Journal of Financial Literacy and Wellbeing (2023), **1**, 79–102
doi:10.1017/flw.2023.4

CAMBRIDGE UNIVERSITY PRESS

ARTICLE

Reverse mortgages and financial literacy

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(Received 15 November 2022; revised 24 February 2023; accepted 25 February 2023; first published online 24 May 2023)

Abstract

Few retirees use reverse mortgages. In this paper, we investigate how financial literacy and prior knowledge of the product influence take-up by conducting a stated-preference experiment. We exogenously manipulate characteristics of reverse mortgages to tease out how consumers value them and investigate differences by financial literacy and prior knowledge of reverse mortgages. We find that those with higher financial knowledge are more likely to know about reverse mortgages, not more likely to purchase them at any cost but are more sensitive to the interest rate and the insurance value of these products in terms of the non-negative equity guarantee.

Keywords: reverse mortgages; savings; retirement planning; insurance

JEL Codes: G53; G21; R21

1 Introduction

Much attention in the financial literacy literature has been directed to the accumulation phase of the life cycle (Lusardi and Mitchell, 2014). Financial knowledge is associated with retirement planning and better outcomes in terms of savings. Much less attention has been devoted to the role of financial literacy for decumulation decisions and outcomes. Decumulation is a hard problem as it involves making decisions as to how to spend down savings, insure against risks, and manage illiquid assets such as housing.

In fact, housing is a major component of household wealth in retirement. The primary residence accounts for approximately 33% of the median wealth accumulated by Canadian households[1]. In retirement, owning a house may provide an important service flow. In addition, home equity may act as an insurance policy against financial risks due to disability risk, since the house is typically sold when individuals enter a nursing home (Davidoff, 2009). Given that housing is to some extent illiquid (at least at the intensive margin), many households are *house-rich* and *cash-poor*, which limits their capacity of extracting home equity to smooth consumption in retirement.

Borrowing against home equity is feasible using two different products. For those who qualify, home equity lines of credit (HELOCs) allow borrowing against equity. HELOCs are quite popular among near-retirees in Canada. Bedard and Michaud (2021) report that 17.9% of Canadians aged 62–66 years have a positive HELOCs balance compared with 4% in the United States. Americans are much more likely to have a mortgage at these ages. However, borrowing using a HELOC exposes owners to the risk that the loan accumulated

[1] https://www150.statcan.gc.ca/n1/daily-quotidien/171207/dq171207b-eng.htm

will end up being greater than the value of the house. Minimum payments need to be made in retirement. Furthermore, qualification for these loans is restricted among the elderly because of more stringent income testing.

Reverse mortgages (RMR) have emerged as an alternative solution. A reverse mortgage is a financial product that allows a homeowner to convert a portion of the current equity of their principal residence into cash. Unlike many other mortgage products, the borrower is not obligated to make payments before moving out, selling, or dying. In addition, the borrower is insured against the risk that the loan is worth more than the house when it is sold. This is called the non-negative equity guarantee (NNEG) of the reverse mortgage. This feature means that the borrower's longevity risk, as well as the risk of a decline in house prices, is transferred to the lender. Given that the guarantee is costly, a reverse mortgage will typically command a higher interest rate. In 2017, the rate on a reverse mortgage was roughly 2 percentage point higher than that of a HELOC.

Yet, the market for reverse mortgage purchases is small in many countries. In 2014, only 2.11% of Canadian households reported planning to obtain a reverse mortgage as a source of income upon retirement (Statistics Canada, 2014). Nakajima and Telyukova (2017) report similar low figures for the United States. Financial literacy may play an important role. The valuation of these products for consumers is complicated. While the consumption smoothing value will be intuitive to many, the distinct feature of reverse mortgages, the insurance value of the NNEG, is likely more difficult to grasp and compute. It involves projecting house prices in the future, survival risk, and other considerations such as when one expects to sell the house. Consumers with limited financial literacy may have a harder time making sense of the price and value of the products offered. For example, if consumers value predominantly the NNEG, those who expect negative price growth for their house should favor reverse mortgages over HELOCs because the NNEG is larger in those cases. Davidoff and Wetzel (2014) show that consumers appear to fail to take advantage of this feature of the product when house prices are declining. This paper aims to understand the interplay between financial literacy and the valuation of reverse mortgage products.

In situations where the take-up of a financial product is low and data scarce at the micro level, an experimental approach is well suited to learn about preferences and how they interact with knowledge.[2] In the case of reverse mortgages, Davidoff et al. (2017) conducts a survey to learn about what consumers know about reverse mortgages. They find relatively high basic awareness of reverse mortgages but poor understanding of actual provisions of reverse mortgages. They also find that while product knowledge is positively associated with demand, general financial literacy is associated with lower demand, a finding similar to Fornero et al. (2016) in the Italian context. To understand how consumers value reverse mortgages, we conduct a stated-choice experiment in which respondents were asked to evaluate various reverse mortgage products. We investigate how financial literacy as well as prior knowledge of reverse mortgages shape the evaluation of reverse mortgage products, in particular the actuarial value of the NNEG and the interest rate charged on the product.

We find that more than half of eligible Canadians (55.48%) lack the basic fundamental knowledge of reverse mortgages prior to participating in our stated-preference experiment. Knowledge of reverse mortgages is positively associated with higher financial

[2] Several recent papers demonstrate the usefulness of such an approach. Ameriks et al. (2020) use an experimental approach to learn about preferences regarding end-of-life savings and long-term care. Brown et al. (2017) use an experiment to learn about the valuation of annuities. Boyer et al. (2020) use an stated-preference approach to learn about demand for long-term care insurance and highlight the importance of product knowledge. Boyer et al. (2020) use a similar approach to learn how consumers value life annuities in Canada whereas Boyer et al. (2022) investigate how financial education helps consumers make better use of tax-sheltered savings accounts.

https://doi.org/10.1017/flw.2023.4 Published online by Cambridge University Press

literacy as well as having high income and assets. Second, we estimate that consumers are price-sensitive to the interest rate charged on reverse mortgages. Importantly, price sensitivity is larger for those with higher financial literacy, while the elasticity is lower and statistically insignificant among those with low financial literacy. Third, only financially literate consumers are sensitive to the actuarial value of the NNEG in these scenarios. Consistent with a poor understanding of the NNEG and a stronger weight put on the consumption smoothing possibilities of reverse mortgages, consumers who expect the lowest house price growth are less willing to purchase a reverse mortgage than those who expect prices to increase.

The paper is organized as follows. In section 2, we present the main type of reverse mortgage product offered to Canadians and discuss the theoretical foundations for the valuation of reverse mortgages. In section 3, we present survey evidence on knowledge of reverse mortgages. In section 4, we present the experiment and how we compute the actuarial value of the NNEG for each respondent and scenario. In section 5, we analyze how respondents value reverse mortgages in the experiment, while section 6 concludes.

2 A primer on reverse mortgages

2.1 The Canadian home income plan

Canadians have access to reverse mortgage products through the Canadian Home Income Plan (CHIP) offered by *HomeEquity Bank*. This program was first offered in the Vancouver area in 1986, and then in Ontario and Alberta starting in 2001. In the following years, the program was gradually offered across the country. In order to be eligible to the program, the borrower must be a Canadian citizen and at least 55 years old. In addition, he or she must be the owner of their own residence. Only primary residences are eligible. The initial loan must be at least $25,000.

The program allows the borrower to remain the owner of the residence, as long as certain conditions are met. These conditions are that the residence must be kept in good condition, property taxes paid, and the property must be insured. Eligibility is dependent on a good record in terms of mortgage re-payment. If there is an existing mortgage on the property at the time of initiation, the mortgage must be paid off first with the proceeds from the reverse mortgage.

The CHIP program provides a NNEG, which means that it guarantees that the amount to be repaid will never exceed the fair market value of the property at the time of sale. Once a loan-to-value limit for the reverse mortgage has been set, the homeowner has several options to choose from in order to receive the funds. They can receive 100% of the funds allowed in one lump sum. They can also initially receive a fraction of the funds granted, in the form of an initial lump sum of $25,000, with subsequent advances. This line of credit option is similar to the Home Equity Conversion Mortgage (HECM) offered in the United States.

There are administrative fees charged to the borrower. First, CHIP charges a closing and administrative fee of $1,495, which includes security lookup, title insurance, and registration. Fees ranging from $175 to $400 are added for an assessment of the property. Finally, a fee between $300 and $500 is charged for independent legal advice.

In 2017, year when we ran our survey and experiment, the CHIP program allowed the borrower to borrow between 10% and 55% of the estimated equity of the residence. Most conditions have not changed since then. The loan-to-value depends on the borrower's age, sex, and marital status. It also depends on the type of residence and its geographical location. Table 1 provides an example of loan-to-value limits for a single-family dwelling by a single woman between 55 and 75 years old, in the cities of Montreal, Toronto, and Vancouver, in 2017.

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Table 1. CHIP maximum loan-to-value: This table presents the maximum loan-to-value ratios of the home equity that can be borrowed by a single woman living in a single-family dwelling. These limits are reported by age and city. Source: HomeEquity Bank, 2017

	Montreal	Toronto	Vancouver
Age			
55	0.260	0.253	0.245
65	0.354	0.364	0.347
75	0.420	0.434	0.413

In order to reduce the losses related to the NNEG, the loan-to-value is lower for younger borrowers. It is also lower for women, since they have a higher life expectancy than men. When compared with single individuals, couples can borrow less since the joint probability of survival is taken into consideration. Finally, according to the type of dwelling and its location, a higher loan is allowed for those for which a higher price growth and a lower price volatility are expected. These reverse mortgages were offered at an interest rate of 5.59% (in 2017) which is above the rate charged on HELOC (4% at the time). Contrary to the United States, these reverse mortgages are not federally insured.[3]

2.2 The value of reverse mortgages

How should households evaluate reverse mortgages? Their value derives from two distinct sources. The first one is the possibility of shifting consumption earlier when an illiquid asset cannot be sold earlier. This first component is not unique to reverse mortgages. One can also shift consumption earlier by extracting home equity using HELOCs. The second source, which is unique to reverse mortgages, is the insurance against the downside risk that the value of the house falls below the value of the loan at the time the house is sold. Hence, a household may be willing to pay a premium on the interest rate charged for a reverse mortgage due to the NNEG.

The impact of illiquid housing wealth on the desire to borrow from home equity was first studied by Artle and Varaiya (1978). Consumers may value borrowing from home equity in retirement because they are liquidity-constrained. The presence of this illiquid asset endogenously creates these constraints. Consider a household deriving a utility flow from living in their home. While healthy, the household wants to stay in their home. The house value could be expected to appreciate in retirement. Assume the house will only be sold near death, potentially when sickness occurs. These are states of the world where the marginal utility of consumption could be low, in particular in Canada where out-of-pocket medical expenditures in the case of sickness (nursing homes) are not as large as in other countries, such as the United States (Boyer et al. 2020). If that is true, the consumption smoothing motive could be strong and push households to extract home equity earlier in retirement, while the marginal utility of consumption is higher. This is the consumption smoothing motive for borrowing against home equity. This should be relevant for those with low levels of liquid assets (relative to income) and with substantial home equity or home equity which is expected to growth fast in retirement.

The second source of value from reverse mortgages is the NNEG. Borrowing a substantial portion of home equity in a HELOC would be risky for the household and their heirs. Since house prices fluctuate substantially, in particular at longer horizons, the loan value at the time the house is disposed off could be larger than the value of the house. Either the

[3] In the United States, the Federal Housing Administration (FHA) provides that insurance.

https://doi.org/10.1017/flw.2023.4 Published online by Cambridge University Press

consumer or his/her heirs would be liable to repay the financial institution who granted a HELOC. A reverse mortgages allows to transfer this risk to the financial institution offering the loan. Hence, from the point of view of the financial institution, a reverse mortgage is more risky than a regular HELOC, since it cannot recuperate some portion of the loan if house prices fall substantially. Therefore, a mortgage insurance premium must be charged to cover the losses associated with this risk. The actuarial value of the NNEG is a function of various risks including longevity risk and house prices. The higher the likelihood that someone lives longer in their house, the higher the likelihood that the value of their loan exceeds the value of their house. Similarly, drops in house prices increase the likelihood that loans exceed the value of house. Hence, someone who expects house prices to decline, or appreciate more slowly, should perceive a higher value from a reverse mortgage over a HELOC. With growing degree of sophistication in the modeling of risks, there is a substantial literature which evaluate the NNEG for various reverse mortgage products (Li et al. 2010; Cho et al. 2015; Alai et al. 2014; Shao et al. 2015). Davidoff (2015) estimates that the value of the NNEG embodied in products offered in the United States can be large, in particular when idiosyncratic house price risk is taken into account. Hence, the value of the NNEG could be nontrivial.

Both motives for borrowing out of home equity suggest a different relationship between the value of reverse mortgages and expected house price growth. They also suggest that the value of reverse mortgages should vary according to a number of other characteristics of borrowers. Putting the two motives together, there has few been attempts to evaluate the value of reverse mortgages to households using a well-defined life cycle framework. For example, Nakajima and Telyukova (2017) estimates using a life cycle model that the value of a reverse mortgage to households in the United States is relatively modest, at 252$ per homeowners and 1770$ per reverse mortgage borrower. They attribute this low demand to bequest motive, uncertainty about health, and high cost. Cocco and Lopes (2019) also estimate relatively low value of existing products which they attribute to the requirement of having to maintain the house when contracting a reverse mortgage and to other design features of the product. There is substantial uncertainty around the value of reverse mortgages to retirees.

3 Survey evidence: Knowledge of reverse mortgages

3.1 The survey

In 2017, we conducted a survey experiment with *Asking Canadians*, an online panel provider in Canada. Respondents were aged 55 to 75 years and lived in the provinces of Quebec, Ontario, or British Columbia. In each province, 50% of respondents came from major census metropolitan areas (CMA), while the rest came from outside the CMA. We focus on those aged 55 to 75 years because this is an age group where reverse mortgages are likely to be most relevant. Because the value of reverse mortgages is tightly linked to house prices, we focus on provinces in which house price growth has been steady over the last decades. This increases the likelihood that respondents have substantial home equity.

The questionnaire consists of five parts. First, we collect socioeconomic, demographic, and health information from respondents. The second section is on preferences, risk perception, and expectations for the future. The third section measures respondents' level of financial literacy and knowledge of probabilities. A fourth section asks respondents about their general knowledge about reverse mortgages. Finally, the last section consists of a stated-choice experiment, where respondents were offered different reverse-mortgage products and had to evaluate them by giving their probability of buying each of these financial products within the next year. A copy of the questionnaire can be found in

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Table 2. Descriptive Statistics: This table presents descriptive statistics on the respondents from the survey. N = 2140. Statistics weighted according to 2010 Canadian Community Health Survey (CCHS)

	Mean	SD	Min	Max
Age	63.388	5.305	55.000	75.000
Men	0.488	0.500	0.000	1.000
Ontario	0.502	0.500	0.000	1.000
British Columbia	0.193	0.395	0.000	1.000
Quebec	0.305	0.460	0.000	1.000
Married	0.755	0.430	0.000	1.000
Has kids	0.765	0.424	0.000	1.000
Less than high school	0.180	0.384	0.000	1.000
High school	0.384	0.486	0.000	1.000
College	0.436	0.496	0.000	1.000
Retired	0.663	0.473	0.000	1.000
Total income ($1,000)	88.544	66.092	0.001	500.000
Total non-housing saving ($1,000)	265.681	424.297	0.000	5000.000
Home value	570.049	468.803	25.322	3000.000
Has a mortgage	0.341	0.481	0.000	1.000
Equity ($1,000)	519.638	456.115	25.322	3000.000
House-rich and cash-poor	0.092	0.287	0.000	1.000
Employer pension plan	0.561	0.496	0.000	1.000
Bequest motive	0.178	0.383	0.000	1.000
House must be sold only if financial hardship	0.580	0.494	0.000	1.000
Financial literacy (three correct answers)	0.541	0.498	0.000	1.000
Understands surv. probabilities	0.846	0.358	0.000	000

the Online Appendix.[4] Because the resulting sample is slightly more educated than the general population, we created a set of weights based on the Canadian Community Health Survey (CCHS) for the year 2010. We construct weights based on age group (5 years), gender, province, and education (three levels).

Of the 3,000 Canadians surveyed, 2,399 reported owning a home. A total of 2,306 respondents had enough home equity to borrow from a reverse mortgage. Of these respondents, 2,163 were single or had a spouse aged 55 years or older, making them eligible for the CHIP program. Finally, 2,140 respondents did not have any missing information and therefore were included in the analysis. Descriptive statistics on those respondents is reported in Table 2.

Respondents are 63.4 years old on average, and half of them are male. Around 20% of them are from British Columbia, 30% from Quebec and 50% from Ontario. Nearly three-quarters (75.5%) of them are married or in a common-law relationship and 76.5% reported having at least one living child. Close to two-thirds (66%) of respondents consider themselves retired. More than half (56.1%) of the sample have an employer pension plan or

[4] The survey also included a stated-choice experiment for annuities. This experiment was analyzed in Boyer et al. (2020).

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receive income from one. On average, their annual household income is $88,544, and they have average total non-housing savings of $265,681.[5] The average current market value of their home is $570,049. Slightly more than a third of respondents (34.1%) still have a mortgage on their primary residence. The median equity value of their residence is around $520,000. To define a group who is house-rich and cash-poor, we borrow from the definition of wealthy hand-to-mouth households proposed by Kaplan et al. (2014). They define wealthy hand-to-mouth consumers as those with positive home equity but liquid assets less than half of total income. To capture the *house-rich* aspect of the definition we are after, we tighten the criterion on home equity and use a threshold of three times total income instead of zero home equity. Respondents who have home equity larger than three times their income but liquid assets (savings) less than half their total income are defined as house-rich and cash-poor. In the sample, 9.2% of respondents qualify as house-rich and cash-poor.

In terms of preferences, we keep two variables for our analysis: one which is a proxy for the presence of a bequest motive and the other to proxy attachment to the house. On a 5-point Likert scale, respondents were asked if they agreed with the following statement: *Parents should set aside money to leave to their children or heirs once they die, even when it means somewhat sacrificing their own comfort in retirement*. We recoded those who agree or strongly agree have shown preferences consistent with a bequest motive (or bequest norm). In the sample, 17.8% of respondents were classified using this statement as having a stronger bequest motive. We also use the response to the statement: *A house is an asset that should only be sold in the case of financial hardship* to characterize a respondent's preference or norm for staying in the home. In the sample, 44% agreed or strongly agreed with the statement.

We asked respondents a series of three questions to assess their level of financial literacy following Lusardi and Mitchelli (2007). The first question is on interest rates, the second on purchasing power, and the third on risk diversification. We create a binary indicator taking value 1 if the respondent correctly answers all three questions and 0 if not. Overall, 54.1% of respondents correctly answer all three questions. Another question asks the respondent about survival probabilities. Respondents are told the probability of surviving to 85 is 60% and asked whether the probability of surviving to 60 is larger, or smaller than 60%. We create a binary indicator if the respondent correctly answers this question. 84.6% of respondents correctly answered this question.

3.2 Prior knowledge of RMR

Respondents were asked a sequence of questions with the objective of measuring their level of prior knowledge of reverse mortgages.

Without naming the financial product, we first presented a sentence containing the definition of a reverse mortgage to the respondents[6]. Then, respondents were asked if they had ever heard of this financial product. As shown in Table 3, 77.3% of eligible Canadian homeowners claimed to have heard of that kind of financial product. Fewer homeowners from Quebec answered having heard this definition, a difference of nearly 20 percentage points with the two other provinces.

Then, we asked those who claimed to have heard of this financial product if they could name it. 59.5% of these homeowners claimed to be able to name the product in question.

[5] To prevent the effect of outliers, we imposed a maximum annual household income of $500,000 and maximum total savings of $5,000,000

[6] The definition was presented as follows: "*Imagine a financial product that lets you turn part of your current home equity into cash. You're not obligated to make any payments until you move, you sell your home, or you die. You have the certainty that once your residence is sold, the required amount to repay the loan will not exceed the selling price of the residence.*"

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Table 3. Prior knowledge of reverse mortgages: N = 2140. Statistics weighted according to the 2010 Canadian Community Health Survey (CCHS)

	Canada	B.C.	Ont.	Que.
1: Ever heard of the existence of this fin product: based on definition of reverse mortgages (N=2,140)				
No	**22.7%**	15.3%	17.1%	36.5%
Yes	**77.3%**	84.7%	82.9%	63.5%
2: Can you name the financial product: based on definition of reverse mortgages (if heard) (N=1,705)				
No	**40.5%**	35.2%	36.5%	53.3%
Yes	**59.5%**	64.8%	63.5%	46.7%
3: Name that financial product: based on definition of reverse mortgages (if can name) (N=1,065)				
Annuity	**0.4%**	0.1%	0.0%	1.7%
Reverse mortgage	**96.8%**	96.6%	98.9%	90.9%
Life insurance	**0.1%**	0.0%	0.0%	0.3%
Line of credit	**1.2%**	2.9%	0.4%	1.7%
None of the above	**1.6%**	0.4%	0.7%	5.4%
Correctly answered all three questions (N=2,140)				
No	**55.48%**	46.94%	47.87%	73.09%
Yes	**44.52%**	53.06%	52.13%	26.91%

Once again, there was a noticeable difference between provinces. Fewer homeowners from Quebec who had heard of this financial product claimed to be able to name it, a difference of 15 percentage points with the two other provinces.

Finally, those who claimed to be able to name the product were asked to identify it from a list of financial product names. 96.8% of them answered correctly. Once again, fewer homeowners from Quebec answered this question correctly. Overall, 44.52% of all homeowners had heard of the existence and correctly identified the reverse mortgage as the name of that financial product. Moreover, the level of knowledge was twice as big among homeowners in Ontario and British Columbia than it was in homeowners in Quebec. One plausible explanation for this phenomenon is that the CHIP program has been offered longer in Ontario and British Columbia than in the province of Quebec.

To understand how prior knowledge of the product is distributed, we estimate a logit regression with as a dependent variable an indicator for whether or not respondents were able to identify the product (answer all three questions and named the product correctly as a reverse mortgage). We include as controls an indicator for financial literacy, for understanding survival probabilities, sociodemographic characteristics, and controls for economic resources. In Table 4, we report estimates of marginal effects along with standard errors.

We find that those with higher levels of financial literacy have a substantially higher probability of knowing what a reverse mortgage is. Even after controlling for a host of factors, there is a 12.2 percentage point difference in knowledge of reverse mortgages between those with and those without financial literacy. There is also a substantial difference between those who understand of survival probabilities and those who don't. In

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Table 4. Who can identify reverse mortgages?: Marginal effects from a logit regression of whether or not respondents understand reverse mortgages (could identify by name based on description) on a series of controls. Total wealth, home value, and savings are included as quartile dummies and the 4th quartile is excluded

	(1)	(2)	(3)
Financial literacy	0.174***	0.130***	0.122***
	(0.0206)	(0.0211)	(0.0213)
Understands survival probabilities	0.150***	0.128***	0.128***
	(0.0317)	(0.0305)	(0.0303)
Age of respondent		0.00575***	0.00701***
		(0.00196)	(0.00200)
Male		0.0709***	0.0649***
		(0.0211)	(0.0209)
Ontario		0.230***	0.220***
		(0.0236)	(0.0261)
Bc		0.263***	0.264***
		(0.0230)	(0.0263)
High school		−0.0695	−0.0732
		(0.0701)	(0.0695)
College		0.0232	0.00608
		(0.0687)	(0.0687)
Married		0.0199	0.00271
		(0.0249)	(0.0258)
Has kids		−0.0545**	−0.0531**
		(0.0249)	(0.0249)
Total income (4th q. excluded)			
1st quartile			−0.0772**
			(0.0325)
2nd quartile			−0.0292
			(0.0310)
3rd quartile			−0.0273
			(0.0292)
Home value (4th q. excluded)			
1st quartile			0.0376
			(0.0349)
2nd quartile			0.0852***
			(0.0303)
3rd quartile			0.0680**
			(0.0289)

(*Continued*)

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Table 4. (*Continued*)

	(1)	(2)	(3)
Savings (4th q. excluded)			
1st quartile			−0.0841**
			(0.0359)
2nd quartile			−0.137***
			(0.0313)
3rd quartile			−0.112***
			(0.0295)
Has mortgage			0.0387*
			(0.0225)
House-rich and cash-poor			−0.0295
			(0.0440)
Has DB pension			−0.0165
			(0.0213)
Observations	2,140	2,140	2,140

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

terms of other correlates, males are more likely to know reverse mortgages. Those with kids are less likely to know about reverse mortgages. In terms of income, those with the lowest level of income (bottom quartile) are less likely to know about reverse mortgages. Those in the second and third quartile of home equity are more likely to know about reverse mortgages (these effects are relative to the fourth quartile). Quite the opposite, those in lowest quartiles of liquid savings are less likely to know about reverse mortgages. Respondents with existing mortgages are more likely to know about reverse mortgages. Interestingly, we do not find that those who are house-rich and cash-poor are more likely to know about the existence of reverse mortgages. In terms of economic resources, those who appear to know about reverse mortgages do not exactly fit the profile of house-rich and cash-poor households. However, they are more financially literate.

4 Stated-preference experiment

For each of the respondents in our sample, we present five different reverse mortgage scenarios. We focus on lump-sum reverse mortgage loans to simplify the description of reverse mortgages and avoid having to specify the path of interest rates, etc. These are simpler products than those offered in the market. In the scenarios, we vary interest rates offered and loan-to-value that can be borrowed. We reproduce below the introductory text presented to the respondents. [7]

> *We will refer to a reverse mortgage as a financial product that lets you turn part of your current home equity into cash. Unlike many mortgage-based financial products, you're not obligated to make any payments until you move, you sell your home, or you die.*

[7] A French version was presented to the respondents who chose to answer the questionnaire in French.

https://doi.org/10.1017/flw.2023.4 Published online by Cambridge University Press

Importantly, you have the certainty that once your residence will be sold, the amount required to repay the loan will not exceed the selling price of the residence. When we use the expression "current home equity," we are referring to the current market value of your primary residence after subtracting outstanding mortgage balances. For the rest of this section, try to have your current home equity in mind. We are going to show you some simple reverse mortgage products and ask you to rate them. Each reverse mortgage has three attributes:

1. *The percentage of your current home equity that you can borrow. The amount borrowed must be a minimum of $25,000.*
2. *A fixed annual interest rate on the balance of the loan, generating interests that you do not need to pay before you move, sell, or die.*
3. *A fixed fee of $2,245 that you only have to pay once. The money you obtain from the reverse mortgage will be used to pay this fee.*

We then presented the scenarios as follows:

1. *You can borrow a minimum of $25,000 and up to β% of your current home equity.*
2. *You will be charged a fixed annual interest rate of r% on the balance of the loan for as long as you hold the loan.*

   Reminder: You're not obligated to make any payments until you move, you sell your home, or you die; and you have the certainty that once your residence will be sold, the amount required to repay the loan will not exceed the selling price of the residence.
3. *There is a fixed fee of $2,245 that you only have to pay once. The money you obtain from the reverse mortgage will be used to pay this fee.*

For each individual i and scenario j, we exogenously propose an interest rate, $r_{i,j}$, which can take the values in the range:

$$r_{i,j} = [3.8\%, 4.1\%, 4.4\%, 4.7\%, 5\%, 5.3\%, 5.59\%, 6\%, 6.5\%, 7\%],$$

each with probability 1/10.

Therefore, the randomization is done around the interest rate of 5.59% proposed by CHIP for a 5-year term at the moment when the survey was conducted. For each individual i and scenario j, a loan-to-value $\beta_{i,j}$ that can be borrowed is shown. We denote the maximum loan-to-value that can be borrowed by the individual i from CHIP as β_i^{CHIP}. We have information on the CHIP's average maximum loan-to-value, by 5-year age group[8], gender, marital status (single or couple), and residence location (inside or outside the metropolitan area)[9]. These values come from the CHIP calculator that can be found on their website[10] and are presented at the end of the Online Appendix. To randomize the loan-to-value around β_i^{CHIP}, we draw a value, $\tau_{i,j}$:

$$\tau_{i,j} = [0.5, 0.75, 1, 1.25, 1.5], \text{ each with probability of } 1/5.$$

The loan-to-value proposed in the scenario j of the respondent i will therefore be $\beta_{i,j} = \tau_{i,j}\beta_i^{CHIP}$.

[8] For couples, we used the average age of the couple, $\frac{age_R + age_S}{2}$, where is the age of the respondent and is the age of the spouse as reported in the survey. We rounded the result to the nearest integer and set the age at 79 when $\frac{age_R + age_S}{2} > 79$.

[9] To identify the residence location, we asked respondents to give us the first three digit of their postal code. This information allowed us to identify the respondents who were or were not part of the main census metropolitan area of their respective province (Montreal, Toronto and Vancouver).

[10] https://www.chipadvisor.ca/calculator/

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Following Manski (1999), we ask the respondent to report the probability, from 0% to 100%, that they would buy this reverse mortgage if a trusted financial institution offered it within the next year. This provides a continuous measure of preference intensity in the form of a probability and accounts for incompleteness of the hypothetical choice situations presented.

4.1 Computing the actuarial value of the NNEG

To compute the actuarial value of each of the contracts offered to respondents, we consider a simple pricing framework. Reverse mortgage pricing models can be extremely sophisticated and account for a number of elements, including stochastic discount factors, yield curve modeling, and endogenous termination probabilities (see e.g., Shao et al. 2015). Since we are interested in the cross-sectional and cross-scenario variation in the actuarial value of the contracts we presented, we will pay more attention to the variation induced across respondents and scenarios than the absolute level of the actuarial value of the NNEG in terms of a mortgage insurance premium. Another important distinction with other pricing models is that we aim to measure the perceived value of the NNEG rather than the actual NNEG. Hence, we will use subjective mortality risk instead of life table risk.

We compute fair mortgage insurance premiums to cover losses related to the NNEG. Let $\gamma_{i,j}$ be the loan-to-value ratio of the equity of the house with (net equity) value $H_{i,a}$, borrowed by an individual i of age a in scenario j. The initial value of the loan, $L_{a,i,j}$, is then given by $L_{a,i,j} = \gamma_{i,j} H_{i,a}$. The value of the loan at $a + t$ is given by:

$$L_{a+t,i,j} = L_{a,i,j}(1 + r_{LC} + \pi_{i,j})^t, \tag{1}$$

where r_{LC} represents the (fixed) interest rate for a HELOC, $\pi_{i,j}$ represents a fair mortgage insurance premium to cover losses related to the NNEG in scenario j, and let $r^*_{i,j} = r_{LC} + \pi_{i,j}$ represents the (fair) interest rate for the reverse mortgage. Let $H_{i,a+t}$ be the resale value of the house if the borrower leaves or dies after t years (at age $a + t$). The NNEG ensures that the amount recovered by the lender at the time of the sale of the house is

$$\min\{L_{a+t,i,j}, (1-c)H_{i,a+t}\}, \tag{2}$$

where c is a transaction cost calibrated at 5% of the selling price [11] of the selling price. The potential loss by the lender at the time of selling the house is then defined as:

$$\max\{L_{a+t,i,j} - (1-c)H_{i,a+t}, 0\}. \tag{3}$$

The expected present value of future losses related to the NNEG is given by:

$$\text{NNEG}(\pi_{i,j}) = E_H\left(\sum_{t=1}^{T} q_{i,a,a+t} \frac{max(L_{a+t,i,j} - (1-c)H_{i,a+t}, 0)}{(1+i)^t}\right), \tag{4}$$

where i is a discount rate-based calibrated to 4% and $q_{i,a,a+t}$ is the conditional probability of dying at age $a + t$ for someone of age a at $t = 0$. These probabilities are respondent-specific. Finally, E_H is the expectation operator for the distribution of future house prices which depends on the region of the country and the type of dwelling. For the lender, the expected present value of the accumulated mortgage insurance premiums paid is given by:

$$\text{MIP}(\pi_{i,j}) = \pi_{i,j} E_H\left(\sum_{t=1}^{T} s_{i,a,a+t} \frac{L_{a+t,i,j}}{(1+i)^t}\right), \tag{5}$$

[11] According to Sun Life Financial, the transaction costs in Canada are between 3% and 7%.

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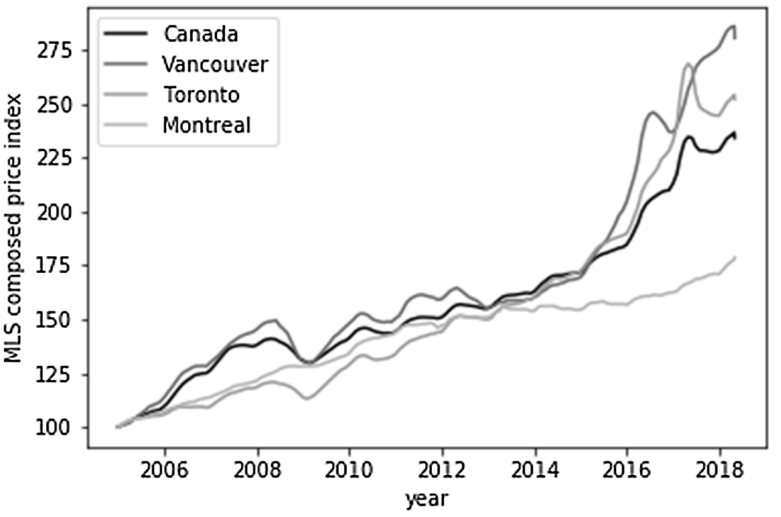

Figure 1. MLS Home Price Index for the cities of Vancouver, Toronto, and Montreal, from 2005 to 2018

where $s_{i,a,a+t}$ is the conditional probability to survive at age $a + t$ for someone aged a at $t = 0$. Finally, the actuarial fair mortgage insurance premium $\pi_{i,j}$ is such as:

$$\text{NNEG}(\pi_{i,j}) = \text{MIP}(\pi_{i,j}). \tag{6}$$

The mortgage insurance premium $\pi_{i,j}$ is the actuarial value of the NNEG guarantee for the risk profile of the respondent. The fair rate on the reverse mortgage is $r^*_{i,j} = r_{LC} + \pi_{i,j}$. To compute the value of the NNEG for each respondent and scenario, we need estimates of house price dynamics as well as survival probabilities.

We first set the interest rate of a HELOC r_{LC} at 4%, which is the average rate that was offered on the Canadian market in 2017[12]. We set the maximum loan-to-values offered by CHIP as reported in Table 1 but use the loan-to-value offered in each scenario using the randomization. We also use a constant discount rate of 4% (i) in the computations.

4.1.1 House price dynamics

We calibrate house price dynamics using the MLS Home Price Index from the Canadian Real Estate Association (CREA), which provides information on housing prices in the major CMAs in Canada. This data set provides information regarding the average price of all types of dwellings, as well as the average price per type of dwelling, namely single-family dwellings, townhouses, and condos. We used monthly data from January 2005 to August 2016 for the cities of Vancouver, Toronto, and Montreal. Figure 1 presents the evolution of the composite price index between 2005 and 2018 for all of Canada, as well as for the cities of Vancouver, Toronto, and Montreal. We see that Vancouver and Toronto are the cities that have had the most substantial growth, with an average annual growth of 6% and 6.8%, respectively, while the city of Montreal experienced an average annual growth of 3.7%. The cities of Vancouver and Toronto also demonstrate having higher variability in prices when compared to the city of Montreal. We drop the last 2 years (2017 and 2018) since the survey was conducted in 2017.

[12] https://www.ratehub.ca

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Table 5. House price dynamic estimates: This table reports estimated parameters of the house price dynamics by city and type of dwelling. SFD refers to a single-family dwelling. $\delta_{h,p}$ is the monthly deterministic trend, ρ_{h_p} is the AR(1) coefficient, and $\sigma_{h,p}$ is the standard deviation of shocks for a dwelling of type h and in city p. SFD refers to single-family dwelling. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Prov	Type	$\delta_{h,p}$	$\rho_{h,p}$	$\sigma_{h,p}$
Vancouver	SFD	0.006***	0.964***	0.023
	Townhouse	0.004***	0.988***	0.018
	Condo	0.004***	0.993***	0.018
Toronto	SFD	0.006***	0.949***	0.022
	Townhouse	0.006***	0.956***	0.021
	Condo	0.005***	0.966***	0.020
Montreal	SFD	0.003***	0.965***	0.011
	Townhouse	0.004***	0.912***	0.016
	Condo	0.003***	0.968***	0.011

We estimate parameters of the house price dynamic using an AR(1) with a deterministic trend:

$$\log H_{h,p,m} = \delta_{h,p}\ m + \epsilon_{h,p,m} \tag{7}$$

$$\epsilon_{h,p,m} = \rho_{h,p}\epsilon_{h,p,m-1} + \eta_{h,p,m}, \tag{8}$$

where $H_{h,p,m}$ is the average house price of type h, in the city p in the month m, $\delta_{h,p}$ is the deterministic trend, and $\eta_{h,p,m}$ is an idiosyncratic error term which is assumed normally distributed with an average of zero and a variance of $\sigma^2_{h,p}$. Table 5 reports estimates by type of dwelling for the cities of Vancouver, Toronto, and Montreal. In each specification, the coefficient of the deterministic trend and the autocorrelation coefficient are significant at a level of 1%. House prices exhibit behavior similar to a random walk with some degree of mean-reversion. These estimates were used to calibrate the house price risk in the provinces of Quebec (Montreal), Ontario (Toronto), and British Columbia (Vancouver). While the dynamics in house prices evolve at the monthly level, they are aggregated in simulations at the annual level (when survival and other outcomes are computed).

Using an aggregate house price index to estimate the dispersion of shocks, as we did, underestimates the volatility in selling prices, since an important component of the volatility in house prices is house-specific and likely idiosyncratic (Davidoff 2015). Since we do not have Canadian information on the dispersion of house prices within CMA, we instead resort to scaling up the standard deviation of shocks. Nakajima and Telyukova (2017) estimate using zip-code-level data a process which is similar to ours (AR(1)). They find an annual standard deviation of (log) house price shocks of 0.125. Our estimates, which vary by CMA and dwelling, are of the order of 0.06 at the annual level. Hence, we scale up the standard deviation of the shocks by a factor of 2 for our computations.

Respondents likely form their own expectations about house price growth. What do respondents expect about house price growth in years following the experiment? We asked respondents to categorize their expectation of their house's price growth over the next 5 years: more than 20%, between 5% and 20%, between −5% and 5%, between −20% and −5%, and less than −20%. Table 6 reports the distribution of subjective expectations for house price growth over the next 5 years by province. Homeowners from the province of British Columbia are those who expected a higher growth, with almost 80% of

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Table 6. Subjective expectation of house price growth over the next 5 years: This table presents the distribution of subjective expectation of house price growth over the next 5 years by province (N=2140). Statistics weighted according to the 2010 Canadian Community Health Survey (CCHS)

	More than 20%	5 to 20%	−5 to 5%	−5 to −20%	Less than −20%
British Columbia	0.190	0.603	0.163	0.035	0.009
Ontario	0.165	0.583	0.217	0.020	0.014
Quebec	0.061	0.598	0.322	0.006	0.013

them expecting a growth higher than 5%. Homeowners from Ontario and Quebec followed, with 75% and 66% expected growth higher than 5%. If we use the expected growth rates in Table 5, we obtain a 5-year expected growth rate for 43% in British Columbia for single-family dwellings and 27% for other types of dwellings. Expected 5-year growth rates are in excess of 35% in Ontario, while they are around 20% for Quebec. This suggests that a significant fraction of respondents were more pessimistic than historical house price growth at the time of the survey, in particular for British Columbia and Ontario. While there is no direct way to incorporate these expectations in the calculation of the NNEG, we will assess the role of these expectations in shaping demand for reverse mortgages.

4.1.2 Survival rates

Since respondents are likely to evaluate the NNEG using their own beliefs about survival, we exploit a question on subjective survival beliefs which has been shown to be predictive of actual mortality (Hurd and McGarry 2002). We asked respondents to provide us with the probability they will live up to the age of 85 years. To transform this into a life table, we use the structure of official life table survival risk by age and adjust those using the information in the subjective beliefs. We follow the approach used by Salm (2010) to model deviations from life table survival. Assume the subjective mortality hazard of respondent i at age a be given by:

$$\lambda_a^S(x_i) = \psi_i \lambda_a^O(x_i), \tag{9}$$

where $\lambda_a^O(x_i)$ is the individual's objective mortality hazard based on life tables (x_i correspondents to province, sex and cohort). In the survey, each respondent was asked to give his subjective probability of surviving until the age of 85 years, $s_{a,85}^S(x_i)$. We use this information to estimate ψ_i. Appendix A provides details on how we estimate this parameter. To avoid indeterminate values at the bounds, we set $s_{a,85}^S(x_i) = 0.01$ as a minimum and $s_{a,85}^S(x_i) = 0.99$ as a maximum for subjective risk responses. Based on the objective life table of individual i, it is then possible to use ψ_i and reconstruct their subjective life table using equation 9.

Table 7 reports the distribution of remaining years of life among respondents by age groups in the sample. It also reports the average remaining years of life according to the official life tables. On average, the expected number of remaining years of life is 23.4 years using the prospective life tables from Statistics Canada and 29 years using the subjective probabilities. Hence, our respondents overestimate survival to the age of 85 years.[13] There is also considerable dispersion in subjective remaining life expectancy with the 25th percentile at the age of 65–69 years expecting to live fewer than 14.8 years on average while the same number is 29.8, nearly double, at the 75th percentile.

[13] The finding that respondents overestimate at age 85 is common in many countries. While respondents tend to underestimate when the target age is set to 75, they tend to over-estimate at older ages (Hurd and McGarry 2002).

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Table 7. Expected remaining years of life: This table reports statistics for subjective and life table remaining life expectancy (N=2140). Statistics weighted according to the 2010 Canadian Community Health Survey (CCHS)

	Subjective			Life table	
Age	25th	Median	75th	Mean	Mean
55–59	28.7	33.5	38.2	34.6	29.3
60–64	22.7	27.3	33.8	29.9	24.5
65–69	18.5	23.0	29.8	25.6	20.1
70–74	14.8	19.1	27.0	22.1	15.6
Total	21.8	27.3	34.8	29.0	23.4

4.2 Estimates of the actuarial value of the NNEG

For each respondent, we first use subjective survival probabilities to generate 1000 draws of death ages which are termination probabilities for the sake of this exercise. For couples, we use the death of the last spouse alive. For spouses, we do not have subjective survival curves. Assuming life table probabilities would lead to an assumption that there is no correlation in life expectancy across spouses. Instead, we use the subjective survival curve of the respondent. Using the age of death as termination age for the reverse mortgage overestimates the duration of reverse mortgage contracts as many respondents are likely to sell their property prior to death. This should lead to an overestimation of the value of the NNEG. We then use the house price process by province and dwelling type of the respondent to generate a distribution of house prices at the time of disposition. Since mortality and house prices are independent, we assume there the decision to sell the house is independent of house prices.

Using the distribution of selling prices and the distribution of durations (time to mortality or termination), we compute both the expected present discounted value of mortgage insurance premiums and NNEG losses for the insurer. We then solve over a grid for the mortgage insurance premium which solves the zero-profit condition. We do this for each of the 2140 respondents and for each 5 scenarios. We express the estimates of $\pi_{i,j}$ in basis points (100 basis point is one percentage point).

Figure 2 shows the distribution of actuarial values of the NNEG across respondents and scenarios for two sets of assumption: the baseline scenario using house price growth estimated over the period 2005–2016 and one where annual growth in house prices (δ) is 50% lower. On average, the actuarial value of the NNEG, represented as a premium on the HELOC rate, is 31 basis points, or 0.31 percentage point. It varies substantially across the sample and scenarios with a standard deviation of 39.7, a first quartile of 13 basis points, and a 90th percentile of 86 basis points. Under the alternative scenario with lower growth, the premium is on average higher, with a mean of 77 basis points and a standard deviation of 57, a 90th percentile 155 basis points. Hence, these estimates are well below the observed premium in the market of over 200 basis points. One needs however to be careful with concluding that the observed premium is too high. We focus on house price trends in three major cities with substantial growth. If growth is much lower in rural areas, for example, this could justify higher premiums, as the sensitivity of our premium estimates to house price growth shows.

To shed light on the variation in the values we computed, we run a regression of the premium in basis point on demographics, subjective remaining life expectancy, and the amount borrowed in terms of Loan-to-Value (LTV) in the scenario. As one would expect due to the effect of mortality on the value of the NNEG, the premium decreases with age (duration lower) and is lower for males and higher for couples. The premium is higher in

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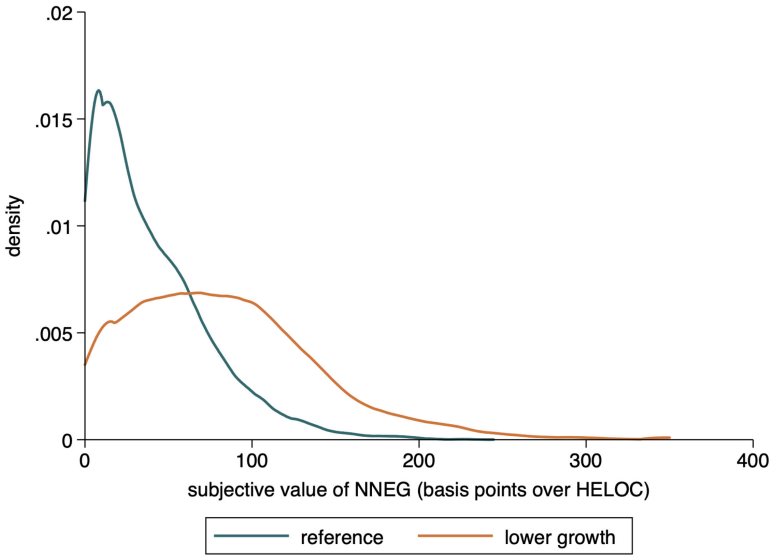

Figure 2. Actuarial Value of NNEG: Density estimate of the distribution of NNEG mortgage insurance premiums computed across respondents and scenarios (rate in excess of HELOC). The premium is reported in basis points (100 = 1 percentage point). The distribution is reported in blue for the reference scenario (with historical growth in house prices 2005–2016) and with an alternative scenario (in orange) where historical growth is half of what has been observed by dwelling type and province.

British Columbia and Ontario. The premium increases with the LTV that is granted as a reverse mortgage in each scenario.

5 Demand for reverse mortgages

5.1 House price growth expectations

Given the central importance of house price expectations, we first look at the correlation between subjective house price expectations over the next 5 years and the probability of purchasing a reverse mortgage in the scenarios presented. We use the average take-up probability over the five scenarios. If the value of the NNEG is what drives demand for reverse mortgages, we should expect a negative correlation between purchase probabilities and house price growth expectations. On the other hand, if the consumption smoothing motive is more important, we should see a positive correlation between the two outcomes.

Table 8 reports average take-up probabilities by province and house price growth expectations. For both Quebec and Ontario, there is a strong positive gradient between subjective house price growth and take-up probabilities. Those who expect the highest growth are more likely to purchase a reverse mortgage in the scenarios we presented. Hence, this would suggest these respondents are motivated by the possibility of taking advantage now of some of the home equity increase they expect to obtain in the future. It could also mean they poorly understand the value of the NNEG. For British Columbia, we do not observe such a gradient which may be due to the fact that most respondents expected substantial house price growth.

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Table 8. Probability of buying a reverse mortgage within the next year: This table presents the average probability of buying a reverse mortgage within the next year by province and category of subjective expectation on the house price growth over the next 5 years (N=2140). Statistics weighted according to the 2010 Canadian Community Health Survey (CCHS)

	Expected change in house price over next 5 years				
	More than 20%	5 to 20%	−5 to 5%	−5 to −20%	Less than −20%
British Columbia	0.059	0.052	0.050	0.064	0.000
Ontario	0.107	0.067	0.038	0.032	0.000
Quebec	0.188	0.052	0.070	0.031	0.052

5.2 Regression analysis

To understand the determinants of take-up probabilities and in particular how respondents respond to the interest rate and the fair value of the NNEG, we specify the following semi-log regression model:

$$p_{i,j} = \alpha_r \log r_{i,j} + \alpha_f \log r^*_{i,j} + X_i\beta + \varepsilon_{i,j}. \tag{10}$$

where $p_{i,j}$ is the reported take-up probability (in percentage points from 0 to 100), $r_{i,j}$ is the interest rate on the reverse mortgage in scenario j, and $r^*_{i,j} = r_{LC} + \pi_{i,j}$ is the interest rate obtained by adding to the HELOC rate of 4% the fair mortgage insurance premium computed for each respondent and scenario, $\pi_{i,j}$. The vector X_i contains a number of respondent-level characteristics, while $\varepsilon_{i,j}$ is an error term. With this specification, the interest rate elasticity of demand is given by $\frac{\alpha_r}{\overline{p}}$ where $\overline{p}$ is a fixed level of the take-up probabilities where the elasticity is evaluated (such as the mean).

The specification nests the case where $\alpha_r = -\alpha_f$ in which case we can express the choice probability as a function of the log of the ratio of the interest rate to the fair rate, a measure of the unfairness of the interest rate charged in the reverse mortgage. Davidoff and Wetzel (2014) show that consumers may have a hard time correctly evaluating the value of the NNEG and therefore the fair rate in the reverse mortgage. This would lead to the prediction of an imprecise estimate of α_f, potentially different from α_r. We can test this assumption given estimation of equation (10).

We control for a rich set of covariates from the survey, including quartiles of income, home value, and savings as well as controls for preferences as well as house price expectations. We estimate parameters by ordinary least square (OLS) using clustered standard errors at the respondent level.[14]

Table 9 reports OLS coefficients for the full sample as well specifications where we estimate parameters separately by financial literacy as well as a third group representing those who know reverse mortgages and have a high level of financial literacy.

For the full sample, the estimated interest rate elasticity is −0.823 and statistically significant. This suggest that consumers are quite sensitive to the price of reverse mortgages. In the full sample, they are however insensitive to the fair rate that represents the actuarial value of the mortgage insurance premium that covers the NNEG. The estimate is positive but statistically insignificant. Although we do not reject the equality $\alpha_r = -\alpha_f$ (p-value = 0.843), this largely reflects the imprecision of α_f. Hence, we find respondents have trouble using the NNEG as in Davidoff and Wetzel (2014). When we split the sample between those with high financial literacy (who could answer correctly all three questions) and those with low financial literacy, we observe

[14] We obtain very similar estimates by tobit regression to account for censoring at values of 0 and 100.

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Table 9. Regression estimates: The table reports coefficients estimates from OLS along with (clustered) standard errors in parenthesis. The dependent variable is the take-up probability in percentage points (from 0 to 100). The first column reports estimates on the whole sample. The second and third column report estimates by level of financial literacy. The last column reports results for the subset of those who have high financial literacy and also have prior knowledge of reverse mortgages prior to the experiment. We report below the R-squared the interest rate elasticity computed at the mean in the total sample as well as the standard error. We also report the p-value on the test for the equality of the coefficients on the log interest rate and the log of the fair rate. Statistical significance is denoted using * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	Total	High financial literacy (FL)	Low financial literacy (FL)	High FL and knowledge RMR
Log interest rate	−5.235***	−7.312***	−2.021	−9.412***
	(0.890)	(1.042)	(1.545)	(1.465)
Log fair rate	4.408	10.67**	−3.727	10.37
	(4.126)	(4.852)	(7.187)	(6.658)
Age (65=0)	−0.203***	−0.250***	−0.112	−0.216**
	(0.0587)	(0.0685)	(0.104)	(0.0892)
Male	2.622***	2.438***	2.916**	3.220***
	(0.618)	(0.687)	(1.171)	(0.958)
High school	−0.855	−2.198	0.151	−7.428
	(2.471)	(4.512)	(2.796)	(7.634)
College	−0.386	−1.412	−0.0545	−5.968
	(2.448)	(4.491)	(2.768)	(7.559)
Married	−0.971	−1.057	−1.008	−1.018
	(0.759)	(0.953)	(1.227)	(1.236)
Has kids	0.0627	0.614	−0.459	1.714*
	(0.704)	(0.819)	(1.355)	(1.009)
Non-CMA region	−0.00639	−1.540**	1.778	−0.991
	(0.667)	(0.766)	(1.172)	(1.025)
Total income (1st q)	1.872*	2.316**	1.585	1.837
	(0.966)	(1.166)	(1.648)	(1.443)
Total income (2nd q)	−0.204	−0.241	0.231	0.236
	(0.840)	(0.968)	(1.565)	(1.385)
Total income (3rd q)	0.938	0.342	2.303	0.0632
	(0.811)	(0.925)	(1.558)	(1.160)
Home value (1st q)	−0.427	−0.811	−0.366	−2.571
	(1.037)	(1.222)	(1.813)	(1.908)
Home value (2nd q)	−0.793	0.0508	−2.060	0.256
	(0.916)	(1.057)	(1.651)	(1.434)
Home value (3rd q)	−1.375*	−0.529	−2.778*	−1.143
	(0.795)	(0.926)	(1.494)	(1.155)
Savings (1st q)	2.885**	3.284**	1.290	4.546**

(*Continued*)

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Table 9. (*Continued*)

	Total	High financial literacy (FL)	Low financial literacy (FL)	High FL and knowledge RMR
	(1.204)	(1.530)	(2.128)	(2.146)
Savings (2nd q)	1.479	2.448**	−0.778	2.130
	(0.924)	(0.975)	(1.958)	(1.380)
Savings (3rd q)	−0.694	0.0502	−2.709	−0.485
	(0.717)	(0.756)	(1.685)	(0.858)
Has mortgage	2.942***	3.284***	2.750**	2.845**
	(0.688)	(0.869)	(1.112)	(1.108)
House-rich cash-poor	−1.253	−1.083	−1.161	−2.543
	(1.281)	(1.807)	(1.766)	(2.480)
Has DB pension	0.111	−0.365	1.008	−0.778
	(0.651)	(0.757)	(1.163)	(0.987)
House price: greater than 20 %	1.867*	1.321	2.819*	2.262
	(1.039)	(1.299)	(1.679)	(1.580)
House price: between 5% and 20%	1.480**	0.896	2.316**	1.776*
	(0.659)	(0.773)	(1.164)	(1.023)
House price: between −5% and −20%	−0.939	−1.094	−2.471	−1.773
	(1.282)	(1.530)	(2.191)	(1.685)
House price: less than −20%	−7.151***	−7.807***	−6.314***	−6.677***
	(1.128)	(1.595)	(1.518)	(2.078)
House only sold financial hardship	1.417**	0.493	2.685***	0.605
	(0.589)	(0.718)	(0.994)	(0.925)
Leaving bequest important	1.942**	0.716	3.121*	1.400
	(0.919)	(0.970)	(1.741)	(1.455)
Financial literacy	−0.631			
	(0.711)			
RMR knowledge	0.388			
	(0.632)			
Observations	10,700	6,440	4,260	3,605
R-squared	0.046	0.056	0.055	0.077
Interest rate elasticity	−0.823	−1.149	−0.318	−1.479
(se)	0.140	0.164	0.243	0.230
Equality interest rate	0.843	0.495	0.426	0.890

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

https://doi.org/10.1017/flw.2023.4 Published online by Cambridge University Press

that the interest sensitivity is entirely driven by those with high financial literacy. Among those, the price elasticity is −1.149 (se=0.164), suggesting a relatively high level of price sensitivity while it is −0.318 and statistically insignificant among those with low financial literacy. The difference between the two estimates is statistically significant (t = −2.89). Moreover, those with high financial literacy are more likely to purchase reverse mortgage products with a higher value of the NNEG. A 10% increase in the value of the NNEG increases demand by 1.67 percentage points. Among those with low financial literacy, the coefficient on the (log) value of the NNEG is imprecisely estimated to be negative. Hence, financial literacy appears to help respondents with the evaluation of the NNEG. In the last column, we refine even further the specification to exclude those who have high financial literacy but did not know the product prior to the experiment. Although we obtain an even larger interest rate elasticity (−1.479), we do not detect a higher sensitivity to the value of the NNEG among this group (the estimate is of similar size but more imprecise). Overall, we find that despite the lack of effect of financial literacy on average take-up probabilities, financial literacy appears to help consumers in evaluating the reverse mortgage products presented.

In terms of demographics, some differences in demand are observed. Demand appears to decrease with age and is higher for males in the full sample. The effect of age is concentrated among those with higher financial literacy and knowledge of the product, while gender differences are widespread across groups. In terms of economic resources, there is some indication that those with low savings and low income, in particular among those with higher financial literacy, have higher demand for reverse mortgages (the 4th quartile is omitted for these variables). However, there is no relationship between demand and the house-rich and cash-poor variable indicator. Therefore, there is some evidence that demand is higher among those with lower resources (both income and savings) but not necessarily the specific group of house-rich and cash-poor respondents. We find that those with an existing mortgage are more likely to purchase a reverse mortgage. In this case, they must pay first the existing mortgage with the funds from the reverse mortgage. Purchasing a reverse mortgage for these households may allow to effectively postpone mortgage payments until they sell the house (by clearing the existing mortgage and avoiding payments while living in the house). For house price expectations, we find some evidence that those who expect higher price growth are more likely to purchase a reverse mortgage. Expecting negative growth is negatively correlated with demand for reverse mortgages. However, this relationship is not always statistically significant and monotonic.

Finally, there is some evidence that households who want to stay in their house unless they experience financial hardship are more likely to demand a reverse mortgage. This is consistent with the consumption smoothing motive as those households are less willing to sell their house to finance consumption at older ages. We find that those who think that leaving money to their heirs is important are more likely to purchase a reverse mortgage. While a bequest motive should decrease demand for reverse mortgages, it is possible that these households are inclined to make *inter vivos* transfers with the proceeds from the reverse mortgage. Overall, several findings are puzzling and one interpretation is that reverse mortgages are poorly understood by respondents, in particular those with lower financial literacy.

6 Conclusion

In many countries, the take-up of reverse mortgage is low. While many factors can explain this low take-up, few studies have looked at the relationship between financial literacy and

https://doi.org/10.1017/flw.2023.4 Published online by Cambridge University Press

reverse mortgage take-up and in particular how financial literacy may change the evaluation that consumers make of reverse mortgages. Reverse mortgage products are complex, and their value arise from both a desire to smooth consumption for liquidity constrained households as well as insuring against downside risk in house prices due to the NNEG. This paper presents survey experimental evidence on the valuation of reverse mortgages by near-retirees and retirees in Canada.

We find that financial literacy is associated with better knowledge of the existence of reverse mortgages. However, we do not find a direct relationship between demand for reverse mortgages and financial literacy. Instead, we find that the interest rate elasticity of demand for reverse mortgages is negative and statistically significant only for respondents who have higher financial literacy. Furthermore, we find that these respondents are also more likely to take-up reverse mortgages when the value of the NNEG is larger. We also uncover an interesting relationship between expected house price growth and demand for reverse mortgages. Respondents who expect higher price growth appear to be more likely to demand reverse mortgages and vice versa for those who expect declines in house prices. This could suggest that the consumption smoothing motive is the value component of reverse mortgages that these respondents value the most.

These results suggest that the effect of financial literacy on some decisions goes beyond simply increasing or decreasing the likelihood of purchasing a product. In some instances, such as reverse mortgages, financial literacy may enable respondents to judge better financial products and assess their value. These results for reverse mortgages are in line with results found in other domains, where financial literacy helps consumers minimize borrowing costs (Huston 2012) or in the savings domain, obtain higher rates of return on savings (Clark et al. 2017).

The findings in this paper highlight that insurance is a hard concept for households to understand because it involves complex risk calculations. Those who are less financially literate may have a harder time with understanding insurance products. More research should be devoted to understanding how financial education may help households with insurance decisions.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/flw.2023.4

Acknowledgements. The authors thank David Boisclair, Martin Boyer, Philippe d'Astous, Amine Ouazad, Tom Davidoff and Raquel Fonseca for their input. They also thank participants of the 2018 conference of the Retirement and Savings Institute on Managing Risks in Old Age.

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A Appendix: Subjective Mortality Curve Estimation

In continuous time, let the subjective probability of surviving from age a to age 85 be given by:

$$s^S_{a,85}(x_i) = \exp\left(-\psi_i \int_a^{85} \lambda^O_s(x_i)\right), \tag{11}$$

where ψ_i is an individual level shifter. The objective probability of surviving based on the model for the same ages is

$$s^O_{a,85}(x_i) = \exp\left(-\int_a^{85} \lambda^O_s(x_i) ds\right). \tag{12}$$

https://doi.org/10.1017/flw.2023.4 Published online by Cambridge University Press

Let $\Lambda^{O}_{a,85}(x_i) = \int_a^{85} \lambda^{O}_{s}(x_i)ds$. Then,

$$\log(s^{O}_{a,85}(x_i)) = -\Lambda^{O}_{a,85}(x_i) \tag{13}$$

and

$$\log(s^{S}_{a,85}(x_i)) = -\psi_i \Lambda^{O}_{a,85}(x_i) \tag{14}$$

Dividing equation (14) by equation (13), we have

$$\psi_i = \frac{\log(s^{S}_{a,85}(x_i))}{\log(s^{O}_{a,85}(x_i))}. \tag{15}$$

Cite this article: Choinière-Crèvecoeur, Ismael, & Pierre-Carl Michaud (2023). Reverse mortgages and financial literacy. *Journal of Financial Literacy and Wellbeing* **1**, 79–102. https://doi.org/10.1017/flw.2023.4