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Mortgage Insurance Adoption in the Netherlands

Ruben H.G.M. Cox* and Remco C.J. Zwinkels**

Individuals tend to underinsure on low probability, high consequence risks. Using a survey data set from a unique institutional context, we provide an assessment of the underinsurance puzzle by studying mortgage insurance adoption among Dutch homeowners. The results indicate that the demand for mortgage insurance is affected by risk exposure, type of mortgage lender, and the involvement of financial advisors. We document that wealthier and younger mortgagors are more likely to insure. However, locus of control, house price expectations, and precautionary savings are not related to insurance demand. Finally, we find evidence that borrower (over)confidence negatively affects the likelihood that insurance is bought.

Introduction

Household financial leverage increased markedly over the past decade in developed economies across the world. Mortgage debt used to finance homeownership is generally a substantial liability on the household's balance sheet (Campbell 2006, Tufano 2009, Guiso and Sodini 2012). Furthermore, the indivisibility of housing leads to a portfolio tilted towards real estate (Yao and Zhang 2005, Flavin and Yamashita 2011). High exposure to mortgage-financed real estate therefore poses risks to household wealth, as declining house prices can lead to negative home equity. Negative equity arises when the outstanding mortgage balance exceeds the property value and potentially affects personal wealth when mortgage lending is recourse.¹ Recourse also limits the threat of strategic default, which borrowers might use to pursue lenders to renegotiate on loan terms.

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¹We refer to personal wealth as all assets besides the property securing the loan that a mortgagee can seek recourse on. Typically, this constitutes savings, substantial other assets (*e.g.*, cars) or in the case of personal bankruptcy, a claim to future income.

Mortgage insurance can be purchased by households to mitigate personal wealth risk. This article addresses the insurance decision. Although risk exposure and the cost of insuring are important factors, Cole *et al.* (2013) demonstrate that there are significant nonprice factors affecting insurance demand, such as a lack of trust or liquidity constraints. Moreover, even the ‘usual suspects’ such as risk aversion and risk exposure have not received uniform support in the literature (Giesbert, Steiner and Bendig 2011, Browne, Knoller and Richter 2015).

Using an extensive panel data set covering a representative sample of the Netherlands, we conduct a broad examination of factors that might affect mortgage insurance adoption. The Netherlands provides for a unique and appropriate test setting for several reasons. First, mortgage insurance is available from a single provider only. Second, all things considered the cost of insuring is modest. Third, buying insurance is a *voluntary* decision instead of a precondition to receive mortgage credit, and not conditional on initial LTV. Fourth, mortgage lending in the Netherlands is recourse. This setup differs from the private mortgage insurance policies that are common in the United States and Canada, where borrowers are typically required to purchase insurance once their mortgage exceeds a certain LTV threshold. In these markets, the observed insurance pattern is codetermined with the amount of mortgage credit and the underwriting standards of the lender, and therefore not exogenously related to household characteristics. Given the characteristics of the insurance policy and mortgage lending in the Netherlands, high adoption rates are expected. Prior to 2010, however, only 30% of the eligible households chose to insure their mortgage. This article aims to study how these households can be distinguished from the 70% of the households that chose not to insure.

We test three categories of explanations for mortgage insurance demand, including heterogeneity in risk exposure (Botzen and van den Bergh 2012), the role of lenders and financial advisors (Sydnor 2010, Browne *et al.* 2015), as well as behavioral explanations such as the effect of peers, financial literacy, precautionary behavior, perceived control over future events, and overconfidence (Bauman and Sims 1978, Ludvigson 2004, Sandroni and Squintani 2007, Wilcox 2007, Giesbert *et al.* 2011, Cole *et al.* 2013, Friedl, Lima de Miranda and Schmidt 2014, Richter, Schiller and Schlesinger 2014).

Our results show that mortgage insurance adoption is a complex phenomenon explained by a mixture of actual risk and mortgagee characteristics (*e.g.*, wealth and income), as well as psychological traits such as (over)confidence. In contrast to prior research, we do not find that precautionary behavior or perceived control over future events (Bauman and Sims 1978), the household’s

financial situation, house price expectations, or risk aversion (Sydnor 2010) are able to explain insurance adoption behavior.

This article extends the literature in three ways. First, we contribute to the household finance literature, where it is argued that households make suboptimal decisions in diversifying risky portfolios (Campbell 2006). We complement and extend the work by Cole *et al.* (2013), who investigate insurance adoption in an emerging economy (India), and Giesbert *et al.* (2011) who study life insurance demand in Ghana by providing a comprehensive assessment for undiversified households.

Second, we contribute to the real estate literature. The financial crisis that roamed in countries like the United States, the United Kingdom, and the Netherlands illustrates that housing is a risky asset that can have profound consequences for the financial situation of households. We are interested in how homeowners handle financial risks associated with mortgage-financed homeownership. Our study therefore complements Sydnor's (2010) investigation that covers homeowner insurance. To our knowledge, our article is the first microlevel study that addresses empirically the insurance behavior of homeowners with respect to mortgage risks.

Third, we contribute to the insurance literature by providing additional analysis on the "insurance puzzle." This puzzle postulates that households fail to purchase coverage for low probability, high-consequence (LPHC) risks, such as floods and natural disasters, and overinsure on high-probability, low-consequence (HPLC) risks (Eisner and Strotz 1961, Slovic *et al.* 1977, Kunreuther 1978, Ganderton *et al.* 2000, Sydnor 2010). The extant evidence on the puzzle's existence and contributing factors is mixed (Laury, McInnes and Swarthout 2009, Schade, Kunreuther and Koellinger 2012, Friedl *et al.* 2014, Browne *et al.* 2015), while nonexperimental evidence is scarce as noted by Sydnor (2010).² Our data set allows us to study the demand for LPHC-insurance policies under real-life conditions. In contrast to Laury *et al.* (2009), we find that underinsurance is present even when incentives are large and real.

Our results provide important insights for policy makers, lenders, and insurers concerned with housing market risks. Notwithstanding the question whether mortgage insurance should be mandatory or subsidized, the results demonstrate that insurance behavior for LPHC-type risks is hard to explain, even with 'field laboratory' data (Browne *et al.* 2015). Consequently, it is challenging to formulate clear policy recommendations. Although nudging households

²See Richter *et al.* (2014) for a discussion of experiments and theory in the analysis insurance decisions.

to insure by default (*e.g.*, an opt-out system) might be an effective solution to prevent underinsurance, low insurance rates caused by underestimation of consequences or unawareness of risks can also be addressed by alternative interventions such as bundling of insurance policies (Kunreuther and Pauly 2004).

We continue this article with a discussion of mortgage insurance in the Netherlands. The third section discusses the data set and method, whereas the fourth section presents our analysis of insurance adoption. The final section concludes our investigation.

Mortgage Insurance in the Netherlands

Dutch mortgagors are personally liable for a deficiency in case of default. The Dutch legal system is considered to be lender friendly, as lenders can foreclose properties without going through court. Moreover, the extensive social security system provides for substantial benefits following, for example, job loss, such that there is a positive expected payoff from having recourse on future income (see ABN Amro 2014). Foreclosure and personal liability therefore result in higher expected cash flows compared to not holding borrowers liable, which motivates lenders to act accordingly. Recourse lending might have different implications in other countries such as the United States, either due to the efforts needed to go through judicial foreclosure or because recourse on future income has limited expected payoff. This decreases the attractiveness for lenders to hold borrowers personally liable even if they can be held liable legally (Congressional Budget Office 2010).

Over 85% of the homeowners in the Netherlands have a mortgage, and mortgage insurance can be obtained from the Homeowner Guarantee Fund Foundation (HGFF) since its inception in 1995. The National Mortgage Guarantee (NMG) provided by HGFF fully indemnifies the mortgage lender in case borrower default is triggered by divorce, involuntary unemployment, or death, and foreclosure proceeds fall short of the outstanding mortgage balance. When the homeowner is uninsured, lenders have recourse on other assets of the borrower to settle the outstanding balance, and homeowners face personal bankruptcy in the worst case scenario. Personal bankruptcy requires households to relinquishing control over their finances to a trustee, and significantly reduces their access to future credit.

The mortgage market in the Netherlands is dominated by four lenders who account for 80% of the originated mortgage volume. The HGFF is the sole mortgage insurance provider in the Netherlands. HGFF was found to support the accessibility of homeownership at the lower segment of the housing

market and covers loss claims out of insurance premiums. If HGFF's reserves are insufficient to cover insurance claims, financial backing by the Dutch government ensures that HGFF stays solvent and remains operable. Therefore, insurer insolvency is largely a hypothetical risk (Doherty and Schlesinger 1990).

The government backing also affects the policy's cost. Policies offered in Canada and the United States typically charge (annual) premiums, depending on down payments and amortization periods. The NMG policy only requires an initial one-time fee equal to (in 2009) 0.55% of the loan amount, irrespective of the down payment.³ Loans eligible for insurance are restricted by size (not to exceed 265,000 euro), initial LTV ratio (lower than 112%), usage of proceeds (only first liens on the primary residence), and amortization type (less than 50% nonamortizing debt).⁴ Households cannot defer decisionmaking and insure the mortgage at a later stage, implying that mortgages are either insured or uninsured at origination. Hybrids, which combine two or more amortization forms in one loan, are available in the Netherlands and eligible for insurance provided that they meet the amortization requirement.⁵

Borrowers insuring on the NMG policy typically receive a rate discount on their mortgage ranging from 30 to 60 basis points. Because the discount is enjoyed over the entire duration of the mortgage, typically lasting 25 or 30 years, the savings on interest payments easily outweigh the insurance premium, even when expected payouts are low.

Market research confirms that only 8% of uninsured households mention 'costs' as a reason not to purchase NMG insurance. Although 36% of the households in our sample have a mortgage with initial LTV ratio in excess of 100%, and might therefore be liquidity constrained, both Linneman *et al.* (1997) and Sydnor (2010) suggest that financial constraints are primarily affecting the tenure decision, which precedes the insurance decision. Therefore, it seems reasonable to assume that a mortgagor unable to pay for the premium, being maximized at 1,460 euros, would not be active in the homeownership market in the first place rather than stay uninsured for liquidity reasons

³Our sample ends in 2009 but premiums have gradually increased to 1.0% of the initial balance in 2014.

⁴Household can purchase a house worth 236,000 euro and finance 28,000 euro of transaction costs such as notary fees, taxes, *etc.* for a total of 264,000 euro corresponding to an initial loan-to-value ratio of 112%.

⁵Hybrid mortgages are reported as two separate mortgages in the survey. Mortgages are classified by type based on the type reported for the first mortgage, which can be an interest-only mortgage.

Figure 1 ■ House price index and unemployment rate in the Netherlands from 1995 to 2010. *Source:* Bureau of Census Statistics.

(Cole *et al.* 2013). Second, the premium can be financed with mortgage credit therefore not requiring any savings. Third, the insurance premium is tax deductible at the marginal income tax rate (42% or 52%), thereby creating a tax subsidy that lowers the effective premium to a maximum of 0.29% of the mortgage balance.

The cost-benefit features and broad scale awareness of its existence (Authority of Financial Markets 2011) lead us to expect high adoption rates, but in reality only 30% of the eligible households choose to insure. This might be driven by low (perceived) probability that the insured risk will materialize (Botzen and van den Bergh 2012), since the Netherlands experienced prosperous economic and housing market conditions between 1995 and 2008 (see Figure 1), with relatively low unemployment and mortgage default rates.⁶

Furthermore, the favorable economic climate could have made mortgage lenders lax in requiring mortgage insurance for high-LTV loans. Anecdotal evidence suggests that lenders might even have discouraged mortgage insurance, because the interest-income forfeited for insured mortgages exceeds the expected losses.⁷ However, apart from the attractive features, amortization

⁶Dutch foreclosure rates were low during this period despite high LTV-ratios, with 0.04% of the properties being foreclosed in 2009, compared to 2.21% in the United States (RealtyTrac 2012).

⁷We thank employees from the main mortgage lenders in the Netherlands for sharing insights in the origination process. NMG-insurance was not actively sold up to 2009,

Figure 2 ■ Insured mortgages as a percentage of mortgages eligible for insurance.
Source: DNB Household survey.

rates decreased and mortgage indebtedness increased during the same period, implying that the risk of negative equity has not decreased proportionately to the increase in house prices. Figure 2 shows that adoption rates hovered around 30% of the eligible mortgages until 2010, after which they increased following the start of the downturn in the Dutch real estate market.⁸

Although the default risk might have been low, the question arises whether this also holds for the consequences of default. In 2009, the average outstanding balance after deducting foreclosure proceeds was 22,500 euro whereas average household savings totaled 46,100 euro. This suggests that households are on average able to cover the shortfall from default by “self-insuring.” Notwithstanding the effects on borrower wealth, it is likely that household savings are depleted once they enter foreclosure as they attempt to keep up with mortgage payments as long as possible (Fitch 2013, Dutch Bankers Association 2014). This illustrates that the risk to nonhousing wealth and future

when both the crisis struck global capital markets and national regulators increased oversight and underwriting criteria for mortgage lending. Moreover, market competition created a “discount”-spiral where no single lender could decide to stop offering discounts for insured mortgages without losing market share.

⁸This percentage is actually close to the insurance adoption rate observed by Laury and McInnes (2003).

income is significant and not just hypothetical, especially if one takes into account that average household income is around 35,000 euro.

Finally, it is likely that explanatory factors for insurance behavior differ between studies conducted in emerging markets, such as India (Cole *et al.* 2013) or Ghana (Giesbert *et al.* 2011), and developed Western nations like the Netherlands. Widespread illiteracy or innumeracy are rather implausible explanations for underinsurance, as the Netherlands ranks in the worldwide top with respect to literacy and numeracy among adults.⁹ Also, low familiarity with basics of insurance or low saliency seem to be an unlikely explanation, as Dutch households are among the European top with regard to total spending on (direct) insurance premiums.¹⁰

Therefore, the design of the mortgage insurance policy coupled with the mortgage market characteristics would, in the presence of fully rational households, likely lead to substantially higher adoption rates than we actually observe. In the remainder of the article, we attempt to provide an answer as to why we do not observe this in reality. We proceed by discussing our data set and descriptive characteristics in the next section.

Data Description and Measurements

The Survey and Descriptive Statistics

We use data from the DNB Household Survey (DHS) collected by CentERdata, an institute affiliated with Tilburg University that specializes in the collection and dissemination of survey data for socioeconomic research (see Guiso, Sapienza and Zingales 2008, Van Rooij, Lusardi and Alessie 2011 for other applications). The DHS started in 1993 and is annually administered via internet among a sample of 2,000 Dutch households. In the earlier years, households without a computer were provided with one by CentERdata. The data set contains a wide variety of information on household characteristics, such as income and employment status, as well as psychological constructs. Participation takes place on a voluntary basis and involves no monetary compensation. CentERdata recruits participants by phone and keeps the panel representative of the Dutch population to limit attrition bias.

⁹See Survey of Adult Skills 2011–2012 administered by the OECD available at <http://www.oecd.org/site/piaac/surveyofadultskills.htm>.

¹⁰See OECD Data on insurance spending (1995–2008) relative to the 17 countries forming the Euro Area. Note that this only includes *direct* spending thereby excluding the premiums that Dutch households (indirectly) pay via taxes for the (extensive) social security system.

An advantage of the DHS is that households can fill out the survey at home, without the intervention of an interviewer, having access to all relevant information with respect to their finances. This reduces reporting errors and eliminates interviewer-induced response biases (Duffy *et al.* 2005). In order to further reduce the impact of reporting errors, the variables measuring income, wealth, mortgage amount, and housing value are winsorized at the 10% level of their respective distributions.¹¹ Our final data set contains 1,855 mortgages originated between 1995 and 2009 and includes 1,262 eligible but uninsured mortgages, 494 insured mortgages, and 99 ineligible mortgages.

Variable definitions are presented in Table 1. The exact wording of the survey questions, answer alternatives, and construction of variables is delegated to the Appendix.

We show an overview of some key statistics of our data set in Table 2. Panels A and B present general loan and risk characteristics, and show that interest rates are higher for insured compared to uninsured mortgages. Although this seems inconsistent with insured households receiving a rate discount, further (unreported) analysis shows that the rate differential between insured and uninsured mortgages increases in the LTV ratio, and becomes negative (*i.e.*, interest rates for uninsured mortgages are below those for insured mortgages) for loans with LTV ratios under 80%. The rate discount seems present for riskier loans, whereas insuring is less attractive for low-LTV loans. This might reflect “discouraging” behavior by lenders. The psychological factors in Panel C show only minor variation across different subgroups.

Demographic statistics (Panel D) show that insured households are, on average, somewhat younger compared to noninsured households, or the complete sample. Similarly, they are more likely to be new to the homeownership market and less wealthy.¹² This corroborates findings that external insurance is less appealing for the wealthy as they are able to “self-insure” (Sydnor 2010, Gollier 2003, Ganderton *et al.* 2000).

We also examine the correlation structure and find somewhat higher correlations ($r > 0.30$) between age, LTV ratio and retirement status, and between

¹¹Our results are quantitatively and qualitatively largely similar when winsorizing at the 1% level, but since substantial noise is introduced in the wealth and income variables they lose some significance in subsequent regressions.

¹²Wealth is defined as the sum of all assets (checking- and savings accounts, savings plans, life-insurance, employee-sponsored savings plans) minus all liabilities (debt) analogously to Van Rooij *et al.* (2011). As wealth and income increased over the sample period, the quartiles are computed year-by-year to account for trending.

Table 1 ■ Definitions of control variables.

Variable name	Definition
Demographic characteristics	
Age	Age of the respondent in years
Male	Dummy equal to 1 if the respondent is male
Married	Dummy equal to 1 if the respondent is married
Children	Dummy equal to 1 if the respondent has one or more children
Higher vocational	Dummy equal to 1 if the respondent has completed higher vocational education
University	Dummy equal to 1 if the respondent has completed university education
Household size	Number of members in household
Retired	Dummy equal to 1 if the respondent is retired
Self employed	Dummy equal to 1 if the respondent is self-employed
Below median income	Dummy equal to 1 if the annual household income is below the median household income
Median income	Dummy equal to 1 if the annual household income is between median and double median household income
Double median income	Dummy equal to 1 if the annual household income is more than twice median household income
Wealth quartile 1	Dummy equal to 1 if household wealth is in the first quartile of the distribution
Wealth quartile 2	Dummy equal to 1 if household wealth is in the second quartile of the distribution
Wealth quartile 3	Dummy equal to 1 if household wealth is in the third quartile of the distribution
Wealth quartile 4	Dummy equal to 1 if household wealth is in the fourth quartile of the distribution
Mortgage characteristics	
Balance missing	Dummy equal to 1 if respondent did not report a mortgage balance
Endowment mortgage	Dummy equal to 1 if the mortgage is an endowment type
Financial Advisor	Dummy equal to 1 if household makes use of a financial advisor
Interest-only mortgage	Dummy equal to 1 if the mortgage is an interest-only type
Interest rate	Yearly interest rate percentage at time of origination

Table 1 ■ Continued.

Variable name	Definition
LTV ratio	Ratio of initial loan size to property value
Mortgage balance	The natural log of (1+the initial mortgage balance in euros)
New entrant	Dummy equal to 1 if the respondent has not owned his previous residence
Originator: bank	Dummy equal to 1 if the mortgage lender is a bank
Originator: insurer	Dummy equal to 1 if the mortgage lender is an insurance company
Alternative risk proxies	
Loan-to-income ratio	Ratio between mortgage balance and annual household income
Debt-service ratio	Ratio between annual mortgage payments and annual household income
Permanent contract dummy	Dummy equal to 1 if respondent has a permanent employment contract
Spouse income dummy	Dummy equal to 1 if respondent's spouse has paid employment
Mortgage-to-wealth ratio	Ratio of initial mortgage balance to total wealth
Years being married	Years that respondent has being married
Behavioural factors	
Spending propensity	Respondent's willingness to spend current income (see data appendix)
Tight budget	Dummy equal to 1 if respondent indicates that current household finances are tight
Self-assessed FL	Self-assessed financial literacy (see data appendix)
Precautionary savings	Saving for a precautionary motive (see data appendix)
Locus of control	Dummy equal to 1 if response is in top quartile of response-distribution (see data appendix)
House price expectation	Dummy equal to 1 if household expects property to appreciate in value over the next two years

Table 2 ■ Descriptive statistics.

	Noninsured Mortgagors			Insured Mortgagors			All Mortgagors		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
Panel A: Mortgage characteristics									
Interest rate	0.053	1.12	1,262	0.054	1.13	494	0.053	1.13	1,855
Interest-only mortgage	0.49	0.50	1,262	0.23	0.41	494	0.40	0.49	1,855
Endowment mortgage	0.06	0.24	1,262	0.12	0.33	494	0.09	0.28	1,855
Log(mortgage balance)	4.42	0.71	1,262	4.63	0.56	494	4.50	0.69	1,855
Financial Advisor	0.31	0.46	1,204	0.29	0.45	483	0.29	0.45	1,783
Panel B: Risk profile									
LTV ratio	0.74	0.27	1,262	0.90	0.22	494	0.79	0.26	1,855
Loan-to-income	2.57	1.73	1,262	2.82	1.70	494	2.65	1.73	1,855
Mortgage-to-wealth	0.70	0.33	1,262	0.74	0.35	494	0.71	0.34	1,855
House price expectation	0.90	0.29	851	0.93	0.26	366	0.91	0.28	1,282
Spouse income	0.35	0.48	1,262	0.45	0.49	494	0.38	0.49	1,855
Permanent employment contract	0.78	0.42	1,262	0.81	0.39	494	0.78	0.41	1,855
Tight budget	0.15	0.35	1,262	0.17	0.38	494	0.15	0.36	1,855
Panel C: Psychological factors									
Locus of control	0.30	0.46	514	0.27	0.45	206	0.29	0.45	749
Self-assessed FL	2.30	0.69	1,262	2.29	0.72	494	2.29	0.70	1,855
Precautionary savings	4.94	1.88	1,262	5.15	1.18	494	5.00	1.84	1,855
Spending propensity	2.99	1.18	1,262	2.93	1.20	494	2.99	1.19	1,855

Continued

Table 2 ■ continued.

	Noninsured Mortgages			Insured Mortgages			All Mortgages		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
Panel D: Demographic characteristics									
Age	52.2	14.2	1,262	44.0	12.4	494	49.3	14.2	1,855
Children	0.31	0.46	1,262	0.36	0.48	494	0.33	0.47	1,855
New entrant	0.08	0.27	1,262	0.15	0.35	494	0.09	0.29	1,855
Retired	0.25	0.43	1,262	0.09	0.29	494	0.19	0.40	1,855
Self-employed	0.01	0.11	1,262	0.02	0.12	494	0.01	0.11	1,855
Higher vocational	0.29	0.46	1,262	0.39	0.49	494	0.32	0.46	1,855
University	0.15	0.36	1,262	0.11	0.32	494	0.14	0.35	1,855
Male	0.89	0.30	1,262	0.85	0.36	494	0.88	0.32	1,855
Married	0.79	0.41	1,262	0.68	0.46	494	0.76	0.43	1,855
Years being married	25.6	15.0	837	16.2	12.7	244	23.1	14.9	1,137
Household size	2.44	1.20	1,262	2.41	1.31	494	2.45	1.25	1,855
Median income	0.66	0.47	1,262	0.67	0.47	494	0.65	0.48	1,855
Double median income	0.10	0.30	1,262	0.05	0.23	494	0.09	0.28	1,855
Wealth									
Quartile 1	0.12	0.32	1,262	0.11	0.31	494	0.20	0.40	1,855
Quartile 2	0.10	0.29	1,262	0.11	0.31	494	0.10	0.30	1,855
Quartile 3	0.35	0.48	1,262	0.45	0.45	494	0.34	0.47	1,855
Quartile 4	0.44	0.50	1,262	0.34	0.47	494	0.37	0.48	1,855

Notes: This table shows weighted means and standard deviations for the complete data set. The column “noninsured” households contains the subset of uninsured mortgages that are eligible for insurance. The column “insured” contains the subset of mortgages that are eligible for insurance and actually insured. Data are from the DNB Household Survey and cover all originated mortgages over the 1995–2009 timeframe.

Table 3 ■ Logit analysis of mortgage insurance adoption.

	(1)	(2)	(3)	(4)
	Dependent Variable: Mortgage Insurance (1 = yes)			
Mortgage balance				0.79*
				[-1.7]
Balance missing				0.40
				[-1.3]
Originator: bank				0.60***
				[-3.9]
Originator: insurer				0.70
				[-1.4]
LTV ratio	4.05***	4.08***	4.67***	5.52***
	[4.6]	[4.6]	[5.0]	[5.0]
Interest rate	0.99	1.09	1.09	1.09
	[-0.1]	[1.3]	[1.3]	[1.4]
Interest-only mortgage	0.44***	0.42***	0.43***	0.45***
	[-5.2]	[-5.2]	[-5.1]	[-4.7]
Endowment mortgage	1.04	1.00	1.04	1.13
	[0.2]	[0.0]	[0.2]	[0.6]
Tight budget	1.11	1.16	1.15	1.16
	[0.9]	[0.8]	[0.8]	[0.9]
Risk appetite	0.98**	0.99	0.98	0.99
	[-2.1]	[-1.4]	[-1.6]	[-1.3]
Retired	0.93	0.90	0.90	0.88
	[-0.3]	[-0.4]	[-0.4]	[-0.5]
Self-employed	1.91	1.77	1.87	1.94
	[1.4]	[1.3]	[1.4]	[1.5]
Higher vocational	1.15	1.18	1.22	1.26
	[1.0]	[1.2]	[1.4]	[1.6]
University	0.71*	0.72*	0.73	0.82
	[-1.7]	[-1.7]	[-1.6]	[-0.9]
Male	0.93	0.94	0.99	0.90
	[-0.3]	[-0.3]	[-0.1]	[-0.5]
Married	0.58***	0.58***	0.56***	0.57***
	[-3.0]	[-3.0]	[-3.2]	[-3.0]
Age	0.98***	0.97***	0.98***	0.97***
	[-3.3]	[-3.4]	[-3.3]	[-3.3]
Children	0.96	0.94	0.97	0.98
	[-0.3]	[-0.4]	[-0.2]	[-0.1]
Median income	0.72**	0.69**	0.68**	0.69**
	[-2.2]	[-2.4]	[-2.5]	[-2.4]
Double median income	0.43***	0.41***	0.41***	0.41***
	[-3.2]	[-3.1]	[-3.1]	[-3.0]
Wealth quartile 2	1.23	1.02	1.00	1.02
	[0.8]	[0.1]	[-0.1]	[0.1]
Wealth quartile 3	1.70***	1.58**	1.57**	1.56**
	[2.9]	[2.4]	[2.4]	[2.3]

Continued

Table 3 ■ continued.

	(1)	(2)	(3)	(4)
	Dependent Variable: Mortgage Insurance (1 = yes)			
Wealth quartile 4	1.66*** [2.7]	1.59** [2.4]	1.60** [2.4]	1.59** [2.4]
Year dummies	No	Yes	Yes	Yes
Region controls	No	No	Yes	Yes
Number of observations	1,756	1,756	1,756	1,756
Pseudo- R^2	0.12	0.14	0.15	0.16
Log likelihood	-906.6	-890.3	-882.2	-870.7
Joint test control variables (p -value)	0.00	0.00	0.00	0.00

Notes: This table shows odds ratios for a logit-model where the dependent variable equals 1 when the households' mortgage is insured and 0 otherwise. Data are from the DNB Household Survey and include all mortgages eligible for insurance originated during the 1995–2009 timeframe. Variable definitions are reported in Table 1. Constant term is included but not reported. Robust t -statistics are reported in brackets. ***, **, * Indicates significance at the 1%, 5%, and 10% level, respectively.

gender and marital status.¹³ However, these values are below levels that would give raise to concerns about multicollinearity.

Results

We estimate logit models for our multivariate analysis, where the dependent variable is equal to one when the household has purchased mortgage insurance and zero otherwise:

$$\text{Mortgage insurance} (1 = \text{yes})_{it} = f(\mathbf{X})_{it} + \varepsilon_{it}. \quad (1)$$

The vector $\mathbf{X}$ contains explanatory variables for default and wealth risk, as well as household characteristics. We control for household income through the inclusion of dummies capturing the level of income and measure income volatility by dummies for self-employed and retirement status. Other household characteristics include gender, age, level of education, and household composition, in line with existing research (Laury et al. 2009, Giesbert et al. 2011, Cole et al. 2013, Friedl et al. 2009, Browne et al. 2015).

To capture differences in indebtedness and amortization structure of the loan, the loan-to-value ratio, the log of one plus the outstanding mortgage balance, the interest rate, and mortgage type dummies are included in all regressions.

¹³All unreported analyses can be obtained from the authors.

The LTV ratio can be interpreted as a proxy for equity risk (Quercia and Stegman 1992, Qi and Yang 2009), whereas marital status proxies for divorce risk, and employment status (self-employed or retiree) proxies for income risk. We test alternative proxies for the borrower's risk profile later in the article. We include wealth dummies to control for the ability to "self-insure," as well as year and region dummies to capture regional and time variation in market conditions (Archer *et al.* 2002, Browne *et al.* 2015). Finally, we include a variable that captures the current financial situation of the household, and dummies for the type of lender to control for heterogeneity in lending standards, or access to borrower information (Norden and Weber 2010).

All our analyses are population weighted such that they are representative for the Dutch population. We report odds-ratios and heteroskedasticity robust standard errors. Variations in sample size that occur between different models are primarily due to survey questions not being included in all waves and therefore not indicative of selection effects.

Mortgage Insurance Adoption

We start our multivariate examination with a base model (see Table 3) that includes standard control variables for the risk profile of the household and test its sensitivity to time (Model 2), region (Model 3), and mortgage size and lender effects (Model 4).

In line with increased equity risk, we find that all models return a positive and highly significant effect of the LTV ratio on mortgage insurance adoption, indicating that increases in household indebtedness is associated with higher insurance rates. The negative effect of the interest-only dummy is likely to capture noise from our classification of hybrid loans in order to determine their eligibility for insurance (see the previous section).

Marital status has a negative effect on insurance adoption inconsistent with a hypothesis that marriage exposes a household to divorce risk. This can be explained, however, because married households also enjoy diversification of income and unemployment risk. We devote more attention to the economic effects of divorce in the next section when we investigate in greater detail the effect of marital capital (South and Spitze 1986).¹⁴

We find a negative age-effect, which might be explained by the finding in Mather *et al.* (2012) that risk seeking behavior over losses is increasing in

¹⁴The average difference in annual household income between singles and couples in our sample is 3,000 euro.

age and hence decreases the likelihood that insurance is purchased for certain risks. Because this is a different dimension of risk appetite, it might not be captured by our measure for risk appetite that is included in all models. The risk appetite measure is constructed from six survey questions that elicit the willingness to take financial risks although it does not specifically address housing risks (see the Appendix for the full explanation). However, weak or no statistical effects on mortgage insurance adoption are generally found in our analyses and we note that the effect of risk aversion, or risk appetite as we prefer to call our proxy, has not received unanimous support in the literature (Giné, Townsend and Vickery 2008, Clarke 2011, Giesbert *et al.* 2011). Explanations offered in the literature for this pattern argue that (noninsurable) basis risk leading to uncertainty regarding the payout once loss events occur or limited experience or unwillingness to experiment with insurance policies (Cole *et al.* 2013).

Household income has a negative effect on the propensity to purchase mortgage insurance, because high income households have also higher risk bearing capacity. Household wealth has a positive and significant effect for households in the third and fourth quartile of the wealth distribution, which is counterintuitive considering that also wealthier homeowners have larger risk-bearing capacity. However, if wealthy homeowners have other risky assets in their portfolio besides their property (Campbell 2006, Guiso and Sodini 2012), mortgage insurance is a cheap external alternative to hedge part of the total portfolio risk (Grace, Klein and Kleindorfer 2004). Moreover, household wealth could also increase the likelihood of insurance if it proxies for financial sophistication (Calvet, Campbell and Sodini 2009), an explanation we consider in more detail later in the article.

The inclusion of year and regions dummies has little effect on the estimated coefficients. In Model 4, we include the initial mortgage balance as a proxy for the initial tax premium and a dummy which equals one if the mortgage balance is not reported. The mortgage size-effect is marginally significant and missing observations seem not to reflect a selection effect. The coefficient on the mortgage balance suggests a negative price elasticity (Cole *et al.* 2013).¹⁵ Because the expected losses enter the model indirectly via the risk proxies and the premium paid is endogenously determined with mortgage amount, we are cautious about interpreting this as a price-elasticity effect. Moreover, mortgage balance is generally insignificant throughout the analyses.

¹⁵Typically the price of an insurance policy is defined as the premium paid less the expected losses (Laury *et al.* 2003).

Finally, we include dummy variables for bank or insurer-type lenders, whereas ‘other originators,’ such as pension funds, constitute the reference group. The results indicate that homeowners obtaining mortgages from a bank-type lender are significantly less likely to purchase mortgage insurance. The lender effect might capture a form of advisory involvement or borrower selection effect (Beck and Brown 2011), which we examine in more detail later in the article.

The Impact of Alternative Risk Exposure Measures on Insurance Adoption

Economic theory suggests that the decision to purchase insurance should be largely driven by the buyer’s risk exposure, although the empirical evidence is mixed (Browne *et al.* 2015). Because a number of causes can trigger mortgage default, we examine in this section various alternative proxies for the household’s risk profile. We hereby concentrate on the three types of risks that the policy covers, namely income risk, divorce risk, and negative equity risk.

In Model 1 and 2 of Table 4, we include two proxies for income risk, namely the loan-to-income and debt-service ratio. Both ratios capture the financial flexibility that the household has in keeping up with its mortgage payments, higher ratios typically being associated with riskier mortgages. However, we do not find that the inclusion of income-based risk proxies is significant, or that coefficients on the other variables change substantially. Note that we exclude the LTV ratio from the model to avoid collinearity with the alternative risk measures, but keep the income dummies because they are only moderately correlated to the loan-to-income and debt-service ratio.

Next, we test whether household portfolio diversification is informative for the decision to purchase insurance. Limited portfolio diversification leads to concentrated risk exposure. If decision makers are concerned with diversification of risks, then we expect undiversified households to be associated with higher probabilities that insurance is bought. However, we find no evidence for this hypothesis as the inclusion of the mortgage-to-wealth ratio in Model 3 renders insignificant results.

Volatility of future income can also be a driver of insurance behavior, as it correlates with the ability of households to keep up with mortgage payments. To measure income volatility, we include a dummy equal to one when the household head has a permanent employment contract and zero otherwise in Model 4. Permanent employment contracts are costly to terminate by employers and offer greater certainty about future income. In Model 5, we test the effect of income diversification proxied by a dummy that equals one if the household head’s spouse has paid employment and zero otherwise.

Table 4 ■ Logit-analysis of mortgage insurance adoption using alternative proxies for risk exposure.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dependent Variable: Mortgage Insurance (1 = yes)						
Loan-to-income ratio	0.97 [-0.7]						
Debt-service ratio		0.61 [-1.0]					
Mortgage-wealth ratio			1.00 [0.6]				
Permanent contract dummy			1.11	[0.6]			
Spouse income dummy					1.39** [2.1]		
Years being married						0.96*** [-3.1]	
Dummy # of Children = 1							1.95*** [3.2]
Dummy # of Children = 2							0.98 [-0.1]
Dummy # of Children = 3							1.04 [0.2]
Dummy # of Children > = 4							1.26 [0.4]
Originator: bank	0.57*** [-4.4]	0.57*** [-4.4]	0.57*** [-4.5]	0.61*** [-3.9]	0.61*** [-3.80]	0.65** [-2.3]	0.60*** [-3.9]
Originator: insurer	0.77 [-1.0]	0.77 [-1.0]	0.76 [-1.0]	0.73 [-1.2]	0.75 [-1.1]	0.49** [-2.0]	0.74 [-1.2]
Mortgage balance	0.97 [-0.7]	0.97 [-0.7]	0.83* [-1.8]	0.94 [-1.4]	0.95 [-1.2]	1.01 [0.1]	0.94 [-1.4]
LTV ratio				4.62*** [4.9]	4.60*** [4.8]	5.16*** [3.9]	4.73*** [4.9]
Interest rate	1.10 [1.5]	1.10 [1.6]	1.10 [1.6]	1.10 [1.4]	1.09 [1.3]	1.26*** [2.9]	1.09 [1.3]
Interest-only mortgage	0.41*** [-5.3]	0.41*** [-5.3]	0.42*** [-5.1]	0.44*** [-4.8]	0.44*** [-4.8]	0.44*** [-3.3]	0.44*** [-4.8]
Endowment mortgage	1.18 [0.8]	1.17 [0.7]	1.17 [0.7]	1.10 [0.4]	1.07 [0.3]	1.13 [0.4]	1.09 [0.4]
Tight budget	1.15 [0.8]	1.13 [0.7]	1.15 [0.9]	1.17 [0.9]	1.20 [1.0]	1.16 [0.6]	1.17 [0.9]
Risk appetite	0.98 [-1.5]	0.98 [-1.6]	0.98 [-1.6]	0.98 [-1.6]	0.98 [-1.4]	0.97* [-1.8]	0.98 [-1.6]
Retired	0.96 [-0.2]	0.96 [-0.2]	0.95 [-0.2]	0.91 [-0.4]	1.00 [0.0]	1.44 [1.0]	0.90 [-0.4]
Self-employed	1.71 [1.2]	1.73 [1.2]	1.79 [1.3]	2.07 [1.5]	2.09 [1.6]	2.70 [1.6]	1.94 [1.5]
Higher vocational	1.25 [1.6]	1.25 [1.6]	1.23 [1.5]	1.23 [1.4]	1.22 [1.4]	0.80 [-1.1]	1.22 [1.4]
University	0.76	0.76	0.75	0.78	0.77	0.49**	0.77

Table 4 ■ Continued.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dependent Variable: Mortgage Insurance (1 = yes)						
Male	[-1.3] 0.98	[-1.3] 0.98	[-1.4] 1.00	[-1.2] 0.93	[-1.2] 0.96	[-2.1] 0.85	[-1.2] 0.92
Married	[-0.1] 0.60***	[-0.1] 0.60***	[-0.1] 0.61***	[-0.3] 0.56***	[-0.2] 0.45***	[-0.2] 0.45***	[-0.3] 0.45***
Age	[-2.8] 0.96***	[-2.8] 0.96***	[-2.7] 0.96***	[-3.2] 0.98***	[-3.8] 0.98***		0.98***
Children	[-5.1] 0.86	[-5.1] 0.87	[-5.1] 0.86	[-3.2] 0.98	[-2.7] 1.00		[-3.1] 1.10
Median income	[-1.0] 0.68**	[-0.9] 0.64***	[-1.0] 0.69**	[-0.1] 0.66***	[0.0] 0.67***	[0.4] 0.74	0.66***
Double median income	[-2.5] 0.41***	[-2.8] 0.39***	[-2.4] 0.43***	[-2.7] 0.39***	[-2.6] 0.39***	[-1.5] 0.36**	[-2.7] 0.39***
Wealth quartile 2	[-3.1] 1.09	[-3.2] 1.07	[-2.9] 1.10	[-3.2] 1.00	[-3.3] 1.02	[-2.5] 1.43	[-3.2] 1.03
Wealth quartile 3	[0.3] 1.54**	[0.3] 1.53**	[0.4] 1.68***	[-0.0] 1.54**	[0.0] 1.54**	[1.0] 1.35	[0.1] 1.56**
Wealth quartile 4	[2.3] 1.43*	[2.2] 1.43*	[2.7] 1.86**	[2.2] 1.58**	[2.2] 1.57**	[1.1] 1.14	[2.3] 1.60**
Year- and region dummies	[1.9] Yes	[1.9] Yes	[2.5] Yes	[2.3] Yes	[2.3] Yes	[0.5] Yes	[2.4] Yes
Number of observations	1,756	1,756	1,756	1,756	1,756	1,074	1,756
Pseudo- R^2	0.14	0.14	0.14	0.16	0.16	0.18	0.16
Log likelihood	-885.6	-885.4	-883.7	-871.7	-869.6	-469.5	-870.5

Notes: This table contains odds ratios for a logit model including alternative proxies for the risk of income loss and divorce. The dependent variable equals 1 when the households' mortgage is insured and 0 otherwise. Data are from the DNB Household Survey and include all mortgages eligible for insurance originated during the 1995–2009 timeframe. Variable definitions are reported in Table 1. Constant term is included but not reported. Robust *t*-statistics are reported in brackets. ***, **, * Indicates significance at the 1%, 5%, and 10% level, respectively.

Assuming that both income sources are reasonably uncorrelated, this provides for diversification of the income stream thereby reducing default risk caused by income loss.

We find mixed results for income volatility as the permanent contract dummy is insignificant, whereas the spouse-income dummy is positive and significant. Further analysis shows that double income households purchase on average more expensive houses and use higher levels of debt. Unreported analyses reveal that the interaction between spousal income and mortgage balance is

significant, whereas the main effect of the income variable becomes insignificant. Therefore, it appears that income risk is not a primary consideration in the decision to obtain mortgage insurance. Although this seems surprising, it is conceivable that households with uncertain income might deliberately select out of the homeownership market and decide to rent. Lenders also employ stricter underwriting criteria for households with uncertain income, decreasing the likelihood that they become homeowners.

As discussed before, divorce is another major cause for mortgage default (National Mortgage Guarantee 2013). Although we do find that income diversification increases the probability that households insure their mortgage, divorce risk might also be correlated with the amount of marital capital that the household has accumulated (South and Spitze 1986). The cost of divorce increases in the duration of the marriage and the number of children born in wedlock, because it increases alimony payments. Hence, one might expect that higher marital capital lowers divorce risk, and subsequently leads to lower insurance demand. Although we found that marital status had a negative effect in prior analyses, the variable might not adequately capture the effect of marital capital if many newlyweds, who have accumulated relatively limited marital capital, are active on the homeownership market.

In order to test the effect of the marital capital explanation, the number of years into marriage and dummies for the number of children living at home are included in Model 6 and 7. The decrease in sample size we experience in Model 6 is caused by conditioning the sample on marital status leading to a loss of 200 observations for which no information on the year of marriage was provided. The results in Model 6 seem to lend some support to the marital capital hypothesis, although the effect of age might now be partially reflected in the marital duration coefficient.

Moreover, we find that the dummies for the number of children are generally insignificant, except for households having one home-living child. These dummies might be correlated with age as well because insured households are younger and starting families. However, we find this correlation to be close to zero ($r = -0.06$). In general, marital capital seems to play a limited role in the insurance decision and households might actually refrain from purchasing insurance to send a signal of commitment to each other.¹⁶

In conclusion, we find mixed evidence that household insurance decisions are responsive to risk exposure other than home equity risk, a phenomenon

¹⁶We thank the editor for suggesting this explanation to us.

that is also documented in Browne *et al.* (2015). This therefore offers limited insights why low insurance rates are observed. We therefore continue by considering supply side factors.

Supply Side Explanations for Mortgage Insurance Adoption

Supply effects can affect insurance adoption because lenders have different channels through which they originate mortgages (*e.g.*, via intermediaries or branches), as well as differential access to borrower information (Norden and Weber 2010). This might especially affect inexperienced or first-time homeowners because they lack a longstanding relationship with their financial service provider and have less experience on the homeownership market. Homeowners might seek professional advice prior to the purchase of a complex financial product (Syndor 2010, Bhattacharya *et al.* 2012, Hackethal, Halliassos and Japelli 2012) and advisors can provide contextual information or assist households in making a risk assessment (Browne *et al.* 2015). To the extent that nonbank lenders are less able to provide these services directly, because they lack a branch-network facilitating this interaction, the involvement of financial advisors might bias the lender effect. It is important to note that the advisors in our sample do not receive additional compensation for selling mortgages with mortgage insurance.

Table 5 contains regressions including dummies for the involvement of a financial advisor and household homeownership experience as well as their interaction. We find a marginally significant effect that financial advisors decrease the likelihood that households purchase mortgage insurance, which occurs if advisors correct the household's overestimation of risk.

However, households seem to underestimate small probabilities, and generally it is suboptimal to be uninsured, irrespective of their risk assessment. Hence, the negative advisor effect might be indicative of something else, such as financial advisors taking advantage of the borrower's lack of experience in return for nonmonetary benefits from lenders when selling uninsured mortgages. However, the insignificance of the interaction term limits the support for this hypothesis. To the extent that housing market experience is correlated with age, we note that the correlation coefficient is only 0.28.

Advisors might also want to save on the paperwork in applying for insurance because they do not receive additional compensation. However, this seems an unlikely explanation as the application form is only one page long. Maybe the negative sign reflects the role of trust where households act counter to what is recommended to them if they distrust advisors (Bhattacharya *et al.* 2012).

Table 5 ■ Analysis of the influence of advisory effects on mortgage insurance adoption.

	(1)	(2)	(3)
	Dependent Variable: Mortgage Insurance (1 = yes)		
Financial advisor	0.79*		0.79*
	[-1.7]		[-1.8]
New entrant		1.21	1.26
		[0.9]	[0.9]
New En- trant*Financial Advisor			0.93
			[-0.2]
Originator: bank	0.59***	0.60***	0.59***
	[-4.0]	[-3.9]	[-4.0]
Originator: insurer	0.73	0.73	0.72
	[-1.2]	[-1.3]	[-1.2]
Mortgage balance	0.94	0.94	0.94
	[-1.4]	[-1.4]	[-1.4]
LTV ratio	4.58***	4.50***	4.47***
	[4.8]	[4.8]	[4.7]
Interest rate	1.08	1.10	1.08
	[1.1]	[1.4]	[1.2]
Interest-only mortgage	0.48***	0.44***	0.47***
	[-4.2]	[-4.8]	[-4.3]
Endowment mortgage	1.12	1.10	1.12
	[0.5]	[0.4]	[0.5]
Tight budget	1.19	1.16	1.18
	[1.0]	[0.9]	[0.9]
Risk appetite	0.98	0.98	0.98
	[-1.6]	[-1.6]	[-1.5]
Retired	0.95	0.90	0.94
	[-0.2]	[-0.4]	[-0.2]
Self-employed	2.11	1.93	2.08
	[1.6]	[1.4]	[1.5]
Higher vocational	1.22	1.23	1.23
	[1.4]	[1.5]	[1.4]
University	0.75	0.78	0.75
	[-1.3]	[-1.2]	[-1.3]
Male	0.91	0.93	0.90
	[-0.4]	[-0.3]	[-0.4]
Married	0.51***	0.55***	0.51***
	[-3.51]	[-3.2]	[-3.5]
Age	0.97***	0.98***	0.98***
	[-3.5]	[-2.9]	[-3.1]
Children	1.02	1.00	1.04
	[0.1]	[0.0]	[0.3]
Median income	0.65***	0.67***	0.66***
	[-2.7]	[-2.6]	[-2.6]
Double median income	0.38***	0.39***	0.38***

Table 5 ■ Continued.

	(1)	(2)	(3)
	Dependent Variable: Mortgage Insurance (1 = yes)		
	[-3.3]	[-3.2]	[-3.3]
Wealth quartile 2	1.09	0.98	1.06
	[0.3]	[-0.1]	[0.2]
Wealth quartile 3	1.58**	1.52**	1.56**
	[2.3]	[2.2]	[2.2]
Wealth quartile 4	1.66***	1.57**	1.64**
	[2.6]	[2.3]	[2.5]
Year, region and lender-type dummies	Yes	Yes	Yes
Number of observations	1,687	1,756	1,687
Pseudo- R^2	0.16	0.16	0.16
Log likelihood	-842.2	-871.5	-841.7

Notes: This table shows odds ratios for a logit-model that controls for the effect borrower experience on the housing market and involvement of financial advisors. The dependent variable equals 1 when the households' mortgage is insured and 0 otherwise. Data are from the DNB Household Survey and include all mortgages eligible for insurance originated during the 1995–2009 timeframe. Variable definitions are reported in Table 1. Constant term is included but not reported. Robust *t*-statistics are reported in brackets. ***, **, * Indicates significance at the 1%, 5%, and 10% level, respectively.

Finally, we also observe that the lender coefficient remains similar in sign and significance when the advisor and experience effects are included, ruling out that the lender dummy is reflecting their impact. Allowing for the interaction between advisor and lender type does not lead to different results, so we leave them unreported. All in all, this strengthens our previous interpretation that lender type correlates with heterogeneity in information access or mortgage underwriting standards and hence the extent to which they require for high LTV loans.

Behavioral Explanations for Insurance Adoption

Because the analyses of risk exposure and supply effects did not result in a clear explanation why low insurance rates are observed, we now shift our attention to behavioral explanations. An extensive literature on insurance behavior has emerged over the past decades, offering psychological explanations for empirical patterns that do not conform to predictions derived from theoretical models that assume rationality.

We consider a set of factors that has been documented in prior literature to influence financial behavior of households, including the impact of house price expectations (Sydnor 2010), financial literacy (Van Rooij *et al.* 2011), precautionary behavior (Dynan 1993, Giesbert *et al.* 2011), perceived control over future events (Bauman and Sims 1978, Goetzmann and Kumar 2008), consumer (over)confidence (Sandroni and Squintani 2007), and peer influence (Friedl *et al.* 2014, Beshears *et al.* 2015). We report the results of our analyses in Table 6.

If prospective homeowners expect that house prices will increase, it decreases the (perceived) risk of negative equity, even conditional on a default. Hence, house price expectations might be informative of insurance behavior, but the inclusion gives insignificant results in Model 1. It should be noted, though, that the power of the test is reduced by a decreasing sample size as this question was only included during part of the sample period.

Next, we consider the effect of financial literacy, which is correlated to financial planning (Lusardi and Mitchell 2011), and risk-taking behavior such as stock market participation (Van Rooij *et al.* 2011). We include self-assessed financial literacy in Model 2, but find surprisingly enough a strong negative effect on insurance adoption. This is contrary to our expectations and we have no clear explanation why this result occurs, other than our variable capturing other effects than financial literacy.¹⁷ This is further confirmed by the observation that the wealth dummies remain unaffected after financial literacy is included, making us wonder whether the self-assessment captures financial sophistication (Calvet *et al.* 2009). We will look deeper into this question later in this section.

Insurance decisions can also be driven by precautionary behavior of households (Dynan 1993, Giesbert *et al.* 2011). However, the proxy for precautionary behavior in Model 3 does not affect the likelihood that insurance is bought.

Another explanation for low adoption rates is that households might not insure against risks because they believe they can deal with the future consequences, a trait which is referred to as ‘locus of control’ (Baumann and Sims, 1978). We test this hypothesis by including a dummy variable that is equal to one if the household perceives to have significant control over future events and

¹⁷We have access to the data used in Van Rooij *et al.* (2011) but since we can only use it in the cross-sectional data of 2005 and 2006, we end up with too few observations to perform econometric analysis when imposing our sample criteria.

Table 6 ■ Analysis of the effect of behavioral factors on mortgage insurance adoption.

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable: Mortgage Insurance (1 = yes)					
House price expectation	1.00 [0.0]					
Self-assessed FL		0.81** [-2.2]				
Precautionary savings			1.06 [1.40]			
Locus of control				0.82 [-0.8]		
Peers income 16K–28K					0.87 [-0.4]	
Peers income >28K					0.88 [-0.4]	
Peers high school					1.10 [0.4]	
Peers college/university					1.24 [0.9]	
Spending propensity						0.90* [-1.9]
Originator: bank	0.63*** [-3.00]	0.61*** [-3.8]	0.60*** [-3.9]	0.58*** [-2.7]	0.70** [-2.5]	0.61*** [-3.7]
Originator: insurer	0.68 [-1.1]	0.74 [-1.2]	0.73 [-1.2]	0.74 [-0.6]	0.71 [-1.1]	0.72 [-1.3]
Mortgage balance	0.90** [-2.1]	0.95 [-1.4]	0.95 [-1.3]	0.91 [-1.4]	0.96 [-0.8]	0.95 [-1.3]
LTV ratio	4.5*** [4.1]	4.8*** [5.1]	4.6*** [4.9]	6.1*** [3.7]	6.9*** [5.5]	4.8*** [5.0]
Interest rate	1.08 [1.0]	1.09 [1.3]	1.10 [1.4]	1.10 [1.0]	1.08 [1.0]	1.09 [1.3]
Interest-only mortgage	0.38*** [-5.0]	0.44*** [-4.8]	0.44*** [-4.8]	0.35*** [-4.1]	0.52*** [-3.6]	0.44*** [-4.8]
Endowment mortgage	1.17 [0.6]	1.10 [0.4]	1.12 [0.5]	1.36 [0.9]	1.00 [-0.4]	1.08 [0.3]
Tight budget	1.30 [1.3]	1.14 [0.7]	1.15 [0.8]	1.46 [1.4]	1.24 [1.1]	1.19 [1.0]
Risk appetite	1.00 [-0.3]	1.01 [1.0]	1.01 [1.3]	1.01 [0.4]	1.02 [1.3]	1.01 [1.3]
	[0.4]	[-1.2]	[-1.6]	[-1.6]	[-0.8]	[-1.4]
Retired	1.06 [0.2]	0.91 [-0.4]	0.92 [-0.3]	0.87 [-0.3]	0.93 [-0.3]	1.04 [0.2]
Self-employed	1.81 [1.1]	1.94 [1.5]	1.96 [1.4]	1.84 [1.0]	2.04 [1.5]	2.45* [1.9]
Higher vocational	1.21 [1.1]	1.23 [1.4]	1.23 [1.4]	1.87*** [2.7]	1.23 [1.5]	1.10 [0.5]

Table 6 ■ Continued.

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable: Mortgage Insurance (1 = yes)					
University	0.84 [-0.7]	0.78 [-1.2]	0.79 [-1.1]	1.10 [0.3]	0.78 [-1.2]	0.76 [-1.1]
Male	0.73 [-1.1]	0.94 [-0.3]	0.95 [-0.2]	0.74 [-0.8]	0.91 [-0.4]	0.92 [-0.3]
Married	0.76 [-1.2]	0.56*** [-3.0]	0.55*** [-3.2]	0.55** [-2.0]	0.55*** [-3.1]	0.5** [-2.6]
Age	0.97*** [-3.1]	0.97*** [-3.5]	0.98*** [-3.1]	0.99 [-0.8]	0.97*** [-3.3]	0.98** [-2.5]
Children	1.04 [0.2]	0.95 [-0.3]	0.99 [-0.0]	1.08 [0.3]	0.98 [-0.1]	1.03 [0.2]
Median income	0.66** [-2.3]	0.67*** [-2.6]	0.70*** [-2.6]	0.53*** [-2.7]	0.66*** [-2.7]	0.62*** [-2.8]
Double median income	0.72 [-0.9]	0.40*** [-3.1]	0.40*** [-3.2]	0.51 [-1.2]	0.39*** [-3.2]	0.41*** [-2.8]
Wealth quartile 2	1.35 [1.0]	1.00 [-0.0]	1.01 [0.0]	1.64 [1.1]	1.03 [0.1]	0.87 [-0.5]
Wealth quartile 3	1.84** [2.4]	1.54** [2.2]	1.55** [2.3]	2.15** [2.0]	1.52** [2.2]	1.65** [2.3]
Wealth quartile 4	2.27*** [3.2]	1.62** [2.5]	1.57** [2.3]	3.44*** [3.3]	1.51** [2.1]	1.58** [2.2]
Year, region and lender-type dummies	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1,141	1,756	1,756	720	1,756	1,417
Pseudo- R^2	0.18	0.16	0.16	0.20	0.16	0.14
Log likelihood	-606.9	-869.2	-870.7	-341.2	-869.9	-714.9

Notes: This table shows odds ratios for the logit-model explaining insurance adoption controlling for behavioural factors. The dependent variable equals 1 when the households' mortgage is insured and 0 otherwise. Data are from the DNB Household Survey and include all mortgages eligible for insurance originated during the 1995–2009 timeframe. Variable definitions are reported in Table 1 and the survey questions are contained in the Data Appendix. Constant term is included but not reported. Robust t -statistics are reported in brackets. ***, **, * Indicates significance at the 1%, 5%, and 10% level, respectively.

zero otherwise. However, we find no effect (see Model 4 and face a decrease in testing power due to a reduction in sample size.

A growing body of research demonstrates that peers have a significant impact on individual decision making (Syndor 2010, Friedl *et al.* 2014, Beshears *et al.* 2015). Friedl *et al.* (2014) experimentally tests whether social comparison explains adoption of disaster insurance, and they find that idiosyncratic

risks (*e.g.*, risks that are uncorrelated between households) are associated with higher coverage than correlated risks (*e.g.*, risks that are correlated among households such as disaster risk). Because mortgage insurance covers a mixture between idiosyncratic risk (income and divorce risk), and correlated risk (house-price risk), it is unclear which effect from peers can be expected. Although our data set does not contain direct information regarding the homeownership status of the household's peer, we do observe income and education levels which correlate to the homeownership status (Lauridsen and Skak 2007). Including these effects in Model 5, we find indeed no effect on the insurance decision. Because our measures are only indirect proxies for the homeownership status of the household's peers we are cautious in interpreting this finding as there being no effect at all.

Consumer confidence might also play a prominent role as the Netherlands faced prosperous economic conditions during the sample period. Consumer confidence correlates positively with consumer expenditures (Ludvigson 2004, Wilcox 2007) making us expect that consumer expenditures are negatively related to the probability that mortgage insurance is bought. We include the willingness to spend current income (*Spending propensity*) as a proxy for consumer confidence in Model 6 and find weak evidence consistent with this hypothesis.

This latter result combined with the effects of the literacy question (Model 2), seems to indicate that overconfidence might be one of the factors explaining low adoption rates during our sample period. Overconfidence decreases the probability that insurance is bought because it contributes to the underestimation of risks (Sandroni and Squintani 2007). Furthermore, it is documented in the psychological literature that individuals tend to overestimate their own abilities (Johnson, McDermott, Barrett, Cowden, Wrangham, McIntyre and Rosen 2006, John and Robins 1994), which makes the self-assessment of financial knowledge a potential indicator for overconfidence in abilities.

In order to test the overconfidence hypothesis, we regress the self-assessed literacy measure on determinants of financial literacy, such as wealth, income, and participation in financial markets (Calvet *et al.* 2009, Van Rooij *et al.* 2011), and compute the residuals. We include the residuals in the logit regression as before, borrowing the approach from Grinblatt and Keloharju (2009) who examine in a similar fashion the effect of overconfidence on stock trading behavior.

The results of the first stage model are reported in Table 7, where two different specifications for the equation explaining self-assessed financial literacy are estimated. In line with Calvet *et al.* (2009), we find that self-assessed

Table 7 ■ Explaining financial knowledge from observable household characteristics.

	(1)	(2)	(1)	(2)
	Dependent Variable: Self-Assessed FL			
	Coefficients		<i>t</i> -Values	
Age	−0.02*	−0.01***	[−1.9]	[−7.8]
Age ²	0.01		[0.5]	
Household income	−4.36***		[−2.6]	
Household income ²	0.22***		[−2.9]	
Peers income 16K–28K		0.05		[0.6]
Peers income >28K		0.02		[0.2]
Peers high school		0.15***		[2.7]
Peers college/university		0.20***		[3.1]
Holding financial assets	0.31***	0.35***	[8.8]	[8.9]
Retired	0.04	0.05	[0.7]	[0.8]
Self employed	0.16	0.17	[1.1]	[1.1]
Higher vocational	0.04	0.01	[1.1]	[0.0]
University	0.02	−0.03	[0.4]	[−0.4]
Male	0.14**	0.19**	[2.2]	[2.6]
Married	0.09*	0.10*	[1.8]	[1.8]
Children	−0.11***	−0.10**	[−2.6]	[−2.2]
Median family income		−0.09**		[−2.2]
Double median income		0.07		[1.4]
Wealth quartile 2	0.16***	0.18***	[3.0]	[2.9]
Wealth quartile 3	0.18***	0.21***	[3.7]	[3.8]
Wealth quartile 4	0.04	0.11**	[0.9]	[2.0]
Constant	24.68***	2.63***	[3.1]	[11.1]
Year dummies	Yes	Yes		
Number of observations	1,710	1,368		
Adjusted <i>R</i> ²	0.11	0.14		

Notes: This table shows OLS regressions explaining self-assessed financial literacy by households. Data are from the DNB Household Survey and include all mortgages eligible for insurance originated during the 1995–2009 timeframe. Variable definitions are reported in Table 1 and the survey questions are contained in the Data Appendix. Robust *t*-statistics are reported in brackets. ***, **, * Indicates significance at the 1%, 5%, and 10% level, respectively.

values increase in financial activity and wealth, but, surprisingly enough, not in education or income. We also find a strong peer income effect, suggesting that self-assessments might highly correlate with the level of affluence in the environment rather than just those of the decision maker. The residuals vary in the anticipated direction across gender, males being more overconfident, and insurance status, overconfidence being higher among uninsured households.

We include the overconfidence proxies in the decision model in Table 8. We find that overconfidence has a negative effect on the likelihood of insuring and interpret these findings as supporting the overconfidence hypothesis. Inclusion of this variable in prior analysis yields similar effects although varying in significance so we leave them unreported.

Given the economic conditions in the Dutch housing market during our analysis period and the variety of other explanations we considered, we conclude that risk underestimation by either borrowers, lenders, or advisors might be one of the explanations for low insurance rates. However, this raises the question whether the overconfidence effect has a transitory nature, and hence varies with the saliency of the underlying risk, or whether it is permanent in nature. The attention paid to home equity risks might, for example, be subject to a threshold (Laury *et al.* 2009) that has not been met during our sample period. These questions require data that are not available to us and are therefore up for future research.

Discussion and Conclusion

What explains mortgage insurance adoption in a developed Western nation? Underinsurance against disaster-type risks has been extensively studied by academics, but there are still unresolved questions as to how this phenomenon can be explained.

Using a unique institutional setting, we examine whether underinsurance is observed in the Dutch mortgage insurance market. We find that only 30% of the eligible households insure their mortgage, despite economically meaningful incentives to do so. We also document that the pattern is difficult to explain by standard theories, such as cost-benefit analysis, portfolio diversification, or perceived risk. Although we find that risk exposure, age, and wealth are informative for mortgage insurance adoption, other factors such as financial affluence, precautionary behavior, or house prices expectations are not significant. We further document an effect for supply-side factors, such as the involvement of financial advisors and type of mortgage lender. The results indicate that trust of borrowers and the information position of lenders might

Table 8 ■ The role of consumer confidence in insurance adoption.

	(1)	(2)	(3)	(4)
	Dependent Variable: Mortgage Insurance (1 = yes)			
Overconfidence	0.84*	0.83*		
Alt. 1	[-1.7]	[-1.8]		
Overconfidence			0.82*	0.81*
Alt. 2			[-1.9]	[-2.0]
Spending		0.91*		0.88*
propensity		[-1.8]		[-2.0]
Originator: bank	0.64***	0.65***	0.74**	0.77*
	[-3.3]	[-3.2]	[-2.0]	[-1.7]
Originator: insurer	0.65	0.65	0.60	0.60
	[-1.6]	[-1.6]	[-1.6]	[-1.5]
Mortgage balance	0.95	0.95	0.95	0.96
	[-1.2]	[-1.2]	[-0.9]	[-0.8]
LTV ratio	6.44***	6.72***	9.02***	9.77***
	[5.8]	[5.9]	[6.1]	[6.2]
Interest rate	1.14*	1.13*	1.09	1.08
	[1.9]	[1.9]	[1.1]	[1.1]
Interest- only	0.44***	0.44***	0.52***	0.51***
mortgage	[-4.6]	[-4.7]	[-3.5]	[-3.5]
Endowment	1.17	1.15	1.00	0.96
mortgage	[0.7]	[0.6]	[-0.0]	[-0.2]
Tight budget	1.17	1.19	1.17	1.18
	[0.9]	[0.9]	[0.8]	[0.8]
Risk appetite	0.99	0.99	0.99	0.99
	[-0.9]	[-0.9]	[-0.8]	[-0.7]
Retired	0.95	0.97	1.06	1.09
	[-0.2]	[-0.1]	[0.20]	[0.30]
Self-employed	1.34	1.38	1.59	1.68
	[0.6]	[0.7]	[0.9]	[1.0]
Higher vocational	1.27	1.28*	1.25	1.26
	[1.6]	[1.7]	[1.3]	[1.4]
University	0.78	0.78	0.89	0.89
	[-1.1]	[-1.1]	[-0.5]	[-0.5]
Male	0.90	0.89	0.86	0.83
	[-0.4]	[-0.5]	[-0.5]	[-0.7]
Married	0.56***	0.57***	0.61**	0.62**
	[-2.9]	[-2.9]	[-2.3]	[-2.2]
Age	0.98***	0.98***	0.98**	0.98**
	[-3.1]	[-3.1]	[-2.4]	[-2.4]
Children	0.97	0.97	1.04	1.04
	[-0.2]	[-0.2]	[0.2]	[0.2]
Median income	0.63***	0.63***	0.60***	0.60***
	[-2.9]	[-2.9]	[-2.9]	[-2.9]
Double median	0.38***	0.38***	0.42***	0.42***
income	[-3.2]	[-3.2]	[-2.7]	[-2.7]
Wealth quartile 2	0.88	0.90	0.75	0.77
	[-0.4]	[-0.4]	[-0.9]	[-0.8]

Table 8 ■ Continued.

	(1)	(2)	(3)	(4)
	Dependent Variable: Mortgage Insurance (1 = yes)			
Wealth quartile 3	1.39 [1.4]	1.36 [1.3]	1.47 [1.5]	1.43 [1.4]
Wealth quartile 4	1.48* [1.7]	1.41 [1.5]	1.43 [1.4]	1.33 [1.1]
Year and region dummies	Yes	Yes	Yes	Yes
Number of observations	1,619	1,619	1,312	1,312
Pseudo- R^2	0.17	0.17	0.15	0.15
Log likelihood	-800.8	-799.5	-660.6	-658.5

Notes: This table shows odds ratios for the logit model explaining insurance adoption including the residuals from the regressions in Table 7 as proxy for overconfidence. The dependent variable equals 1 when the households' mortgage is insured and 0 otherwise. Data are from the DNB Household Survey and include all mortgages eligible for insurance originated during the 1995–2009 timeframe. Variable definitions are reported in Table 1. Constant term is included but not reported. Robust *t*-statistics are reported in brackets, ***, **, * Indicates significance at the 1%, 5%, and 10% level, respectively.

play a role in insurance adoption (Norden and Weber 2010, Bhattacharya *et al.* 2012). Finally, consumer (over)confidence is negatively related to the likelihood that households purchase mortgage insurance. This explanation coincides with prosperous housing market conditions that characterize our sample period and is further evidenced by the rising mortgage insurance adoption levels following the downturn of the Dutch housing market.

It remains an open question why households refrain from obtaining subsidized insurance, and whether the overconfidence effect is transitory in nature. The overconfidence effect might be reflective of a temporary attention threshold towards risks (Laury *et al.* 2009), or permanent and thereby requiring policy interventions. Additional empirical analysis is needed to further our understanding of the drivers of insurance behavior.

Because the housing markets are exposed to cyclical dynamics, the question that remains open is whether lenders and borrowers will collectively default towards noninsurance again when the saliency of housing risks vanishes. Because household portfolios will likely remain significantly underdiversified (Englund, Hwang and Quigley 2002), insurance against real estate risks might have to be offered as a default option in order to “nudge” homeowners and prevent underinsurance on LPHC risks. However, further analysis on the cost

effectiveness of such a policy is required. Significant opportunities to improve household risk management are present (Shiller 2008), but our findings raise the question as to whether households are able to properly assess financial risks themselves, or whether they are in need of assistance.

Finally, analyzing insurance behavior in a unique setting like ours comes with the drawback that results might not generalize to other markets or insurance products. Again, inconsistent findings in prior work seem to make generalizability largely an empirical question, whose answer can shed further light on the international comparability of insurance decisions given institutional and cultural differences.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Data Appendix