase.

After purchasing a house, households have less liquid wealth to invest in risky assets than before and benefit less from equity market participation. Moreover, housing increases a household's exposure to risk and illiquidity (Grossman and Laroque, 1990; Flavin and Yamashita, 2002). Thus, a homeowner's willingness to take on stock market risk is also reduced. Therefore, we expect that the equity market participation rate will remain low after a house purchase. As households build up their liquid wealth over time, the equity market participation rate will likely increase.

We also study the post-house purchase risky asset share of liquid wealth conditional on participation. Here, too, a number of theoretical papers guide our empirical testing. These papers identify three channels that provide different incentives for households to rebalance their liquid wealth toward more risky or safer positions.

First, Yao and Zhang (2005) study how households optimally choose their liquid wealth portfolios when the households also decide whether to rent or own a house using a life-cycle model. When households are indifferent between owning and renting, the

[8]Equity market participation costs could be one-time or per-period costs. Previous studies by Basak and Cuoco (1998), Vissing-Jorgensen (2002), Haliassos and Michaelides (2003), Gomes and Michaelides (2005), and Alan (2006) suggest that costs can significantly impact equity market participation.

authors show that investors choose substantially different portfolio compositions when they own a house versus when they rent a house. When owning a house, investors reduce the stock share in their total wealth (i.e., the sum of bonds, equity, and home equity), reflecting the substitution effect of home equity for risky stocks, but the investors hold a higher risky asset share in their liquid wealth portfolios (i.e., bonds and stocks), reflecting the diversification effect. The diversification effect is due to the low correlation between stocks and housing returns and the high equity risk premium that makes holding stocks relatively attractive.

Second, Becker and Shabani (2010) explore the debt retirement channel and argue that when households hold mortgage debt after a house purchase, conditional on equity market participation, they increase the risky asset share of their liquid wealth. Investing their liquid wealth in stocks allows households to earn a higher expected return than the return on safe assets (i.e., a risk-free rate). Otherwise, these households can be better off by using their liquid wealth to pay back their mortgage debt, as retiring mortgage debt offers households a return equal to the interest rate on their mortgage loan, which is almost always greater than the return on investing in safe assets.

Third, Fratantoni (2001) and Hu (2005) emphasize the importance of liquidity demand. They argue that homeowners with a mortgage face expenditure risk due to the committed mortgage payments over a long horizon. When labor income is uncertain, homeowners face a liquidity concern. Therefore, buying a house has a negative impact on the risky asset share, as bonds provide liquidity to make mortgage payments in case of income shortfalls.

Based on the discussions above, the first two channels suggest that the conditional risky asset share of liquid wealth will immediately increase following a house purchase, while the third channel argues for the opposite.

To summarize, to the extent that households foresee an upcoming house purchase, we expect they accumulate more liquid wealth. Before a house purchase, the equity market participation rate will likely fall, and households reallocate their liquid wealth from risky assets to safe assets. After a house purchase, liquid wealth is low due to the investment in housing, and we expect that the equity market participation rate will remain low. As households build up liquid wealth over time after a house purchase, the equity market participation rate will gradually increase. Regarding the conditional risky asset share of liquid wealth after a house purchase, economic theory offers three channels through which a house purchase can affect the demand for risky assets. However, the net impact is ambiguous. Thus, it is an empirical question to investigate which channel dominates

and the overall net impact.

3 Data

We exploit administrative panel data from Statistics Denmark that contains the entire Danish population for 11 calendar years over the period 2002—2012. For each individual, we have access to annual data on demographics, income, as well as asset and debt holdings, which include information on real estate. All these variables are available on December 31 for each year. We then aggregate all the financial variables into the "household" level using the family identifier available from Statistics Denmark and use the household head's age, marital status, and highest educational attainment as the household characteristics. We choose "household" as opposed to "individual" as the research unit because buying a house and the associated housing investment are commonly a shared household decision.

We select a number of demographics and financial characteristics as the control variables based on portfolio choice theories (see Haliassos and Bertaut, 1995; Guiso, Haliassos, and Jappelli, 2002; Christiansen, Joensen, and Rangvid, 2008): age, age-squared, marital status, number of children, highest education obtained, labor income after tax and deductions, compulsory pension savings, bank loans,[9] net wealth, and profit and losses from stock investments.[10] Our goal is to estimate the temporal patterns of household portfolio choices of liquid wealth around a house purchase. In particular, the outcome variables we are interested in are the total liquid wealth, the equity market participation rate, and the risky asset share of liquid wealth. We begin with 47,847,174 individual-level observations in the period from 2002 to 2012.

We restrict the sample based on several criteria: (i) We keep only households with the head aged between 28 and 59 years in the year of the house purchase to avoid noisy effect of early retirement or being in full-time education on household portfolio choice. House purchase refers to the purchase of an owner-occupied housing; i.e., purchases of holiday housing, private rentals, and cooperative housing are not included. The year of the house purchase is defined as the first time the "taxable property value" appears greater than zero. (ii) We require the "house purchase" event to occur during the period 2005 to 2009

[9]Bank loans include consumer loans and the proportion of a loan for buying a house that is not covered by mortgage. The maximum lending limits for Danish mortgages are set up for each type of property and documented in the Act on Mortgages and Mortgage Bonds § 5. For owner-occupied homes, cooperative homes, and housing projects, mortgage loans can represent up to 80% of the property value. The remaining 20% can be borrowed from a commercial bank with a rate that is typically higher than the mortgage rate and lower than the consumer loan rate.

[10]A complete list of variable definitions can be found in the Appendix (Table 6).

to ensure that we have household information for at least 3 years before and 3 years after the house purchase. (iii) For those who bought houses during the period 2005—2009, we further impose a strict requirement that these households should not have owned a house in the 3 years leading up to the house purchase year.

After these sample selection criteria are applied, the panel is balanced based on the list of covariates and outcome variables. This gives us 44,970 unique households (463,523 observations); i.e., these households bought a house during the period 2005—2009, and we have the total information on the outcomes and covariates for at least 7 years around the house purchase (3 years before to 3 years after). The sample of these 463,523 observations is referred to as the main sample.[11]

We select another sample as the control group. As there is no natural control group, we select households that did not purchase a house during the whole sample period 2002—2012. We then apply the same age restriction as the main sample, and assign the control group a random house purchase year during 2005—2009. Finally, we keep only the observations with information throughout all 7 relative artificial house purchase years. This gives us 4.69 million observations or 436,068 unique households.

Using register-based data for the whole population eliminates the concern of attrition bias usually present in survey data and ensures that our results do not suffer from sampling error. The large sample size increases the external validity of the results and allows us to perform various sub-sample tests while having enough observations in each specification to produce robust inferences. The detailed information available also gives us a broad spectrum of control that captures the background risk to the largest extent. Finally, the panel data structure allows us to account for time-invariant unobserved household heterogeneity which is a pervasive problem in cross-sectional analysis.

Table 1: House Purchases from 2005 to 2009

Purchase Year	Frequency	Percentage	Cumulative Frequency
2005	12,495	27.79	27.79
2006	9,834	21.87	49.65
2007	9,171	20.39	70.05
2008	7,332	16.30	86.35
2009	6,138	13.65	100.00
Total	44,970	100.00	

[11]The sample selection criteria for the main sample and the control sample can be found in the Appendix (Table 7).

Table 1 shows the number of households that bought a house during the period 2005 to 2009 in the main sample. About 28% of the main sample households bought a house in 2005, and the percentage gradually decreases during the 5-year period. This trend is consistent with the aggregate-level data provided by Statistics Denmark.[12]

Table 2 presents the summary statistics for the main sample in the representative year 2010 and in the 3 years before and after a house purchase, where T represents the year of the house purchase. The riskiness of the household portfolio is measured by the ratio of the market value of the stocks and the risky mutual fund investments at year end to liquid wealth (i.e., the risky asset share or stock share).

The average household head in the main sample in 2010 is 41 years old and has 12-14 years of education. The average household has labor income of DKK 529,842, has DKK 389,831 in bank loans outstanding, has a household net wealth of DKK 22,918, makes a profit of DKK 2,259 in stock investments, and owns liquid wealth of DKK 194,961, of which DKK 31,870 is risky. In 2010, 32.12% of the main sample households are stockholders. Among those who participate in the stock market, on average, 26.32% of their liquid wealth is invested in risky assets.

From 3 years before to 3 years after purchasing a house, the households have additional children, on average, receive higher labor income, and accumulate higher net wealth and more pension savings. More households become married during the period. Bank loans increase 106% from T-1 to T, indicating that the households, in addition to their mortgages, often borrow from banks to buy a house, as mortgages can represent up to only 80% of the property value at the time of purchase. The summary statistics also show that households' liquid wealth (i.e., financial assets) continuously increases before a house purchase. The average liquid wealth falls in the year of the house purchase and only starts to recover 3 years after. Safe assets follow the same pattern. Households tend to reduce the riskiness of their liquid portfolios before purchasing a house. On average, the share of risky assets reaches its lowest point at 1 year before the house purchase and increases immediately after the house purchase. This is the case for conditional and unconditional risky asset shares. There seems to be no clear pattern for the equity market participation rate around house purchases. On average, equity market participation remains stable with a slight increase during the 7-year period.

[12]See the variable "Sales of real property (EJEN88)."

Table 2: Summary Statistics: The Main Sample

	2010	T-3	T-2	T-1	T	T+1	T+2	T+3
Demographics:								
Age	40.99	34.65	35.64	36.64	37.64	38.64	39.64	40.64
	(8.35)	(8.25)	(8.25)	(8.25)	(8.25)	(8.25)	(8.25)	(8.25)
Married	55%	36%	39%	42%	46%	50%	53%	55%
	(50%)	(48%)	(49%)	(49%)	(50%)	(50%)	(50%)	(50%)
Education	5.75	5.25	5.40	5.52	5.61	5.67	5.72	5.75
	(2.34)	(2.48)	(2.45)	(2.42)	(2.39)	(2.37)	(2.35)	(2.34)
Number of Children	1.13	0.74	0.80	0.88	0.95	1.02	1.07	1.12
	(1.12)	(1.01)	(1.02)	(1.04)	(1.05)	(1.07)	(1.09)	(1.11)
Income & Debt:								
Compulsory Pension Contribution	11,630.72	6,498.38	6,677.79	6,732.14	7,936.41	8,808.13	9,792.45	10,943.53
	(43416)	(24588.59)	(27432.58)	(30601.28)	(34172.36)	(36770.08)	(39218.89)	(41910.05)
Labor Income	529,842.10	340,389.30	374,448.10	418,312.80	459,972.20	487,715.40	508,204.70	521,360.20
	(342381.5)	(227180.5)	(236013.6)	(249066.5)	(262773.9)	(283612.8)	(306069)	(329182.8)
Bank Loans	389,831.10	153,206.00	165,205.50	200,198.10	412,033.00	405,341.50	400,279.50	386,757.40
	(766759.2)	(273523.5)	(334595.3)	(416786.3)	(627708.7)	(911305.2)	(913148.6)	(691970.6)
Net Wealth	22,918.08	-32,370.88	-17,544.32	-79,354.88	132,572.10	161,257.70	197,634.90	143,108.90
	(1372024)	(510498.1)	(603787.8)	(837695.3)	(1321940)	(1400118)	(1419992)	(1336426)
Stock Income	2,259.46	1,129.25	1,277.56	1,513.24	2,126.37	1,780.26	2,195.05	1,889.78
	(77079.53)	(93661.84)	(49762.27)	(53686.61)	(59976.83)	(53892.19)	(76801.54)	(64085.95)
Outcomes:								
Financial Asset	194,961.10	128,435.70	154,712.40	202,516.20	177,167.30	176,009.00	177,679.20	182,442.70
	(507155.2)	(337166.1)	(420564.5)	(524832.3)	(778585)	(1037932)	(738956.6)	(488786.6)
Risky Asset	31,870.21	18,161.31	24,286.03	27,402.12	28,694.61	29,709.01	27,165.21	27,088.95
	(180025.2)	(132103.7)	(186002.6)	(216725.8)	(339990)	(319846.7)	(221680.1)	(168433.4)
Safe Asset	163,090.90	110,274.30	130,426.40	175,114.10	148,472.70	146,300.00	150,514.00	155,353.70
	(425158.9)	(273029.8)	(322906.7)	(411083.5)	(513074.9)	(761275.6)	(578804.6)	(415597.3)
Stockshare % (unconditional)	8.58	7.63	8.26	7.98	8.54	9.10	8.67	8.08
	(20.01)	(18.59)	(19.33)	(18.93)	(19.79)	(20.76)	(20.25)	(19.49)
Stockshare % (conditional)	26.32	25.87	27.27	25.71	27.79	28.83	27.06	25.03
	(27.58)	(26.47)	(26.74)	(26.43)	(27.19)	(28.23)	(27.98)	(27.43)
Stock Market Participation Rate	32.12%	28.83%	29.68%	30.54%	30.33%	31.05%	31.50%	31.75%
	(46.69%)	(45.30%)	(45.68%)	(46.06%)	(45.97%)	(46.27%)	(46.45%)	(46.55%)

Note: This Table reports summary statistics (mean value) based on our main sample of 463,523 observations (44,970 unique households). Column 1 reports the summary statistics in the base year of our regressions 2010. T represents the year of house purchase. Column 2-8 show the summary statistics for a 7-year period before and after house purchase, from 3 years before to 3 years after, respectively. Where applicable, values are in Danish Kroner (DKK) and measured at the end of each year. Standard deviation in parentheses.

4 The Empirical Strategy

In this paper, we estimate the temporal patterns of household portfolio choices before and after a house purchase. We use two empirical strategies to address this issue.[13]

[13]Another intuitive method is to match households that have similar demographic and financial characteristics and did not purchase a house during 2005—2009 with the main sample. Then, the differences

4.1 The Main Empirical Strategy

We adopt a similar approach from the job loss literature (Jacobson, LaLonde, and Sullivan, 1993; Davis and von Wachter, 2011; Basten, Fagereng, and Telle, 2016). The empirical strategy is illustrated by the following specification:

$$Y_{it} = \eta_i + \gamma_t + \sum_{k\geq -3}^{k\leq 3} \delta_k D_{it}^k + \beta X_{it} + \varepsilon_{it}. \tag{1}$$

where dependent variable Y_{it} is a particular outcome for household i in year t. The outcomes we focus on in this paper are liquid wealth, the equity market participation rate, and the share of risky assets in liquid wealth. Equation 1 includes a vector of the dummies for 7 relative years around the year of the house purchase: $D_{it}^k = \{D_{it}^{-3}, D_{it}^{-2}, D_{it}^{-1}, D_{it}^0, D_{it}^1, D_{it}^2, D_{it}^3\}$, where the relative year zero is the year of the house purchase. Let $D_{it}^k = 1$ if year t is k years relative to the house purchase year.[14] X_{it} contains a broad spectrum of controls on households' demographics and financial characteristics: household head's age, age-squared, marital status, highest education attainment, number of children, household's total labor income after tax and deductions, compulsory pension savings, bank loans and net wealth. We also control for household fixed effects (η_i) and calendar-year fixed effects (γ_t).[15] This means that time-invariant household heterogeneity and aggregate calendar-year variation (i.e., macroeconomic conditions, such as the interest rate, stock market return, and mortgage regulation), which may potentially affect the timing of the house purchase and household portfolio decisions, will not bias the results. δ_k is our parameter of interest, which describes the time path of the portfolio choice outcomes

in the portfolio choices between the two otherwise similar groups will be the effect of a house purchase. However, the nature of our research topic violates an important assumption of the propensity matching method, which is that the treatment (house-purchaser vs. non house-purchaser) has to be exogenous to the outcome (household portfolio choice). For a similar reason, the difference-in-difference (DID) method will not work in this setting, either. The standard regression DID model relies on a common trends assumption for causal interpretations. In other words, the model assumes that the portfolio outcomes for the treatment group would have developed on a parallel path as the control group had they not bought the house. A key challenge of implementing the DID method in this study is that a house purchase is an anticipated decision. The pre-house-purchase evolution in portfolio outcomes between the two groups is likely to be unparalleled. The nonparallel evolution in the portfolio outcomes of the treatment and control groups is confirmed in Section 5.2. In this case, the resulting DID estimates would be spurious.

[14] For example, when $k = -2$, $D_{it}^{-2} = 1$ means year t is 2 years before household i bought a house; and when $k = 3$, $D_{it}^3 = 1$ means year t is 3 years after household i bought a house.

[15] Our empirical strategy has a significant advantage compared to cross-sectional regression. For example, some may be concerned that the households that bought a house when prices increased during 2005 to 2007 might be fundamentally different from those that bought a house when prices fell (2008 and 2009). The two groups could have different levels of risk aversion. Our strategy directly accounts for this effect and produces unbiased results and robust inferences.

from 3 years before to 3 years after the house purchase. ε_{it} is an idiosyncratic error term. The observations are assumed to be independent across households but not necessarily across time.

For the risky asset market participation decision (the extensive margin), we adopt a panel data fixed-effect logit model to control for stable household characteristics. Let $y*$ be a latent variable that represents the households' net utility of holding risky assets. Assume $y*$ is determined by $y* = \eta_i + \gamma_t + \sum_{k\geq -3}^{k\leq 3} \delta_k D_{it}^k + \beta X_{it} + \varepsilon_{it}$. $y*$ is not observed. However, we observe Y for each household at each time period as a choice households make according to the rule $Y = 1$ if $y* > 0$ and $Y = 0$ if $y* \leq 0$. Then the probability that a positive holding choice is made is illustrated by the following functional form:

$$Pr(Y_{it} = 1|Z) = F(\eta_i + \gamma_t + \sum_{k\geq -3}^{k\leq 3} \delta_k D_{it}^k + \beta X_{it}) \tag{2}$$

where Y_{it} denotes a binary variable indicating whether a household holds risky assets. Z is a vector of the independent variables that include 7 relative year dummies around the house purchase, control variables, and fixed effects. $F(\cdot)$ is the cumulative logistic distribution function. ε_{it} is assumed to follow a logistic distribution. We allow a household's behavior to be correlated through time; therefore we report cluster-robust standard errors.

For liquid wealth and the risky asset share (the intensive margin), Equation 1 is estimated using a panel data fixed-effect model with cluster-robust standard errors, clustering at the household level. Households' behavior is assumed to be independent from each other, but correlated through time. Results are estimated using only *within-household* differences, and therefore should be interpreted as the development of household decisions over time instead of differences in decisions across households. Additionally, when estimating the risky asset share, we add one more covariate, profit and losses from stock investments at year end, to X_{it}. In doing so, we attempt to isolate the change in the risky asset share that is driven by active rebalancing of the portfolio instead of pure market movements.

Finally, to shed light on the reliability of our empirical strategy, we repeat the analyses by looking at households by wealth, age, family disposable income and income volatility, geographic location, and whether the household experienced capital gains or losses.

4.2 Random Assignment of an Artificial House Purchase Year to the Control Group Sample

Although we have included a rich set of control variables in our main empirical strategy, concerns may still remain as to whether the results are driven by macroeconomic trends or whether the sample selection criteria induce a spurious pattern in the data. To address these concerns, our second empirical strategy is to consider a control group of households that are subjected to the same criteria as the main sample but that do not buy a house during the entire sample period 2002—2012.

As none of the control group households bought a house during the sample period, we randomly assign an artificial house purchase year (in 2005—2009) to each of these households.[16] We then merge these households with the main sample. As the households in the control group did not actually buy houses in 2002—2012, we have no reason to expect any special patterns of household portfolio choice around the randomly assigned house purchase year. If this is the case, and we simultaneously find clear patterns of household portfolios related to the actual house purchase, it would present further evidence for the relation between a house purchase and the portfolio choice of liquid wealth. We run the following regression:

$$Y_{it} = \eta_i + \gamma_t + \sum_{j=0}^{j=1} \sum_{k\geq -3}^{k\leq 3} \delta_{kj} \tau_j D_{it}^k + \beta X_{it} + \varepsilon_{it}. \tag{3}$$

Equation 3 estimates the magnitude and temporal patterns of the household liquid portfolio choice around the artificially assigned house purchase year and the actual home purchase year. Let τ_0 be a dummy for the control group (i.e., $\tau_0 = 1$ for the control group) and τ_1 be a dummy for the main sample (i.e., $\tau_1 = 1$ for the main sample). δ_{k0} is the first column of a 7×2 matrix that contains the parameters that measure the effect of the artificially assigned house purchase years on the portfolio outcomes. And δ_{k1} is the second column of that matrix that contains the parameters that capture the effect of the actual house purchase years on the portfolio outcomes.

For the extensive margin, Y_{it} is a binary variable indicating whether the household is a stockholder. We estimate this equation using a panel data fixed-effect logistic regression with cluster-robust standard errors. For liquid wealth and the intensive margin (the risky asset share), a fixed-effect model with a cluster-robust standard error is implemented as

[16] Some households in the control group may be homeowners before 2002 and continue to be homeowners in 2002—2012. Thus, the control group households consist of homeowners (i.e., those have owned a house since 2002) and non-homeowners.

in the main empirical strategy. We expect the magnitude and temporal patterns of the household portfolio outcomes to hold for those who actually bought a house during 2005—2009, while we should not observe any systematic relation between the portfolio outcomes and the artificial house purchase year.

5 Results

In this section, we report the findings for the two empirical strategies. We also perform robustness checks to test the validity of the estimations.

5.1 Results from the Main Empirical Strategy

We focus on the development of liquid wealth, the equity market participation rate, and the risky asset share of liquid wealth around the time of a house purchase.[17] Not surprisingly, households accumulate more liquid wealth before a house purchase. Figure 1 shows that Danish households, on average, hold DKK 204,558 (about USD 37,000 or EUR 28,000) in liquid wealth 3 years before purchasing a house. Liquid wealth keeps increasing and reaches its highest level of DKK 295,082 (about USD 53,000 or EUR 40,000) 1 year before the house purchase. There is a sharp decline in liquid wealth in the year of the house purchase, which is mainly driven by households putting down payments and converting part of their liquid wealth into home equity. We estimate the magnitude of the decline is DKK 180,549 (about USD 32,000 or EUR 24,000), which accounts for 61.19% of the liquid wealth 1 year before the house purchase. Liquid wealth stays at a low level for the next 2 years following the house purchase and does not start to increase until 3 years later. By the end of the third year after a house purchase, a household's liquid wealth is DKK 18,589 higher than that at the end of the house purchase year, a 16.23% increase.

[17] Table 4 in the Appendix shows the corresponding predicted outcomes from regressions for liquid wealth (Figure 1), the equity market participation rate (Figure 2), and the risky asset share (Figure 3). Table 3 in the Appendix shows the regression coefficients.

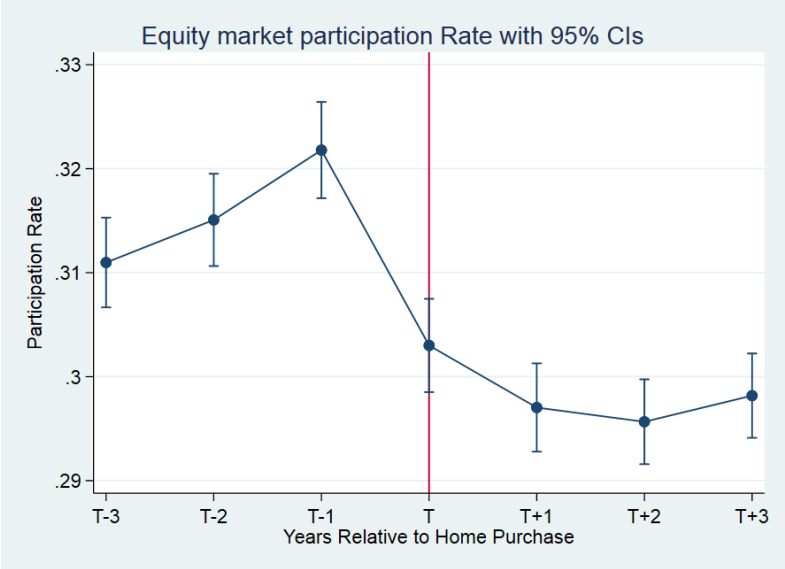
Figure 1: Liquid Wealth and Safe Assets

5.1.1 The Extensive Margin

Figure 2 shows the equity market participation rate before and after a house purchase. The pattern of equity market participation around a house purchase follows a similar pattern as liquid wealth accumulation. Before a house purchase, the equity market participation rate increases about 1 percentage point in 2 years from T-3 to T-1. In the year of house purchase, the equity market participation rate falls by 2 percentage points, which is statistically significant at the 1% level and represents a 6.2% decline relative to the participation rate 1 year before the house purchase. Our finding that the equity market participation rate decreases in the year of the house purchase provides strong evidence that housing investments induce households to withdraw funds from the risky asset market.

After the house purchase, the equity market participation rate falls another 0.7 percentage points in the next 2 years. As households hold very low liquid wealth immediately after a house purchase, we suspect that the further decline in the participation rate is related to the liquidity demand facing some households. We test whether the pattern of equity market participation differs by wealth level and income group in the robustness check section. In the third year after a house purchase, participation in the risky asset market starts to increase.

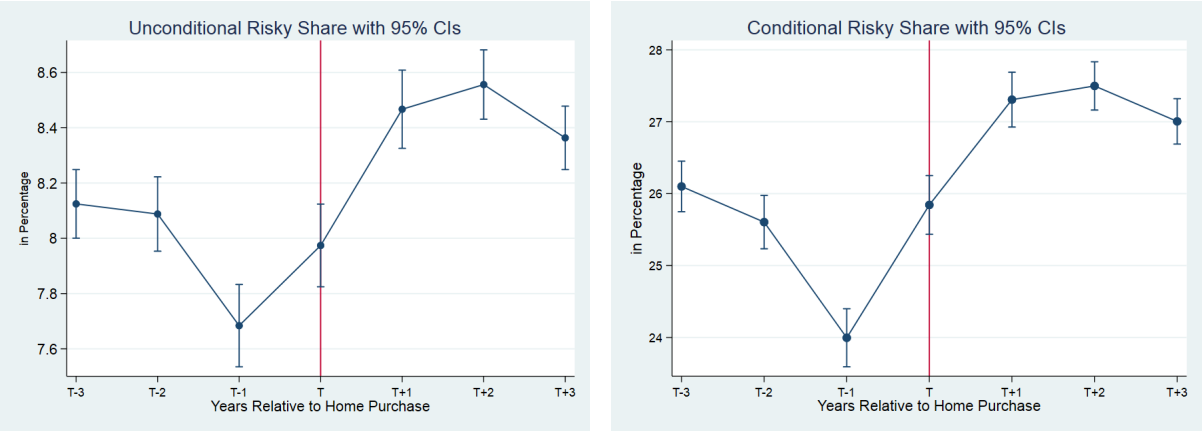
Figure 2: The Equity Market Participation Rate



5.1.2 The Intensive Margin

For the intensive margin, Figure 3 shows the temporal pattern of the risky asset share of liquid wealth before and after a house purchase. Conditional and unconditional on equity market participation, households rebalance their liquid wealth portfolios from risky to safe assets before a house purchase, which is consistent with the theoretical prediction that investors become more risk averse when they face borrowing constraints (Paxson, 1990; Grossman and Vila, 1992; Teplá, 2000). Conditional on participation, the risky asset share falls 2.1 percentage points from 3 years before (26.10%) to 1 year before a house purchase (24.0%), which is an 8% decline.

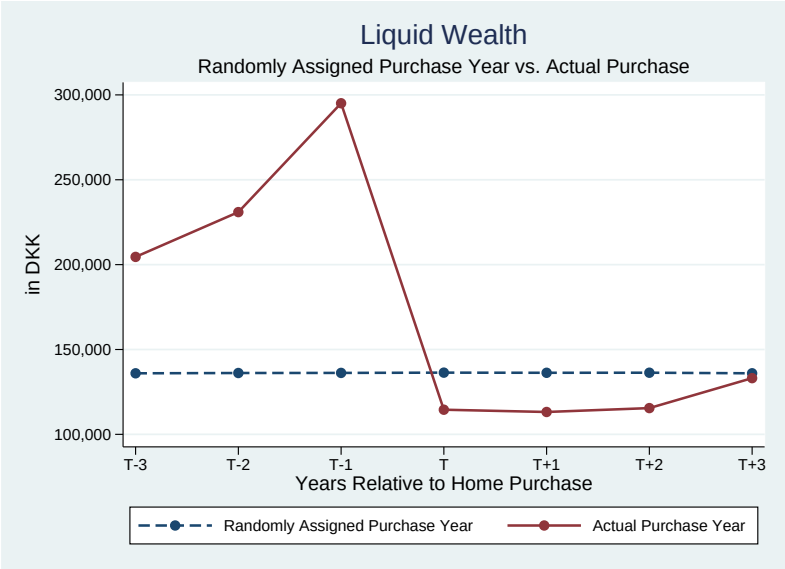
Figure 3: The Risky Asset Share



There are three theoretical arguments about the risky asset share of liquid wealth conditional on equity market participation after a house purchase: the diversification effect (Yao and Zhang, 2005), the debt retirement channel (Becker and Shabani, 2010), and the liquidity demand hypothesis (Fratantoni, 2001; Hu, 2005). The first two channels predict that the conditional risky asset share increases immediately following a house purchase, whereas the third channel suggests a decrease. We are not able to estimate the effect of each channel separately. However, the results suggest a strong dominant effect for the first two channels. The conditional risky asset share jumps from 24.0% 1 year before the purchase of a house to 25.8% in the year of the house purchase. The jump is statistically significant at the 1% level. The risky asset share continues to increase in the next 2 years following the house purchase. Overall, the conditional risky asset share is 3.3 percentage points higher 2 years after the house purchase than 1 year before the house purchase, a 13.8% increase.

5.2 Result for the Randomly Assigned Artificial House Purchase Year

Figure 4: Liquid Wealth



In this section, we report the results from the second empirical strategy.[18] By randomly assigning an artificial house purchase year to households that did not purchase a

[18]Table 5 in the Appendix shows the corresponding regression coefficients for liquid wealth (Figure 4), the equity market participation rate (Figure 5), and the risky asset share (Figure 6).

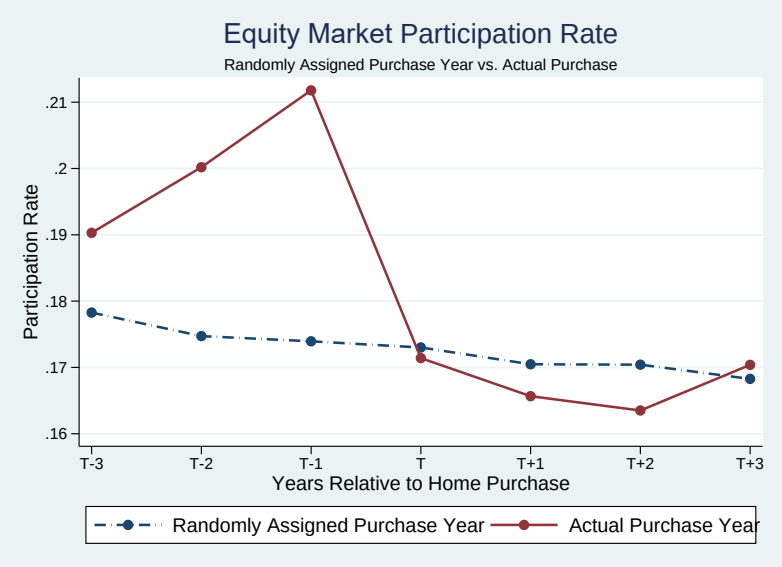
house, we intend to address the potential bias caused by the sample selection criteria or macroeconomic trends in this analysis.

As shown in Figure 4, households accumulate liquid wealth before the actual house purchase. They use a large portion of their liquid wealth to finance down payments in the year of the actual purchase, and then slowly save up after the purchase. Thus, the result from the main sample remains the same. However, we do not observe a notable change in liquid wealth before and after the artificial house purchase year. Households' liquid wealth stabilizes around DKK 136,000 for the control group sample. Note that households in the control group sample have considerably less liquid wealth compared to those in the main sample during the pre-house-purchase period, but they have higher liquid wealth in the first few years immediately after the house purchase.

5.2.1 The Extensive Margin

Figure 5 shows the temporal patterns of the equity market participation rate before and after a house purchase for the main sample (with the actual house purchase year) and the control group sample (with the artificial house purchase year). We observe the same pattern and magnitude of the participation decision for households that actually bought a house during 2005—2009. However, there is no statistically significant relation between the artificial house purchase year and the development of the equity market participation decision. The participation rate hovers around 17.3% for the control group sample.

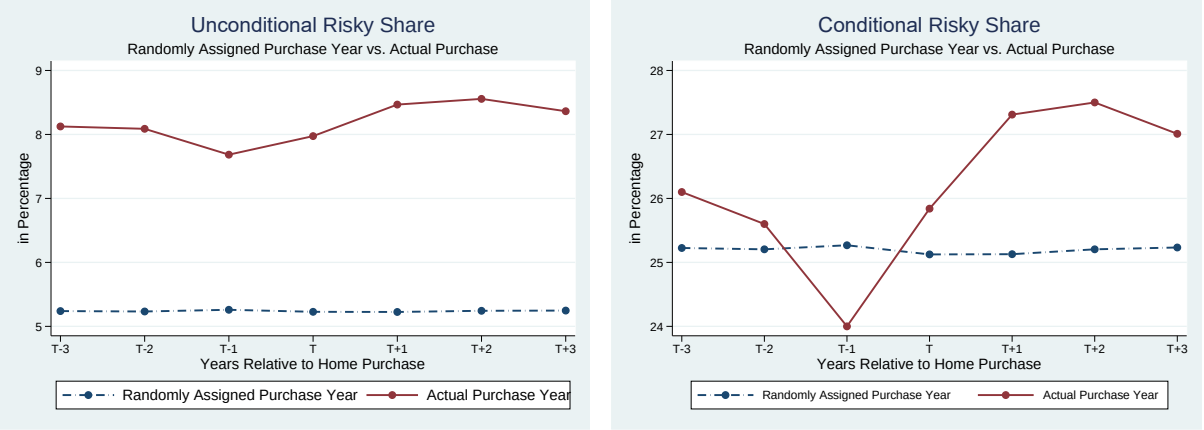
Figure 5: The Equity Market Participation Rate



5.2.2 The Intensive Margin

Figure 6 reports the time path of the risky asset share before and after the actual and artificial house purchase year. The time path of the conditional and unconditional risky asset share around the actual house purchase year remains the same as reported in the main results. Again, for the control group sample, we do not observe any systematic relation between the risky asset share and the artificial house purchase. For example, conditional on participation, the risky asset share is around 25.2% before and after the artificial house purchase year.

Figure 6: The Risky Asset Share: Unconditional vs. Conditional on Participation



Overall, we find no statistically significant correlations between household portfolios and the artificial house purchase year, while the temporal patterns of the household portfolio outcomes for those who actually bought a home during 2005—2009 remain unchanged. This finding suggests that concerns about macroeconomic trends or sample selection criteria do not bias the results.

5.3 Robustness Check

In this section, we conduct robustness checks for the main empirical strategy. We address concerns about wealth (more financially constrained households versus wealthier households), the life-cycle stage, labor income, and macroeconomic conditions in different regions. Moreover, we test the results for two groups of households in particular: those that experienced large capital gains and those that experienced capital losses.

5.3.1 By Wealth

In the main empirical strategy, we control for the level of wealth by including the household net wealth reported in the year end by Statistics Denmark in the fixed-effect

model or by including the log-transformed value in the fixed-effect logistic regression as a control variable. To compare the more financially constrained households (i.e., poor households) with less financially constrained (i.e., wealthier) households, we split the population by the median value of household net wealth and estimate the fixed-effect model and the conditional logit model on the two sub-samples.

Figure 7 shows a big gap in terms of liquid wealth for these two sub-samples (DKK 86,500 vs. DKK 470,000 in the 1 year before a house purchase). Although the overall pattern of liquid wealth accumulation around the house purchase year is similar, there is one key difference. Liquid wealth dropped further 1 year after the house purchase for the low-wealth households, while liquid wealth started to increase for the high-wealth households. This suggests that the liquidity issue is a bigger concern facing low-wealth households after buying a house, which could affect their portfolio choice as discussed next.

Figure 7: Liquid Wealth by Net Wealth Level

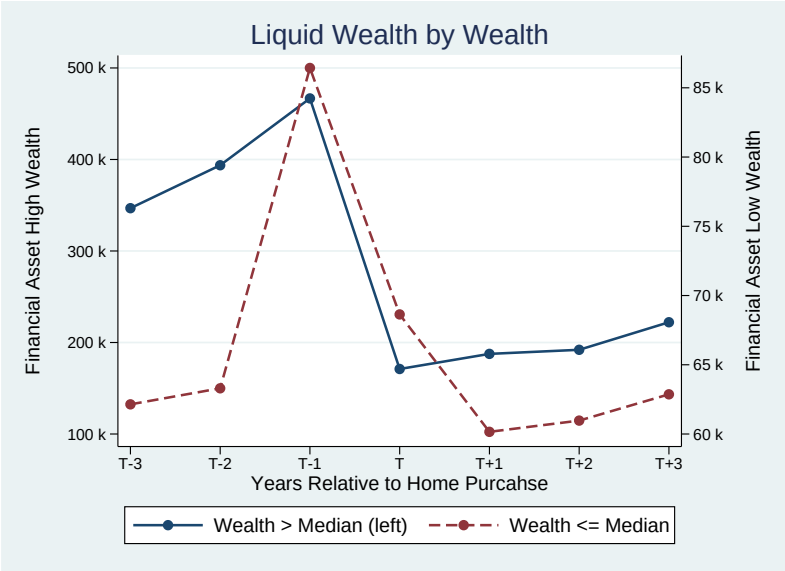


Figure 8: Equity Market Participation by Net Wealth Level

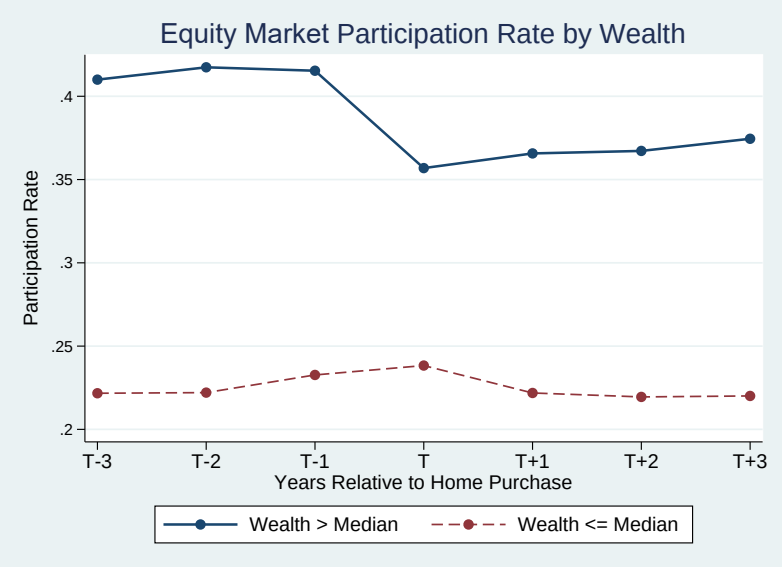
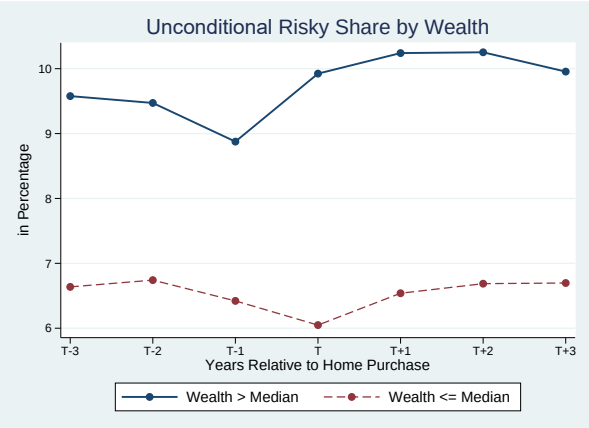
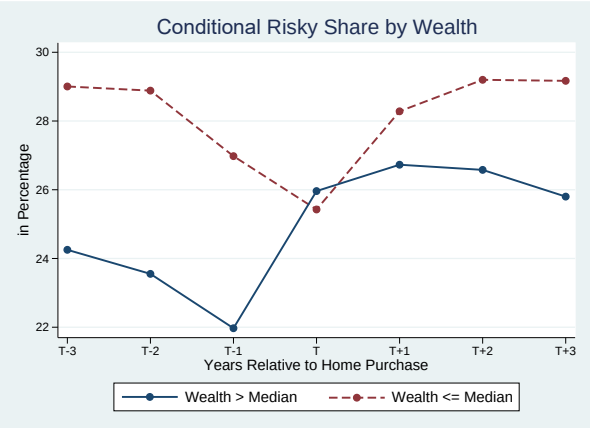


Figure 9: The Risky Asset Share: Unconditional vs. Conditional on Participation by Net Wealth Level





For wealthier households, the equity market participation rate stays relatively flat before a house purchase, and the rate falls 5.85 percentage points in the year of purchase (Figure 8). However, for low-wealth households, the equity market participation rate increases slightly before a house purchase, and the rate increases further in the year of the house purchase. This suggests that instead of becoming more risk averse, a small portion of low-wealth households in the main sample is actually taking on more stock market risk immediately before and during the period of buying a house. In doing so, these households might be hoping to earn higher returns from the stock market to relax their borrowing constraints. This behavior likely reflects a channel suggested by Chetty

and Szeidl (2007) that a housing commitment affects risk preferences. For some low-wealth households, a housing commitment creates an incentive to make bets that have large payoffs by participating in risky investments (i.e., similar to buying a lottery ticket). The analysis also provides evidence for the finding in Figure 2 that the big drop in the overall participation rate in the house purchase year is driven by high-wealth households.

Figure 9 presents the risky asset share of liquid wealth conditional and unconditional on participation by wealth level. The pattern of the conditional risky asset share around a house purchase for high-wealth households is similar to the overall result reported in Figure 3. In particular, there is a jump for the conditional risky asset share in the house purchase year. However, for low-wealth households, the conditional risky asset share of liquid wealth dropped in the year of the house purchase. This may suggest that the liquidity demand is a big concern for low-wealth households, resulting in a lower risky asset share for these households as suggested by Fratantoni (2001) and Hu (2005).

5.3.2 By Age

Life-cycle consideration is an important determinant for household portfolio choice, and it is well studied in the literature (e.g., Cocco, Gomes, and Maenhout (2005)). Age and age-squared are included in the main analysis as control variables. To compare household portfolio choice around a house purchase for different age groups, we split the sample into three sub-groups: households aged 28 to 38, 39 to 48, and 49 to 59 years. We have 238,519 observations in the youngest group, 122,661 observations in the middle-age group, and 63,057 observations in the 49 to 59 age group.

As expected, older households have higher liquid wealth than the other two groups, but the patterns of liquid wealth accumulation around house purchases are similar for all three sub-groups (Figure 10). Figure 11 and Figure 12 show the time path for the equity market participation rate and the risky asset share, respectively. Overall, the temporal patterns of the household portfolio outcomes for different age groups remain the same as in the main sample. Thus, age consideration does not change the results.

Figure 10: Liquid Wealth by Age

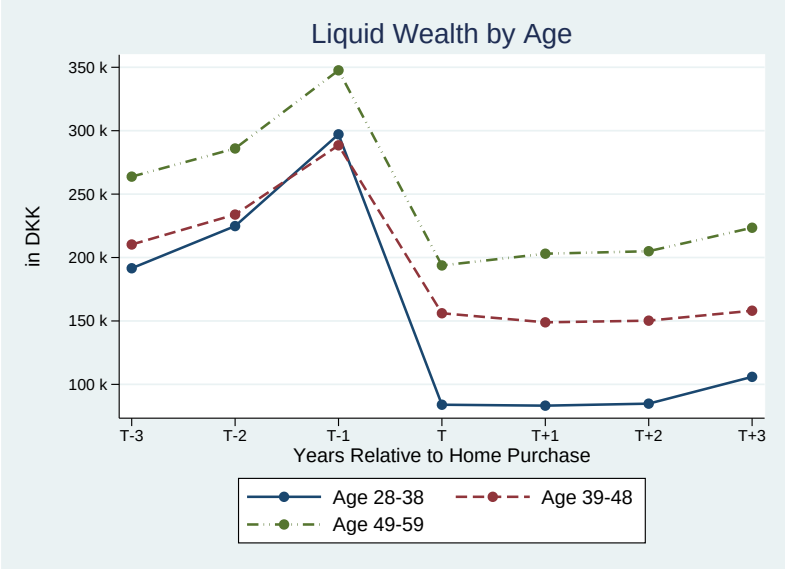


Figure 11: Equity Market Participation by Age

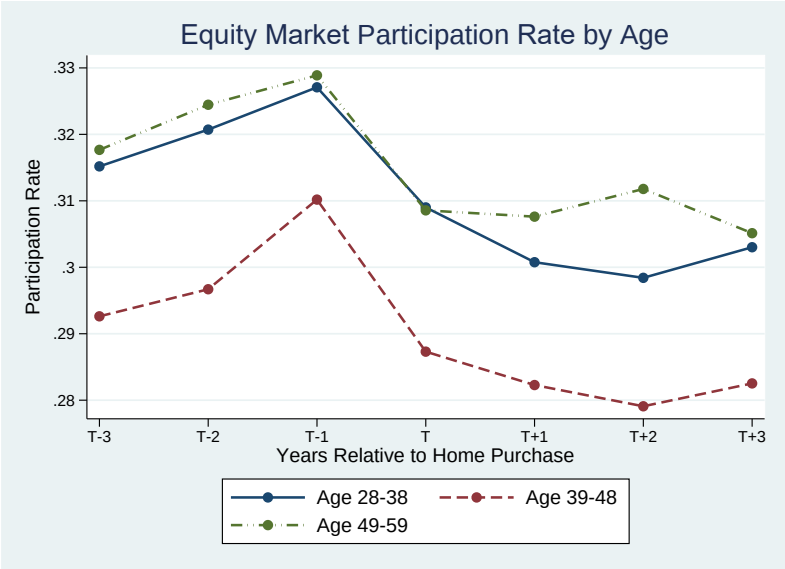
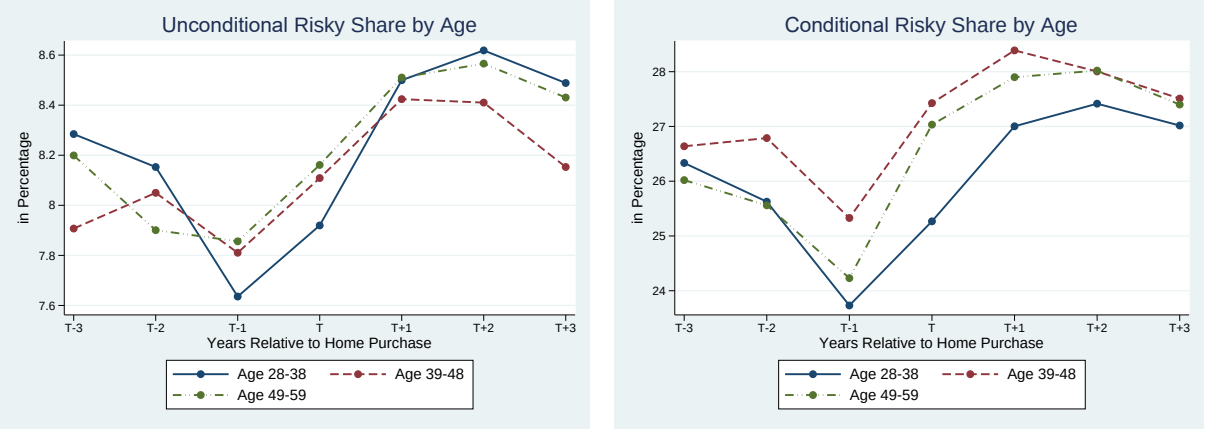


Figure 12: The Risky Asset Share: Unconditional vs. Conditional on Participation by Age



5.3.3 By Income

After buying a house, households are subject to committed housing expenditure risk. Liquidity demand may be a concern for homeowners. As income is closely linked to liquidity, we compare the time path of portfolio choice outcomes around a house purchase among different income groups. The main sample is divided into four sub-groups by income quartile.

Figure 13 shows the liquid wealth around the year of a house purchase by income group, while Figure 14 and Figure 15 show the equity market participation rate and the risky asset share, respectively. The patterns are similar to what we find for the main sample.[19] For example, the equity market participation rate drops for all income groups in the year of the house purchase. Low- and high-income households increase their risky asset share after purchasing a house, confirming the dominance of the diversification effect and the debt retirement channel over liquidity demand as in the main sample.

[19]We also explore heterogeneity in income volatility. We replicate the regressions in the main analysis for three groups of workers categorized by skill levels: (1) senior management and high-skilled workers, (2) ordinary employees, and (3) basic and unskilled workers. The patterns are similar to the main findings.

Figure 13: Liquid Wealth by Income

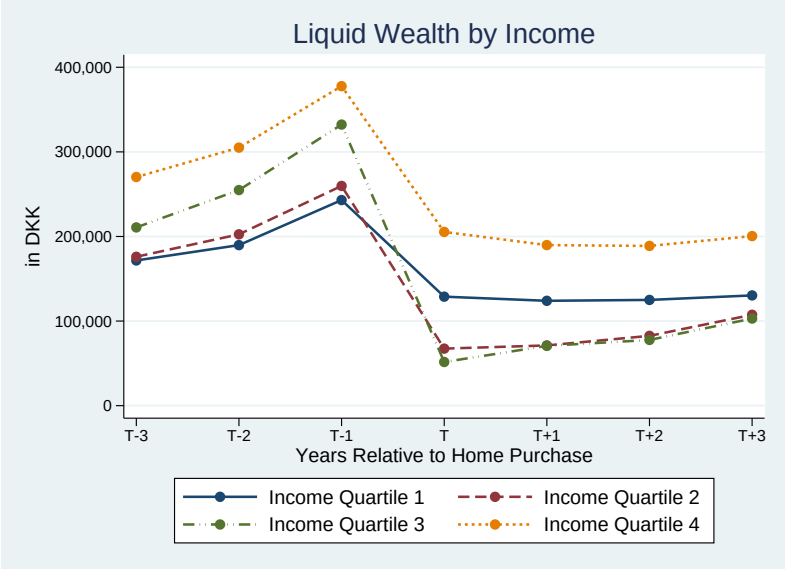


Figure 14: Equity Market Participation by Income

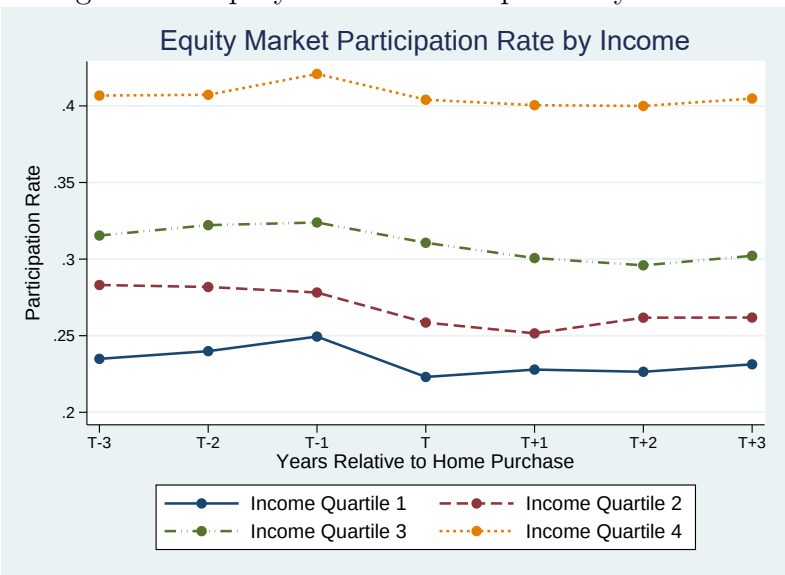
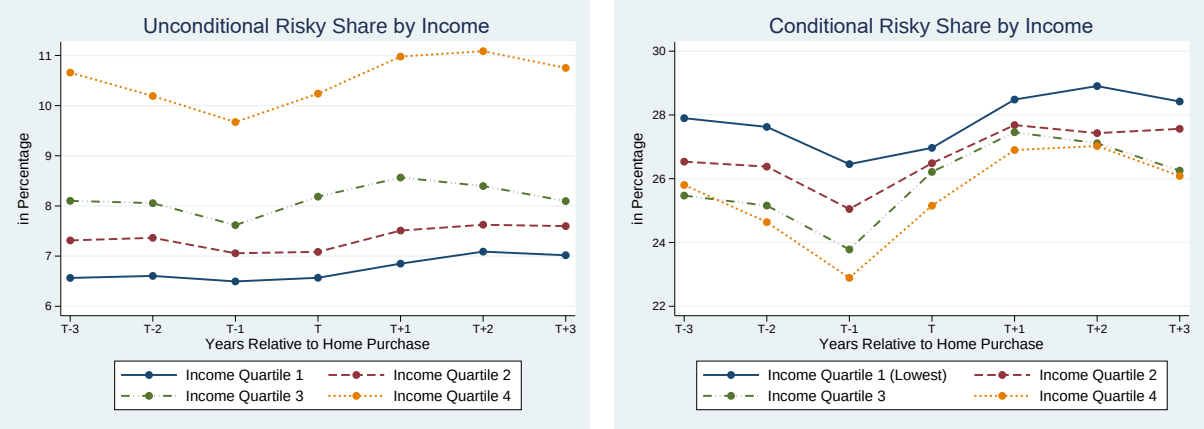


Figure 15: The Risky Asset Share: Unconditional vs. Conditional on Participation by Income



5.3.4 By Region

We compare the development of the household portfolio outcomes among different regions, as the different demographics and socioeconomic environment in each region may influence households' portfolio choice of liquid wealth and house purchase decisions.

Figures 16, 17 , and 18 show the temporal patterns for liquid wealth, the equity market participation rate, and the risky asset share of liquid wealth by region, respectively. The patterns in each region are similar to the patterns we report in the main results.

Figure 16: Liquid Wealth by Region

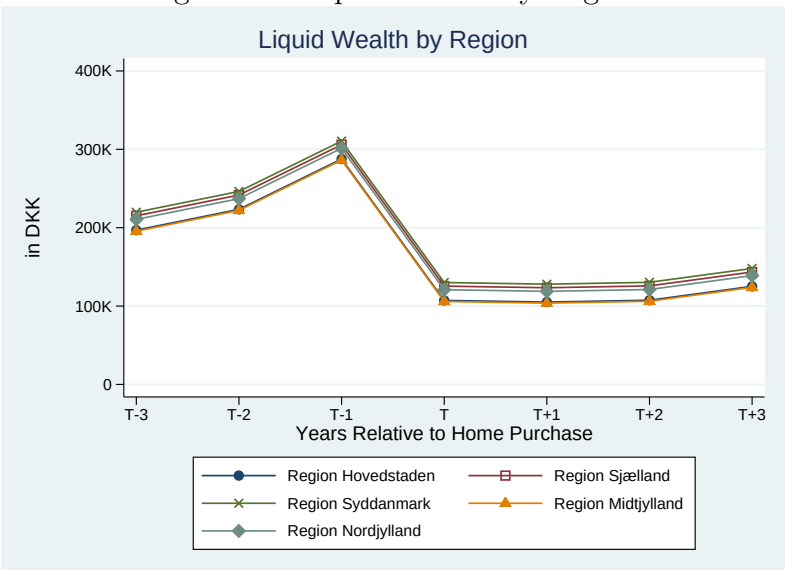


Figure 17: Equity Market Participation by Region

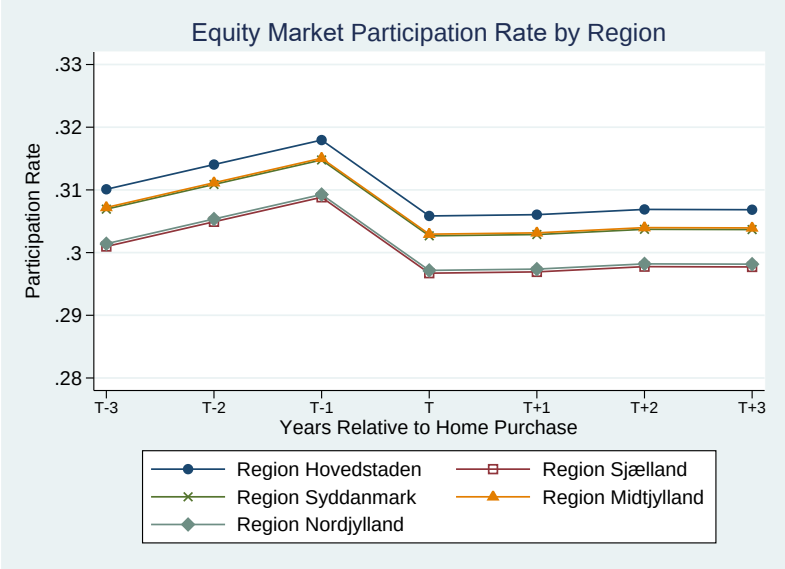
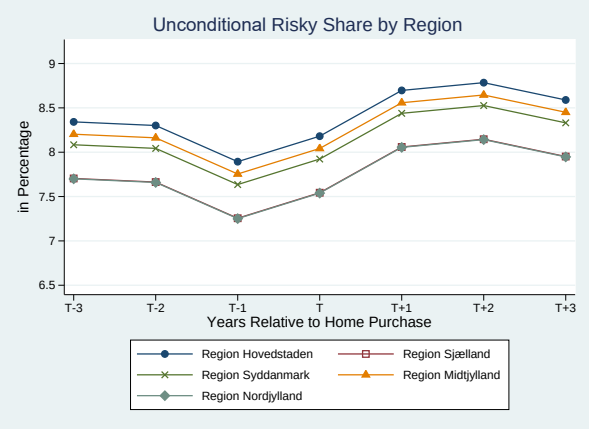
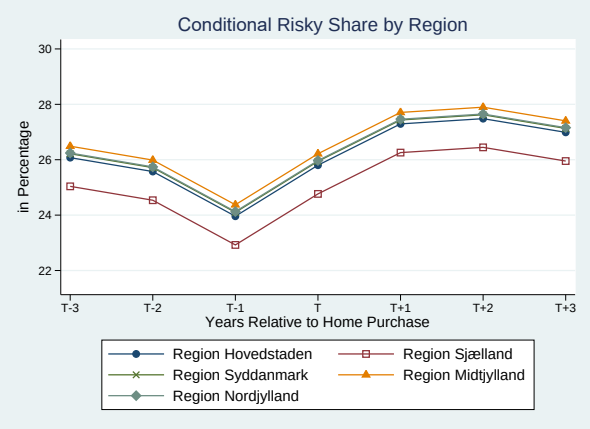


Figure 18: The Risky Asset Share: Unconditional vs. Conditional on Participation by Region





5.3.5 Capital Gains and Losses

Finally, we address the concern that households' risky asset return may affect their house purchase decision or timing, which, in turn, affects their liquid wealth accumulation pattern and financial investment decisions around the house purchase event. The concern is that households that have experienced capital gains from the stock market may be able to buy a house early and/or finance their down payments with risky asset returns. However, those who have experienced capital losses may have to postpone buying a house and reduce their risky asset holdings. We look at two groups of households that either

realized capital gains or experienced capital losses in the stock market 1 year before purchasing a house. Again, for these two particular types of households, we find robust evidence for the temporal patterns of liquid wealth accumulation (Figure 19) and risky asset shares (Figure 21) over the 7-year period around the house purchase as in the main sample.

However, the patterns of equity market participation for these two groups of households differ during the post-event period (Figure 20). For households that realized capital gains, the equity market participation rate fell at and after the house purchase year, which is similar to the main results. However, households that experienced capital losses increased their equity market participation, on average, after purchasing a house. This finding may reflect the loss aversion of these households (Kahneman and Tversky, 1979). They continue to participate in the stock market in the hope that they can recover their losses.

Figure 19: Liquid Wealth for Two Types of Households

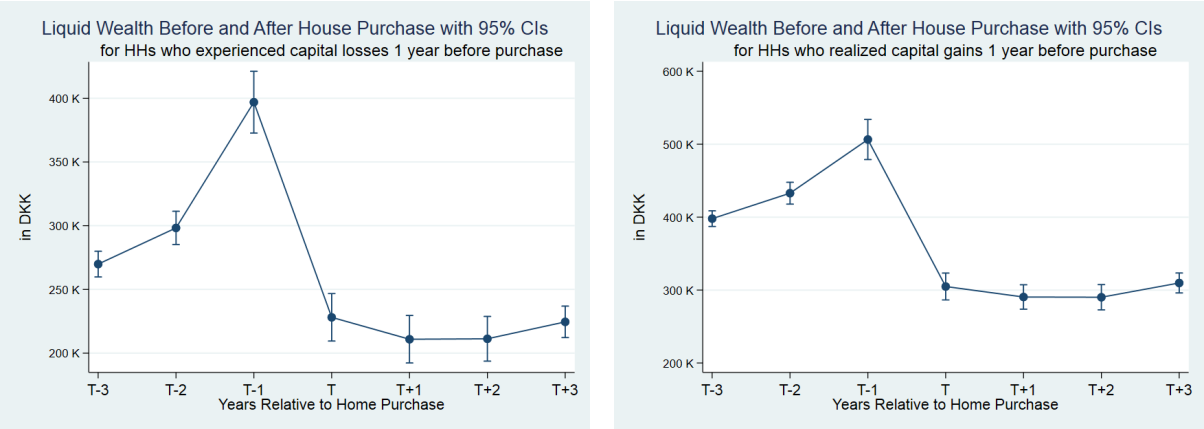


Figure 20: Equity Market Participation for Two Types of Households

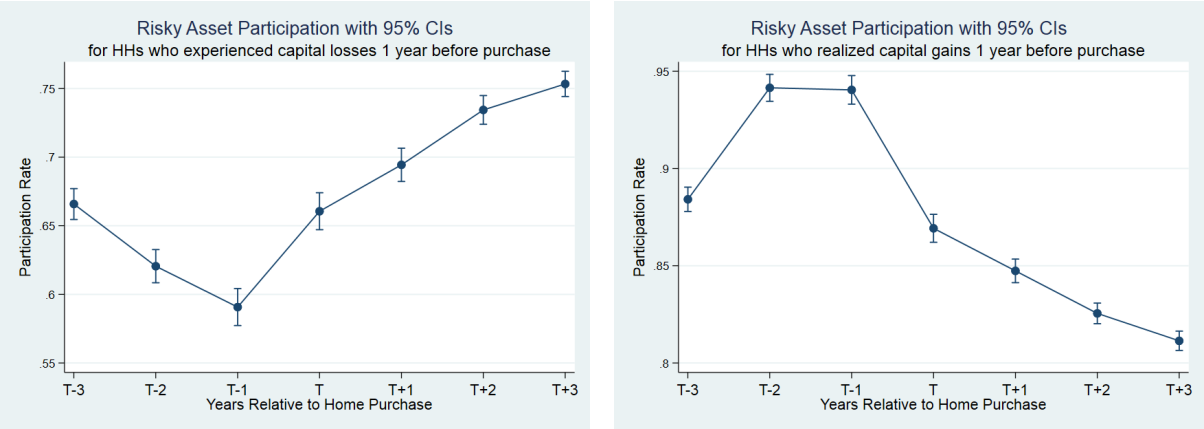
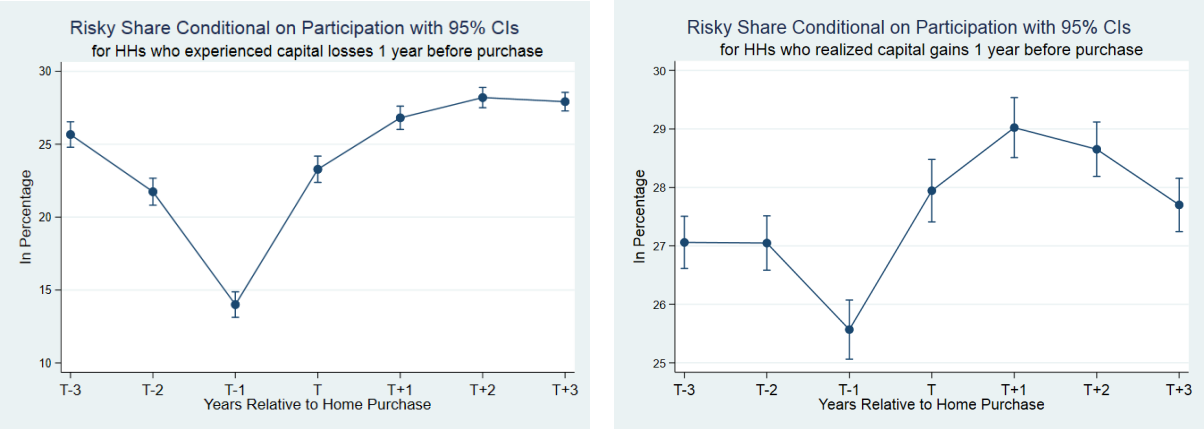


Figure 21: The Risky Asset Share: Conditional on Participation for Two Types of Households



6 Conclusion

Housing is the single most important asset for the majority of households. Many theoretical studies have shown that housing decisions have a great influence on households' saving decisions and portfolio choices. The purpose of this paper is to provide empirical evidence for the temporal patterns of households' portfolio choice of liquid wealth before and after the purchase of a house. We make use of unique administrative panel data from Denmark that span 11 years from 2002 to 2012 with a broad spectrum of controls on households' demographics and financial characteristics.

We find that households accumulate considerably more liquid wealth in the few years before a house purchase and liquid wealth falls by 61% in the year of the house purchase. After purchasing a house, households slowly save up liquid wealth. The equity market participation pattern around a house purchase follows the similar pattern as liquid wealth accumulation. The participation rate increases slightly before a house purchase, and there is a significant drop in the equity market participation rate in the year of the house purchase. After a house purchase, the equity market participation rate continues to drop slightly in the next 2 years and starts to increase 3 years after the house purchase. Conditional on participation, the risky asset share of liquid wealth decreases before a house purchase, likely reflecting a reduced willingness to take on risk before purchasing a house. As the stock investment is risky, holding a relatively safe form of assets reduces the probability of becoming credit constrained in the near future. After a house purchase and conditional on participation, the risky asset share jumps immediately to a level that is higher than 2 years before the house purchase. The literature has identified three channels

that could affect the conditional risky asset share after a house purchase. Our results suggest that the diversification effect and the debt retirement channel have a dominant effect compared to the liquidity concern.

This analysis provides new evidence for the relation between a house purchase and households' portfolio choice of liquid wealth. There seems to be a clear link between the stock market and the housing market. The reduction in demand for risky assets due to house purchases could contribute to the volatility in asset prices. It is also important to bear in mind that these results stem from an economy with a relatively low minimum down payment requirement, convenient and low-cost mortgage refinancing and prepayment terms, as well as a mature stock market. In countries where households face stricter borrowing constraints and stock markets are more volatile, there could be an even stronger link between house purchases and households' portfolio choice of liquid wealth.

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Appendix

Table 3: Main Result: Coefficients

VARIABLES	(1) Liquid Wealth (in DKK)	(2) Safe Asset (in DKK)	(3) Risky Share (in %)	(4) Risky Share (%) Conditional on Participation	(5) Equity Market Participation	(6) Equity Market Participation Odds Ratio
T-3	32,263***	23,740***	-0.0532	-0.469*	0.0346***	1.0353***
	(10,282)	(6,966)	(0.0929)	(0.258)	(0.0107)	(0.0110)
T-2	58,653***	44,043***	-0.0899	-0.965***	0.0552***	1.0567***
	(17,270)	(11,590)	(0.114)	(0.308)	(0.0124)	(0.0131)
T-1	122,787***	98,992***	-0.494***	-2.573***	0.0885***	1.0925***
	(27,781)	(18,166)	(0.128)	(0.342)	(0.0133)	(0.0146)
T	-57,762**	-42,269**	-0.204	-0.725**	-0.00568	0.9943
	(26,893)	(18,031)	(0.131)	(0.350)	(0.0131)	(0.0130)
T+1	-59,107***	-45,988***	0.289**	0.739**	-0.0362***	0.9644***
	(20,095)	(13,127)	(0.123)	(0.328)	(0.0120)	(0.0115)
T+2	-56,818***	-44,292***	0.379***	0.929***	-0.0433***	0.9576***
	(17,276)	(11,242)	(0.106)	(0.283)	(0.0102)	(0.0098)
T+3	-39,173***	-30,762***	0.186**	0.436*	-0.0304***	0.9701***
	(11,427)	(7,407)	(0.0863)	(0.231)	(0.00811)	(0.0079)
Controls	X	X	X	X	X	X
HH&Year fixed effects	X	X	X	X	X	X
Observations	463,523	463,523	463,523	141,465	463,523	463,523
R-squared	0.705	0.670	0.630	0.670	0.0573	0.0573

Note: cluster-robust standard errors in parentheses, clustering at household level, *** p<0.01, ** p<0.05, * p<0.1. Columns 1 to 4 are estimated with fixed effects model. Column 5 is estimated with fixed effects/conditional logistic regression. Column 6 reports the odds ratio from the logistic regression in Column 5. Numbers reported in this Table are regression coefficients, unless otherwise specified. Regressions include household head's age, age-squared, marital status, highest education attainment, number of children, household's total labor income after tax and deductions, compulsory pension savings, bank loans and net wealth as control variables. Column 1 to 4 include an additional control: profit and losses from stock investment. Additionally, we control for household and year fixed effects. The outcome variables from column 1 to 5 are: liquid wealth, safe asset, risky asset share as percentage of liquid wealth, risky asset share conditional on participation, and whether or not the household holds risky assets in a particular year, respectively. T represents house purchase year.

Table 4: Main Result: Predicted Outcomes

VARIABLES	(1) Liquid Wealth (in DKK)	(2) Risky Share (in %)	(3) Risky Asset (in DKK)	(4) Safe Asset (in DKK)	(5) Risky Share conditional on participation (in %)	(6) Equity Market Participation
T-3	204,558***	8.125***	35,219***	169,339***	26.10***	0.297***
	(12,132)	(0.0633)	(4,100)	(8,095)	(0.179)	(0.00232)
T-2	230,947***	8.088***	41,305***	189,642***	25.60***	0.301***
	(19,113)	(0.0686)	(6,470)	(12,715)	(0.189)	(0.00240)
T-1	295,082***	7.684***	50,491***	244,591***	24.00***	0.308***
	(29,632)	(0.0760)	(10,461)	(19,302)	(0.206)	(0.00250)
T	114,533***	7.974***	11,202	103,330***	25.84***	0.288***
	(24,856)	(0.0763)	(8,229)	(16,703)	(0.208)	(0.00242)
T+1	113,187***	8.467***	13,577**	99,611***	27.31***	0.282***
	(18,031)	(0.0722)	(6,374)	(11,766)	(0.194)	(0.00229)
T+2	115,477***	8.556***	14,170***	101,308***	27.50***	0.281***
	(15,227)	(0.0640)	(5,444)	(9,897)	(0.171)	(0.00221)
T+3	133,122***	8.363***	18,285***	114,837***	27.01***	0.283***
	(9,407)	(0.0586)	(3,432)	(6,100)	(0.161)	(0.00220)
Controls	X	X	X	X	X	X
Household & Year fixed effects	X	X	X	X	X	X
Observations	463,523	463,523	463,523	463,523	141,465	463,523

Note: cluster-robust standard errors in parentheses, clustering at household level, *** p<0.01, ** p<0.05, * p<0.1. Columns 1 to 5 are estimated with fixed effects model. Column 6 is estimated with fixed effects/conditional logit model. Numbers reported in this Table are predicted outcomes, not regression coefficients. All regressions include household head's age, age-squared, marital status, highest education attainment, number of children, household's total labor income after tax and deductions, compulsory pension savings, bank loans, and net wealth as control variables. Column 1 to 5 include an additional control: profit and losses from stock investment. Additionally, we control for household and year fixed effects. The outcome variables from column 1 to 6 are: liquid wealth, risky asset share as percentage of liquid wealth, risky asset, safe asset, risky share conditional on equity market participation, and equity market participation, respectively. T represents house purchase year.

Table 5: Result for Randomly Assigned Artificial Purchase Year

	Fixed Effects Model			Fixed Effects Logit Model
VARIABLES	(1) Risky share	(2) Risky share Conditional on Participation	(3) Liquid Wealth	(4) Equity Market Participation (Odds Ratio)
T-3	-0.0133	-0.0506	670.0**	1.017***
	(0.0208)	(0.0778)	(299.8)	(0.00291)
T-2	-0.0197	-0.0716	886.5**	0.992**
	(0.0259)	(0.0968)	(359.4)	(0.00342)
T-1	0.00623	-0.0248	980.7**	0.987***
	(0.0292)	(0.110)	(451.2)	(0.00377)
T	-0.0254	-0.170	1,269**	0.981***
	(0.0295)	(0.112)	(560.0)	(0.00375)
T+1	-0.0275	-0.171	1,530**	0.963***
	(0.0276)	(0.104)	(607.9)	(0.00340)
T+2	-0.00896	-0.0846	1,708***	0.963***
	(0.0238)	(0.0915)	(570.4)	(0.00302)
T+3	-0.00507	-0.0400	81.28	0.948***
	(0.0231)	(0.0893)	(181.9)	(0.00258)
T-3 *treated	-0.0191	-0.487*	44,689***	1.121***
	(0.0955)	(0.269)	(6,055)	(0.0144)
T-2 *treated	-0.0292	-0.936***	84,614***	1.194***
	(0.118)	(0.323)	(10,955)	(0.0178)
T-1 *treated	-0.419***	-2.605***	183,472***	1.282***
	(0.136)	(0.361)	(21,563)	(0.0208)
T *treated	-0.235*	-0.524	-94,824***	0.987
	(0.136)	(0.367)	(15,977)	(0.0160)
T+1 *treated	0.263**	0.967***	-97,390***	0.947***
	(0.128)	(0.344)	(14,065)	(0.0141)
T+2 *treated	0.338***	1.091***	-98,094***	0.932***
	(0.111)	(0.298)	(13,825)	(0.0119)
T+3 *treated	0.162*	0.558**	-67,448***	0.980**
	(0.0905)	(0.247)	(10,015)	(0.0101)
HH&Year fixed effects	x	x	x	x
Controls	x	x	x	x
Observations	4,978,605	1,081,894	5,152,225	5,152,225
R-squared	0.647	0.672	0.899	0.114

Note: cluster-robust standard errors in parentheses, clustering at household level, *** p<0.01, ** p<0.05, * p<0.1. Columns 1-3 are estimated with fixed effects model. Columns 4 is estimated with fixed effects/conditional logistic regression. Numbers reported in this Table are regression coefficients, unless otherwise specified. All regressions include household head's age, age-squared, marital status, highest education attainment, number of children, household's total labor income after tax and deductions, compulsory pension savings, bank loans, and net wealth as control variables. Column 1-3 include another control variable: profit and losses from stock investment . Additionally, we control for household and year fixed effects. The outcome variables from column 1 to 4 are: risky asset share, risky asset share conditional on participation, liquid wealth and equity market participation, respectively. T represents house purchase year. "*treated" denotes results for households who actually bought a house during 2005 to 2009 (main sample), where as the first 7 rows without "*treated" show results for the control sample.

Table 6: Variable Definition

Variable Name	Definition	Unit	Level
Age	Household head's age on 1st January of a specific year	-	Household head
Marital Status	Married = 1 when the household head is married (including separated but still legally married couples) or involved in registered partnership. Otherwise, Married = 0	-	Household head
Education	Education is defined in categories: 1 denotes lower than primary education; 2 denotes primary education, 9 years of schooling; 3 denotes preparatory courses, 10 years of schooling; 4 denotes upper secondary education, 11 years of schooling; 5 denotes high school and apprenticeship education, 12 years of schooling; 6 denotes shorter cycle higher education, 14 years of schooling; 7 denotes vocational bachelors education, 15 years of schooling; 8 denotes a bachelor's degree, 16 years of schooling; 9 denotes a master's degree, 18 years of schooling; 10 denotes a PhD, 20 years of schooling.	-	Household head
Number of children	Children include all people under 25 who is the child of at least one other person in the household. Furthermore, the person is only counted as a child in the household, if he/she does not have children of his/her own and have never been part of a couple in a marriage or registered partnership.	-	Household
Compulsory pension contribution	National and early retirement pension (taxable) incl. supplementary pension, retirement pension and tax-free supplement to early retirees + Special pension contribution	in 10,000 DKK	Household
Labor income	Taxable salary including benefits, tax-free pay, annual bonus and the value of stock options	in millions DKK	Household
Bank loans	Bank loans include consumer loans and the proportion of a loan for buying a house which is not covered by mortgage. Maximum lending limits for Danish mortgage are set up for each type of properties and documented in the Act on mortgages and mortgage bonds § 5. For owner-occupied homes, cooperative homes and housing projects, mortgage loans can represent up to 80 percent of the property value. The remaining 20 percent can be borrowed from a commercial bank with a rate that is typically higher than the mortgage rate and lower than the consumer loan rate.	in 10,000 DKK	Household
Net wealth	Net wealth includes property value, bank deposits, stocks, bonds, debt in different financial institutions including mortgage and consumer debt. This measure doesn't include pension wealth, value of cars, boats, cash, value of inventory, private debt and undocumented corporate bond value.	in millions DKK	Household
Stock income	Realized capital gains or losses	in DKK	Household
Liquid wealth	Deposits in banks etc., market value of bonds and mortgage deeds in deposit measured on 31 December (excluding childcare, self-retirement and index contracts) + Market value of stocks and investments in risky mutual fund measured on 31st December	in DKK	Household
Risky asset	Market value of stocks and investments in risky mutual fund measured on 31st December. Do not have information on each stock in investor's portfolio	in DKK	Household
Safe asset	Deposits in banks etc., market value of bonds and mortgage deeds in deposit measured on 31 December (excluding childcare, self-retirement and index contracts)	in DKK	Household
Stock share	Risky asset/Liquid wealth, measured on 31st December	in percentage	Household

Note: where applicable, financial variables are in nominal term, not adjusted by CPI. Data Source: Statistics Denmark

Table 7: Sample Selection

Panel A.

Selection criteria for main sample	**Number of observations**	**Number of distinct households**
Initial sample	47,847,174	-
Drop individuals age less than 25	42,458,008	-
Keep only household head (1 observation per household per year)	27,783,510	-
Drop duplicate by family identifier and year	26,998,570	4,428,829
(i) require the event of "house purchase" to occur during the period 2005 to 2009	2,495,209	478,693
(ii) keep only households with household's head aged between 28 to 59 at the year of house purchase	1,719,343	324,172
(iii) By the end of step ii, we have an unbalanced panel with household information from 7 years before to 7 years after a house purchase. In this step, we select those with complete information on portfolio choice and background information from 3 years before to 3 years after a house purchase. We also require households not to own a house in the 3 years leading up to the house purchase year.	463,523	44,970
Final main sample	463,523	44,970

Panel B.

Selection criteria for control sample	**Number of observations**	**Number of distinct households**
Initial sample	47,847,174	-
Drop individuals age less than 25	42,458,008	-
Keep only household head (1 observation per household per year)	27,783,510	-
Drop duplicate by family identifier and year	26,998,570	4,428,829
(i) households who did not purchase a house between the whole sample period 2002—2012	9,404,682	1,446,908
(ii) age between 28 to 59 at artificially assigned house purchase year	4,688,702	436,068
Final control sample	4,688,702	436,068

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