Annuity-enhanced reverse mortgage loans

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STATEMENT OF INDEPENDENCE

ABSTRACT

This paper proposes a way to make reverse mortgage loans more attractive to both borrowers and lenders by reducing the risk that the loan balance grows to exceed the value of the mortgaged home. In particular, loan amounts would be increased at origination to purchase a life annuity. The annuity would be used to pay down principal and interest on the loan while the borrower remains in the home. This effectively transfers loan balances from long after loan origination, when the borrowers' home is likely to be worth less than the outstanding balance, to earlier dates when the home is most likely worth more than the borrower owes. Numerical examples show that the costs to lenders of limited liability may be significantly reduced by this smoothing of the loan balance across time. Lenders may thus be able to provide more cash to borrowers at loan origination while offering lower fees and interest rates. This proposal may ease a significant problem with reverse mortgage loans, which seem like a promising way to improve retirement finance but have not proven popular: borrowers may not appreciate the significant costs that limited liability imposes on lenders.

ACKNOWLEDGEMENTS

Introduction

Many seniors, particularly those with low income and net worth, hold most of their wealth in the form of home equity. Combined with a preference for remaining in their home, this means that a large fraction of their wealth may not be spent until very late in retirement, if ever. Reverse mortgage loans offer the seemingly considerable benefit of letting seniors spend home equity while remaining in their home, without the need to make payments until the home is sold. However, only a tiny fraction of retirees use reverse mortgages. The risk that accumulated principal and interest on the loan will wind up exceeding the home value appears to be an important reason for the small size of the market. By reducing that risk, a very large source of retirement finance might be unlocked.

This paper proposes a novel way of reducing lender risk by linking the reverse mortgage to a life annuity.[1] In particular, a standard reverse mortgage would be enhanced with further borrowing against the home to purchase a life annuity. The annuity income would be used to reduce the loan balance during the life of the loan. The key insight is that this annuity reduces expected losses to lenders by moving balances from the distant future, where shortfall risk is high, towards the near future, where that risk is low. Beyond possibly unfair annuity pricing, this risk reduction would come at no cost to the borrower and lender.

The Home Equity Conversion Mortgage (HECM) is the dominant reverse mortgage product in the U.S. HECM lets borrowers choose between a lump-sum advance or a line of credit. Borrowers do not need to make any payments back to the lender until they die or no longer use the mortgaged home as their primary residence, although they must continue to pay property taxes and insurance. The balance on the loan thus grows with time. Because no payments are required, borrowers with low income or poor credit have access to larger loans than they would with conventional home equity loans.

Reverse mortgages like HECM have an important limited liability feature: should the borrower's home be worth less than they owe on the loan, lenders have no recourse to the assets of the borrower or their estate. When the loan becomes due, the borrower's liability is thus limited to the lesser of the outstanding loan balance or the value of the home.[2]

The Federal Housing Administration (FHA) sets the rules for HECM loans and provides guarantees that lenders will be repaid in the event there is a shortfall between the value of the home and the outstanding loan balance. In exchange, lenders pay FHA an insurance premium of 2 percent at loan origination, and an ongoing premium of 0.25 percent on the outstanding balance through the life of the loan. The initial premium is typically taken out of the initial loan proceeds, and the ongoing 0.25 percent insurance premium comes through an increase in the loan balance. If borrowers remain in the home long enough that the loan balance grows large relative to the initial appraised value of the property, FHA buys loans back from lenders.

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1.   A more technical complement to this study that develops the proposal more rigorously is provided in Davidoff (2019).

2.   A shortfall between the home value and the loan amount due may or may not result in an adverse credit score event.

Reverse mortgages seem like a promising way to finance retirement. Hicks (2014) estimates that U.S. seniors hold $7.14 trillion of home equity. By contrast, total residential mortgage debt among seniors was $1.69 trillion, including conventional mortgage debt carried over from working years. Redfoot, Scholen, and Brown (2007) report that refinancing conventional mortgage debt (presumably to avoid the need for payments) is among the most common uses of HECM loan proceeds.

The theoretical gains to reverse mortgage loans were laid out in detail by Artle and Varaiya (1978): tapping into home equity can help smooth the consumption trajectory of a cash-poor, house-rich retiree. Building on that theoretical insight, Mayer and Simons (1994) estimated that up to 20 percent of senior Americans could benefit significantly from a program like HECM because they held such a large fraction of their resources in home equity.

Despite the potential gains, the reverse mortgage market in the U.S., as elsewhere, is disappointingly small. The Congressional Budget Office (2019) estimates that as of the end of fiscal year 2018, $111 billion of HECM credit was outstanding, for a penetration rate of 1.5 percent by value. Combining recent estimates from the Congressional Budget Office (2019), Housing Studies (2018), and Community Living (2018), there are approximately 40 million homeowners over age 65, and roughly 400,000 outstanding HECM loans, for a penetration rate of 1 percent.

The limited liability feature of reverse mortgage loans should be appealing to borrowers but may underlie a major obstacle to expanding the market. FHA incurred considerable costs paying out insurance claims in the wake of the Great Recession. Many loans were originated in markets like Phoenix and Miami near the top of the home price cycle of the mid-2000s. When prices crashed, many loans terminated with balances greater than the value of the mortgaged homes. The prospect of such losses in the future justifies the large up-front fee and ongoing insurance premium on balances. But consumers, and many economists, consider the overall costs of HECM excessive.[3] Some U.S. reverse mortgage lenders have left the industry due to the frequency of property tax defaults (Haurin et al., 2014) which lead to both financial and reputational servicing costs.

Private investors may require more compensation for default risk than the U.S. government charges through FHA.[4] For example, Canada has over 10 percent of the U.S. population and a similar home ownership rate, and so might be expected to have a similar reverse mortgage penetration rate. In Canada, the dominant product is Home Equity Bank's Canadian Home Income Plan (CHIP). CHIP is structured quite similarly to HECM in that it offers reverse mortgage loans in lump sum or planned withdrawal payout options. CHIP, though, has only roughly 3 percent of the outstanding balances of HECM loans. A notable

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3.   Caplin (2002) and Lucas (2015) discuss the challenges related to high costs (the latter study recognizes, but comes to a similar conclusion regarding, consumer valuation of put options as expressed in the text above.) Up-front fees are much larger than for conventional home equity loans.

4.   HECM loans were originated in largest numbers in neighborhoods where the 2000s home price boom and bust cycle was most severe (Davidoff, 2014). As a result, the FHA, which guarantees lenders that they will be repaid in full, faced extremely large losses. The picture has brightened since then, but by how much depends on modeling assumptions. Contrasting views on the actuarial picture can be found in Congressional Budget Office (2019) or the FHA 2016 actuarial report (Integrated Financial Engineering Inc., 2016).

difference in reverse mortgage lending environments between the two countries is the absence of federal insurance of reverse mortgage loans in Canada. CHIP offers lower loan sizes than HECM and higher interest rates.[5]

Two "moral hazard" problems associated with reverse mortgage loans add to the cost of insuring against losses. First, if the borrower believes that the home is likely to be worth less than the outstanding balance, it will be in their interest to undermaintain the home, and poor seniors generally are likely to undermaintain their homes.[6] Second, a large fraction of seniors move out of their homes while alive, but once the home is worth less than the outstanding loan balance, there is no incentive for seniors to move.[7] Reducing the likelihood that the value of the home will be less than the loan balance when the loan terminates would make these issues less problematic.

While lenders, investors in reverse mortgage backed securities, and insurers must all recognize the risk of limited liability, there is considerable evidence that borrowers do place much value on the benefit they may derive from borrowing more than the value of their eventual repayment. Davidoff (2012) shows that for many years of the life of HECM the value of the "put option" to repay with the value of the home rather than the outstanding loan balance was worth more than the up-front insurance costs of the loan. That is, even ignoring any benefit to being able to borrow against one's home, HECM was *underpriced* for its limited liability feature in many parts of the US. It is exceedingly difficult to rationalize demand for a better-than-fairly priced asset that enhances older homeowners' liquidity (unlike life annuities) and provides insurance against rising interest rates, home prices, and longevity.[8]

Further evidence of consumer disinterest in the ability to repay lenders less than they owe at the date of loan termination comes from a study of HECM borrower use of credit lines. Davidoff and Wetzel (2013) show that borrowers who had credit lines (a common form of HECM loans) were not prone to draw on these lines shortly before terminating loans, even when those credit lines had limits greater than their property value. A "ruthless" borrower would seek to exhaust a credit line in excess of property value, as any borrowing above mark-to-market property value is free money absent lender recourse to borrower assets. The *ex-post* failure to exploit this feature of HECM loans strongly suggests an *ex-ante* disinterest in that feature.

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5. Canada and other countries without may also have fewer homeowners with the extremely high ratio of home equity to other wealth that appears to trigger HECM demand. HECM debt may have been deductible for some borrowers in the past, but recent tax reforms have taken away deductibility for home equity extraction loans.

6. See Miceli and Sirmans (1994), Shiller and Weiss (2000), Davidoff (2004), and Capone, Chang, and Cushman (2010).

7. See Davidoff and Welke (2006).

8. Since loan proceeds and the benefit of the option to "default" on the mortgage debt can be transferred to heirs, bequest motives are not a satisfactory explanation. An underrated point in favor of reverse mortgage loans is the ability to refinance heirs' high interest rate debt. A conjecture is that only a very small fraction of low-income U.S. seniors do not have liquidity-challenged loved ones who would benefit from the collateralized lending that HECM provides.

That seniors would not put much weight on the put option feature of limited liability is not surprising. Many authors have questioned seniors' (and other Americans') basic financial sophistication.[9] The put option embedded in HECM cannot even be valued using the standard option value methodology employed by financial economists, because the risk involves all of mortality, mobility, and home price risk. Both borrower mobility and individual home price appreciation are subject to borrower behavior that itself is subject to change based on the value of the put option. That is, borrowers have less incentive to move or to maintain their homes when they are likely to owe more than their homes are worth. Of course, difficulty in computing the value of a financial asset could lead to over- or under-valuation. But seniors may find the idea of taking on a loan with the purpose of exploiting even an understood default option odious. There is considerable evidence that consumers do not "ruthlessly" exploit default options in both the conventional and reverse mortgage markets.[10]

Reverse mortgage borrowers appear to be reluctant to exploit the implicit put option embedded in HECM through strategic credit line use, but that does little to offset the cost of shortfalls between collateral value and mortgage debt to lenders and particularly FHA. This is for several reasons. First, most borrowers exhaust their credit lines early, and so their balances have been maximized independent of a desire to exploit limited liability. Second, whether due to rising home equity or rising put option value, HECM market share was highest near the peak of the 2000s home price cycle in the markets with the largest *ex-post* price busts. Third, generous refinancing terms exacerbated a propensity for borrowers to exit the home when prices are rising but stay longer while prices are declining. These behavioral choices by borrowers to act in a way that increases risk to lenders may all be made without any thought being given to the put option value.

Lucas (2015) comes to the conclusion that making reverse mortgage loans less risky would be a natural way to expand the market. Facing less risk, insurers and lenders can charge lower fees and interest rates, providing consumers with a benefit at little perceived cost. A critical challenge is how to do so without further whittling away at consumer demand with smaller loan sizes.

Life annuities and reverse mortgage loans

One way to make reverse mortgages less risky is to link them to life annuities in a way similar to older fixed-debt reverse annuity mortgages. In the 1970s, reverse mortgage proceeds were commonly converted to life annuities, and called reverse annuity mortgages (RAMs).[11] Some RAMs featured rising balances as annuity payments were made to the borrower, akin to a HECM credit line. Some, however, were fixed-debt reverse annuity mortgages. Fixed-debt RAMs use a mortgage loan on the home to purchase a life annuity for the borrower. The payments are split between the borrower and the lender, with the borrower

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9. See Lusardi, Mitchell, and Curto (2009).

10. See Foster and Van Order (1984), Vandell (1995), Bhutta, Dokko, and Shan (2011).

11. Reverse mortgages are still sometimes referred to as RAMs. In the past, HECM and the Canadian Home Equity Plan have offered annuitized payouts, although they have not proven popular. In places such as France, annuitized payouts are common.

receiving the difference, attributable to the mortality premium annuitants receive in exchange for the loss of principal upon death. The key difference with the proposal below is that the mortality premiums until death would be available to the borrower as a lump sum at the date of mortgage origination as proposed, and the rest of the loan proceeds need not be annuitized.[12]

Life annuities pay annuitants a rate of return on invested principal benchmarked to some asset such as Treasury bonds, with an additional amount paid out as a mortality premium. The mortality premium reflects the fact that the insurer providing the life annuity retains the invested capital at the annuitant's death rather than returning it to their estate. Essentially, life annuities take money from people who die young and give it back to those who live a long time, and thereby transfer money from early retirement to late retirement.

The modification proposed here to existing reverse mortgage loans is to require an additional amount be borrowed at loan origination. That amount would fund the purchase of a life annuity for the borrower (a joint life annuity that pays until the last member of a couple dies in the case of a married couple of borrowers). The cash flow from the life annuity would be paid to the lender as long as the borrower is alive and, in the home, and those payments would go to paying down principal and interest on the reverse mortgage, so that the balance would grow at a slower rate than standard reverse mortgages do. If the borrower moves out of the home before they die, the annuity payments would revert to the borrower/annuitant until death.

Table 1 describes features of the proposed product innovation.

Table 1. Policy Proposal versus Status Quo

Feature	Status Quo	Annuity Enhancement
Loan interest rate	Spread above riskless as "insurance"	Lower spread
Loan balance growth	Rapid	Slow
Initial loan size	Smaller	Larger
Initial cash proceeds	Same	Same
Annuity	None	Mandatory
Annuity proceeds while:		
* alive and in home	None	Go to lender
* alive and out of home	None	Go to borrower
* dead	None	None
Value of limited liability:		
Early loan years	Lower	Higher
Later loan years	Higher	Lower

Davidoff (2019) shows that there is a natural link between reverse mortgages and life annuities. The value of a home owned by a senior can in theory be separated into two parts: (a) the benefits that the current owner would derive by remaining in the home for the remainder of their life plus (b) the benefits that accrue to all subsequent owners. Part (a) is roughly equal to the discounted value of the net operating income (rent minus expenses . . .

12. Fixed-debt RAMs are discussed in Cowan and Foley (n.d.).

like property taxes and maintenance) that the owner could receive if they rented their home to someone else. This flow of benefits will be larger the longer the owner's life and could be funded by a life annuity with payouts indexed to the property's net rent. Part (b) should be the maximum that a reverse mortgage lender could possibly lend: no matter how high the interest rate a lender charges, the most they receive is the value of the borrower's home at any future date, and that future value must be discounted back to the present. When interest rates are lower, the borrower is older, and expected price growth is greater, part (b) is large, and a large reverse mortgage loan is feasible. When interest rates are high, the borrower is young, and expected price growth is low, part (a) is large, and the feasible immediate reverse mortgage proceeds are smaller.

Fixed-debt RAMs operated in a way that highlights the link between (a) and (b). The entire loan amount was annuitized, with annual interest on the amount going to the lender so that the balance stayed constant. The remaining part (from the mortality premium component of annuity returns) was paid to the borrower. For a 100 percent loan-to-value (LTV) reverse mortgage on a property with a value expected to remain constant, the interest payments correspond to part (a) of property value above, and the mortality premiums going to the borrower represent part (b).[13] As an example, consider a 5 percent interest rate, a $100,000 home, and a borrower who will certainly die in exactly 15 years. The cost to fund part (a), which would pay $5,000 per year for 15 years, would be approximately $51,900. The remaining approximately $48,100 could go the borrower as a lump-sum or immediate life annuity.

Fixed-debt RAMs have not proven popular, likely because reverse mortgage borrowers very strongly prefer cash in the present to cash in the future.[14] However, there is no reason why part (b) of value, the feasible reverse mortgage loan amount, could not be provided as a cash lump sum, while part (a) is annuitized and paid to the lender as long as the borrower is in their home.[15]

Generalizing beyond the case where the mortgaged property's value is expected to remain constant over time, a retiree owner could receive amount (b) as cash through a standard reverse mortgage, with no repayment due until repaid at the earlier of death or a move out of the home while alive, with the part of value representing part (a) pledged to the lender. If g is the rate of home price growth and r the lender's discount rate, an annuity paying the initial home value times $r - g$ in each period would preserve a 100 percent loan-to-value ratio at all dates.[16]

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13. This is an exact decomposition of value if the net rent on the property is always equal to the required rate of return.

14. See Haurin et al. (2014) and Davidoff and Wetzel (2013).

15. This is the central insight of Davidoff (2019).

16. $r - g$ would be a natural "capitalization rate" or ratio of net rental income to property value if price growth were a constant at rate g. To see this, note the rent-mimicking annuity payment is a constant fraction of the value of the home, because it is assumed to grow at the same rate as the home. The loan amount in this case grows by rate r from one period to the next, but the annuity then pays the lender $r - g$ times the value of the home. Thus, the net growth rate of the loan balance is g, the same rate as growth of the home. This stylized loan thus always has an LTV of 1.

Fixed-debt RAMs are an old example of product design similar to that proposed here: life annuities were used to keep the loan balance from rising too quickly (as well as to provide regular payments to the borrower/annuitant). More recently, FHA has imposed rules that approximate the mandatory annuity for some borrowers.

In the wake of the Great Recession, HECM borrowers began defaulting on property tax and insurance obligations in remarkably large numbers (Haurin et al., 2014; Begley et al., forthcoming). Triggered by this problem, FHA began requiring that borrowers with low incomes or poor credit scores use a portion of loan proceeds to fund a Life Expectancy Set-Aside (LESA). That set-aside is placed into an account that grows with time and can only be used to fund property tax and insurance payments, although there is limited protection against longevity.[17]

Absent LESA, borrowers unable or unwilling to make property tax or insurance payments effectively borrow against the HECM to finance these required payments.[18] In this way, LESA is a portion of the loan amount used to reduce the growth in the outstanding balance of the loan. LESA is unlike the proposed life annuity enhancement, in that the payments do not affect normal interest accrual on the loan and provide imperfect longevity insurance at the loan level.

The annuity enhancement has an advantage over LESA in the eyes of a borrower who very strongly prefers cash today to a similar amount of money in the future. Whereas LESA reduces the cash available from a fixed loan amount, the proposed annuity enhancement subtracts risk by adding to the initial loan amount, leaving cash proceeds available to the borrower no smaller than without. Indeed, if this annuity reduces the value of limited liability, initial fees taken out of proceeds may be smaller, leaving the borrower with more up-front cash available.

The annuity enhancement transfers balances from late to early

Figure 1 plots the loan-to-value ratio over time of three reverse mortgage loans. The first, plotted in circles, represents a standard HECM-type loan, originated at an interest rate of 4.5 percent and an initial loan-to-value ratio of roughly 75 percent (this LTV ratio allows for exactly zero profit, and is greater than for a standard loan, because resale value is assumed riskless in this example). Home price appreciation is assumed to be 2 percent per year. The loan-to-value ratio grows with time, and the loan balance due "crosses over" the property value roughly 12 years after origination because the interest rate exceeds property appreciation.

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17. This is described in FHA HECM Mortgage Letters 2014-21 and 2015-09. Upon the loan's termination, LESA reverts to borrowers, undoing true annuitization.

18. Servicers must make property tax and insurance payments on behalf of borrowers and add the amount to the balance.

The dashed line represents the loan balance if in addition to the 75 percent mortgage loan, the borrower is compelled to purchase a life annuity growing at the inflation rate, and priced actuarially fairly for a 72-year-old woman (based on 2019 Social Security Administration life tables) with the remaining approximately 25 percent of pledgeable collateral. In that case, the annuity proceeds are paid out to the lender as long as the borrower is alive and in the home. Those payments reduce the outstanding loan balance relative to the accrual of the standard reverse mortgage. After any move while alive, the annuity reverts to the borrower. We see that with a constant real annuity (the dashed line), the loan-to-value ratio is constant at 100 percent, so the loan is never "underwater." A constant nominal annuity, with a higher initial payment, but no payment growth, generates loan-to-value ratios over time that are intermediate between the other two cases, but closer to the real annuity. The loan balance with a constant nominal annuity is plotted in a solid line.
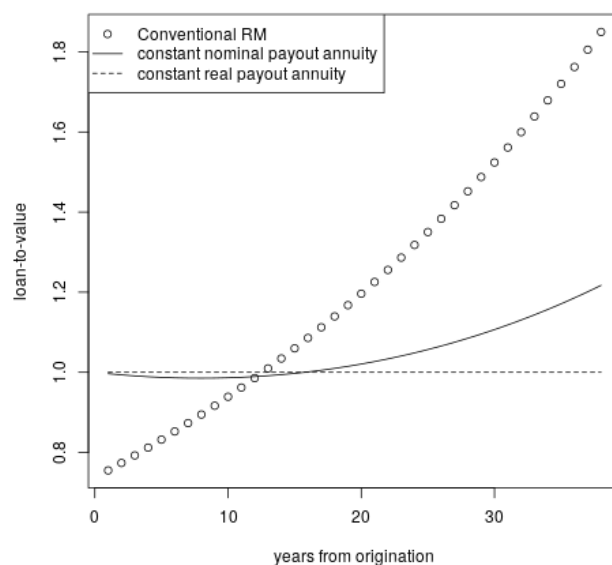

Figure 1. Loan-to-value ratios over time for three reverse mortgage loans: A conventional Home Equity Conversion Mortgage-style loan (circles), an annuity-enhanced loan with real payouts (dashed line), and a nominal annuity-enhanced loan (solid line). Top panel: 74 percent initial loan-to-value, 26 percent annuity enhancement. Bottom panel: 55 percent initial loan-to-value ratio, 22.5 percent annuity enhancement

The key feature of the mandatory annuity can be seen by comparing the time pattern of the loan balance with and without an annuity paid to the lender while the mortgage is in force. The loan balance is shifted from late in the loan's life, when the balance is large relative to the property value to early in the loan's life, when the home would be worth more than the loan balance, absent the annuity.

In the example of Figure 1, homes grow with certainty at the rate of inflation, and lenders demand a spread of 2.5 percent above inflation to invest in a safe reverse mortgage loan, reflecting, in theory servicing costs and a lack of liquidity relative to riskless bonds. In the

current interest rate environment, that would likely be a relatively high spread.[19] In reality, home prices are uncertain, so lending cash in the full feasible amount of roughly 75 percent LTV at origination would likely not be desirable. In this case, it might also be desirable to make the annuitized debt (Part b) less than the remaining home value.

The bottom panel of Figure 1 repeats the plotting exercise with a conventional reverse mortgage, a nominal annuity-enhanced reverse mortgage, and an inflation-adjusted annuity-enhanced reverse mortgage. In this case, the initial cash proceeds given to the borrower is only 55 percent, roughly what a 75-year-old borrower can currently attain from HECM, and of the remaining 45 percent of home value, only half, or 22.5 percent are dedicated to annuity payments to the lender during the life of the loan. The assumptions from the top panel: 2 percent price growth, and a 4.5 percent interest rate, are retained. While the loan balance now grows with time even with the real annuity enhancement in place, the original pattern emerges. Loan balances are made higher at the start of the loan by the borrowed annuity, but lower later when the risk of the balance exceeding the collateral value is greater.

Risk and incentives: Date of termination and maintenance

The loan amount in Figure 1 was determined as the maximal loan available when the borrower always moves out of the home while alive at the rate of mortality plus 30 percent. That 30 percent is an actuarial assumption based on historical average mobility rates among older seniors.[20] From the lender's perspective, however, it would be better if borrowers remain in their home for longer than average when prices are rising rapidly, as the lender earns a spread over their cost of capital as long as the terminal loan balance is below the home price. By contrast, when price growth is low or negative, to avoid losses, lenders would prefer borrowers leave their homes more quickly. Unfortunately for product design purposes, incentives for the borrower work the opposite way.

For "underwater" HECM borrowers, whose homes are worth less than their loan balance due, there is a financial disincentive to move that would not exist without debt: selling the home generates no cash inflow and requires the payment of rent or living with relatives. Thus, terminations are likely to be little above population mortality rates among borrowers close to or past the "crossover" date (roughly age 82, 10 years past origination in the figure). This disincentive to move represents a moral hazard contracting problem: moving is in the lender's interest, but the reverse mortgage contract provides the borrower a financial

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19.   [19] See Stumberger (2016).

20.   See Szymanoski, Enriquez, and DiVenti (2007) and Davidoff (2012).

disincentive to move even in settings when they would have found it optimal to move without the loan in place (e.g., if they would modestly, but not very strongly, prefer a move).[21]

Because the life annuity enhancement reverts to the borrower after they move while alive, there is always a modest financial incentive to move in the proposed annuity-enhanced loan structure. In fact, under one natural assumption about asset pricing, the benefit of moving out of the home is the same with the annuity-enhanced reverse mortgage in place as it would be with no debt on the home.[22] Thus the life annuity enhancement should not only reduce the severity of losses to lenders through the reduction in loan balances late in the loan's life, but also by shortening the duration of loans when price growth is low.

Just as crossover of loan balances above property value provides borrowers with distorted incentives to remain in their homes, it also may remove incentives to maintain the property. If a borrower perceives that the property is likely to be worth less than the loan balance when the loan terminates, it may make better sense to let the home deteriorate over time rather than spend money on maintenance and improvements. The annuity enhancement could improve incentives this way. The net impact of the annuity enhancement on maintenance is not as clear as the impact on moving out while alive, because the loan balance starts at a higher level, so large repairs could become less attractive earlier in the loan's life if more attractive later.

Property value and interest rate risk

In the example of Figure 1, the property value grows at a constant rate and the lender's cost of capital is known in advance. Realistically, interest rates vary over time and property values grow differently over time both across and within housing markets: prices in metropolitan Washington, D.C. might grow differently from those in San Antonio, and prices in Silver Spring might grow differently from those in Bethesda.

Figure 1 thus really only shows the loan-to-value ratios under one particular path of prices and interest rates. There is no guarantee that the home value will equal the outstanding loan balance under the annuity-enhanced loan, and the crossover date for the standard loan might come earlier or later than as plotted. Thus, the apparent benefit of avoiding crossover problems associated with the annuity enhancement in the later years of the loan's

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21.   See Davidoff and Welke (2006).

22.   That occurs if the value of the home follows a "Gordon growth" rule. If rent on a home is equal to the lender's cost of capital r minus the growth rate of rents and prices g, a net rent of $r - g$ times property value is then equal to the annuity enhancement's payout rate. In that case, selling the home provides the owner with an annual benefit equal to the net rental value of owning the home. As without any reverse mortgage debt, with the annuity-enhanced reverse mortgage, the borrower moves if and only if the effective cost of living elsewhere exceeds the annual rental flow.

life may be matched by exacerbating such problems in the early years of the loan's life. Which effect is larger is a numerical question.

To illustrate how the annuity enhancement affects the likelihood of a loan terminating with a shortfall, Figure 2presents the probability over time that a loan lasts to a particular date (the solid line). The dotted and dashed lines now represent the LTV over time in a bad state of the world where prices remain constant nominally rather than growing with inflation, with the dots representing LTV with no enhancement, and the dashed line representing the annuity-enhanced loan. This loan, made to a 72-year-old woman who terminates her loan (regardless of prices for now) has a loan-to-value ratio at origination of 55 percent and an interest rate of 4.5 percent, with price appreciation expected to equal 2 percent per year. Recognizing that the large increase in near-term loan-to-value ratio from the annuity-enhancement introduces risk, in this case only 50 percent of the difference between the initial loan and 100 percent (22.5 percent, or half of 45%) is invested in a real annuity enhancement as in the bottom panel of Figure 1.
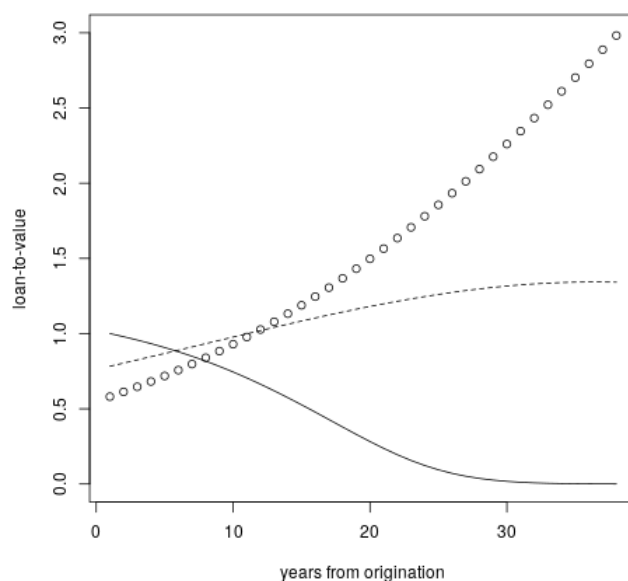

Figure 2. Probability that (loan-to-value insensitive) borrower remains alive and in their home and to each date past origination (at 1.3 times female mortality exit rate) and loan-to-value ratio when prices are constant rather than growing at inflation of 2 percent. Circles are LTV with no annuity enhancement. Dashed line is with 50 percent annuity enhancement.

Figure 2 displays the risk horse race: the annuity-enhanced loan is at risk of higher loan-to-value ratios than the conventional reverse mortgage early after the loan is taken on, when the loan is most likely to remain active. Larger losses are concentrated in later years of the loan's life. The risk to lenders (to FHA as insurer in the case of HECM) in expectation is the product of any shortfall between the outstanding loan balance and the value of the home multiplied by the probability that the loan terminates at a given date. Davidoff (2019)

presents calibrations that aim to determine whether annuity-enhanced reverse mortgage loans are safer than conventional loans once price risk is incorporated.

The appendix to this paper describes calculations from Davidoff (2019) that calibrate the improvement or harm to different extents of annuity enhancement to reverse mortgage loans of different levels of risk. The value of the annuity enhancement in reducing loan risk appears to be economically significant. In what might be characterized as an intermediate case, an interest rate-price growth spread of 2.5 percent and volatility of 5 percent,[23] for a 65 percent loan-to-value loan, the cost to the lender of the option to pay back with the home rather than the full outstanding balance, falls from roughly 4.8 percent to 3.0 percent moving from zero to 70 percent annuity enhancement before flattening with increased enhancement. One way to interpret this difference is that the lender could rebate 1.8 percent of the loan amount, roughly the magnitude of the entire up-front FHA loan insurance premium to the borrower, if this annuity enhancement were put in place.

Who benefits from annuity enhancement?

We have seen that annuity enhancement of reverse mortgages reduces the expected losses to lenders. This should make originating these loans more appealing to lenders concerned about reputational and servicing costs associated with shortfalls between property value and the loan balance when the owner moves or dies.

For consumers, there are one or two benefits. First, the reduction in limited liability costs to lenders should result in lower fees and interest rates. Given seniors' apparent disinterest or difficulty in valuing the benefits of limited liability, this should make reverse mortgage borrowing more appealing. Second, the annuity income from the loan enhancement reverts to the borrower upon any exit from the home while alive. Voluntary annuitization rates are low, suggesting that potential reverse mortgagors would not value the borrowed portion as much as they would cash, but many economists believe that rational consumers would annuitize more of their savings than most retirees actually do.[24] The "nudge" toward annuitization might be particularly effective given that the non-reverse-mortgaged portion of home equity would be deferred until sale from the borrower's perspective, so impatience would not necessarily argue against annuity enhancement. Indeed, three papers in this

. . .

23. Between 1979 and 1989, the mean difference between the 1979 10-year treasury yield and home price appreciation was 3.9 percent per year in the panel of U.S. metropolitan areas surveyed in the Federal Housing Finance Agency repeated sale home price index. In the decades starting 1989, 1999, and 2009, that gap was 5.5 percent, 0.2 percent, and 0.8 percent respectively. The standard deviation across metropolitan areas by decade were: 3.0 percent, 1.8 percent, 1.5 percent, and 1.5 percent. There is also variation in home price performance across decades within metropolitan areas and within decades and metropolitan areas across individual borrowers. The values cited above are intermediate among the values calibrated in Davidoff (2012).

24. See Brown et al. (2017).

series explore ways in which annuities can be designed to make them more appealing to retirees: Baily and Harris (2019), Hurwitz (2019), and Horneff, Maurer, and Mitchell (2019).

The small sizes of the reverse mortgage, long-term care insurance, and life annuity markets represent a long-standing "holy trinity" of retirement finance puzzles to researchers, insurers, and policymakers. Home equity is a very large fraction of retirement wealth for households in the lower middle of the income distribution and is commonly not spent until late in retirement if at all;[25] the need for long-term care is a very large expenditure risk, and longevity uncertainty presents a significant obstacle to planning retirement savings and consumption.[26] In the last quarter-century, researchers have devoted considerable attention to the way the absence of any one of these three actuarial markets can lead to absence of demand for another. For example, absence of a reverse mortgage and holding most wealth in illiquid home equity can undermine demand for annuities or long-term care insurance. This is because home equity is typically only extracted at very old ages or upon entry into a nursing home. Home equity may thus represent a (highly imperfect) substitute for insurance against longevity or the need for long-term care.[27]

One might ask whether it is fair to the borrower to require them to purchase an annuity that is paid to the lender. However, as long as the LTV is less than 100 percent, the net proceeds from sale upon loan termination to the borrower or their estate are unaffected by the annuity. Annuity enhancement benefits the lender only, and not the borrower, in states of the world where the loan would have terminated with negative equity without the enhancement. As indicated in the Appendix, however, the reduced cost of losses to limited liability will presumably be passed on to the borrower in the form of lower fees or interest rates. As with any annuity product, there is a transfer from the estates of borrowers who die young to the estates of those who live a long time: the former receive less home equity upon sale than they would otherwise. The latter receive more benefits from lower interest costs, possibly greater home equity in late retirement, and annuity payments after any move while alive.

Summary

Both the theoretical promise and risks and associated moral hazard and adverse selection problems with reverse mortgages were put forward around the inception of the HECM . . .

25. See, e.g., Venti and Wise (2001) and its many successors.

26. Yaari (1965) provides the classic reference on the role of life annuities in retirement finance.

27. Artle and Varaiya (1978) show how illiquid home equity undoes key results in Yaari (1965) regarding annuitization. Essentially, both owner housing and life annuities provide large payouts late in retirement and can be substitutes for that reason. Turra and Mitchell (2004) and many others have argued that because annuities are illiquid, stochastically arriving long-term care insurance costs may undo demand for annuitization. Davidoff (2009) shows that home equity may not only substitute for annuities and long-term care insurance absent revere mortgage lending but may also render life annuities and long-term care substitutes rather than complements.

program in the 1980s. The housing price bust of the Great Recession showed that these problems were all too real. Many loans "crossed over," and borrowers in that situation appeared to have lived in high-risk submarkets, undermaintained their homes, and stopped moving out while alive, exacerbating the losses to FHA and the servicing costs to lenders. At the same time, evidence discussed above suggests that borrowers do not place much value *ex ante* on the limited liability protection against home equity declines provided by reverse mortgage loans, even though borrowers often terminate loans and enjoy limited liability *ex-post*.

A natural way to reduce put option costs is to offer smaller, but lower-cost loans, such as the HECM Saver or the Canadian Home Income Plan. However, no reverse mortgage program has proven as popular as analysts hoped. Indeed, HECM originations have been persistently lower than during the 2000s home price boom since 2014 reforms reduced loan-to-value formulas to reduce the value of limited liability.

An alternative way to protect lenders against losses is to build upon the Life Expectancy Set-Aside approach in HECM and the fixed-debt reverse annuity mortgages of the past. Using additional loan proceeds to purchase an annuity enhancement that must be used to make payments on the loan while the borrower is alive effectively transfers loan balances from dates in the distant future when the balance is likely to exceed property value to early dates in the loan's life where there is room beneath property value for a higher balance. In a world with no uncertainty, a full annuity enhancement that brings the total loan-to-value ratio to 100 percent can provide an equal initial loan size to borrowers as a loan with an arbitrarily high interest rate. The difference is that the borrower gets deeper and deeper underwater with the latter loan over time, but equity remains at zero in perpetuity with the former.

Numerical simulations reveal that under realistic degrees of price or interest rate uncertainty and borrower mobility moral hazard, partial annuity enhancement dramatically reduces limited liability value relative to a standard contract like HECM. A natural set of parameters shows that the expected "put option" costs falls from 4.8 percent to 3 percent of loan proceeds, a decline almost equal to FHA's up-front HECM mortgage insurance premium with an enhancement of roughly half the possible size. In the same setting, the required annual mortgage loan spread to preserve profitability falls from 40 to 12 basis points per year holding the up-front fee constant.

The annuity enhancement has additional benefits: by providing the borrower with annuity payments after exit from the home, the borrower's incentives to move if they need care are not artificially diminished by negative equity, as they are under the traditional reverse mortgage structure. Similarly, incentives to undermaintain are attenuated by the slower balance growth. By some economists' reckoning, by providing a "nudge" for a low-income and low-wealth group to annuitize home equity, the annuity enhancement would provide further benefits. Finally, some would argue that an expanded reverse mortgage market has an additional benefit of improved community stability by allowing seniors to remain in homes in which they lived during their working and child-rearing years.

Appendix

Calculations of the value of limited liability and break-even interest rates for reverse mortgage loans with and without annuity enhancement (Davidoff 2019).

Each panel in each of Figures 3 and 4 figure represents a combination of (a) the wedge (always assumed positive) between investors' required rate of return (labeled "rate"), and the standard deviation (labeled "sd") of the annual differences between that discount rate and price appreciation. Each line within a panel represents a different loan-to-value at the date of origination to a 72-year-old female facing mortality given by the U.S. Social Security Administration Life Tables. Unlike in Figures 1 and 2, the borrower in each case moves in a way designed to capture the negative empirical correlation between moves while alive and loan-to-value ratios described in Davidoff and Welke (2006).

Figure 3 shows how the cost to lenders of limited liability (the "put option" described in Davidoff, 2012), the expected discounted positive difference between loan amount due and property value, varies for each loan-to-value ratio at origination as the annuity enhancement varies from zero to 100% of the difference between the property value and loan amount. For example, for 60% loan-to-value at origination, a 50 percent annuity enhancement on the horizontal axis represents 50 percent $\times$ [$1 - 60$ percent] = 20 percent of property value. In each case, the interest rate on the loan is set to the rate at which profits to the lender are zero in expectation, inclusive of a 2 percent up-front fee (set to match FHA's up-front insurance premiums).[28]

As a matter of calibration, the annuity enhancement is assumed to be invested in a real riskless security at the investors' required rate of return r,[29] with the payout subjected to a 5 percent load, a moderate to low level for single women.[30]

Consistent with the basics of option valuation, the put option value granted to the borrower by the lender grows as the discount rate-price growth wedge increases (moving from the first to second column), and as the standard deviation of returns grows (moving down each column). However, the reduction in option value associated with the annuity enhancement
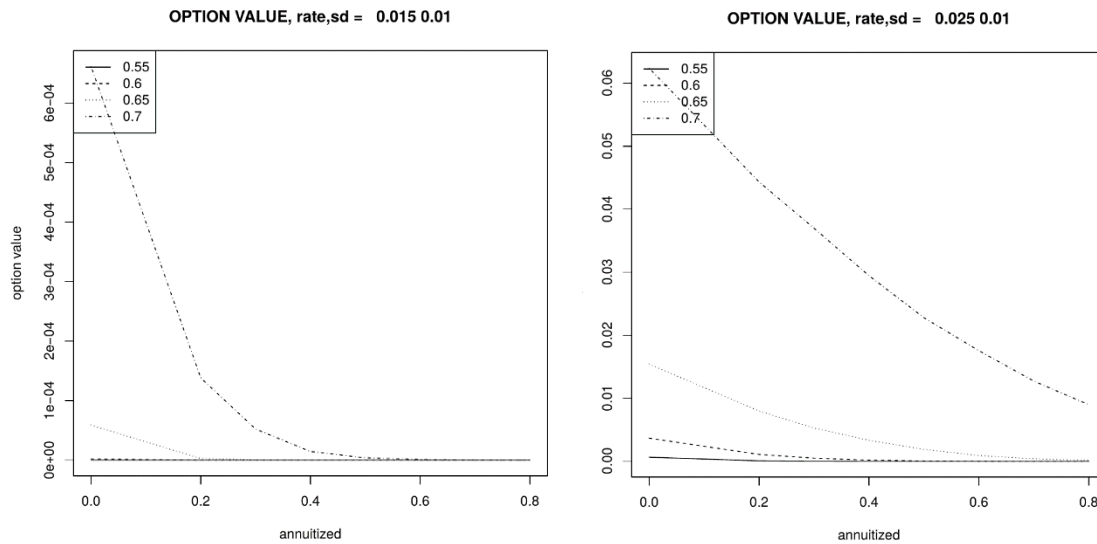
. . .

28. A larger up-front premium is more attractive from a risk management perspective than an interest rate spread (because the spread induces high loan-to-value ratios and disincentives to sell); however, potential borrowers are inherently impatient to spend home equity, so fully loading insurance on an up-front premium may not be desirable.

29. The reverse mortgage loan interest rate is higher to account for loan default risk.

30. See Mitchell et al. (1999). Annuitization could occur at the pool level, avoiding adverse selection costs to generally poorer and presumably shorter-lived reverse mortgagors and possibly introducing a higher investment rate. The risk impacts of such pooling would be complicated – losses were greatest in low-income areas to HECM in the Great Recession. A "tontine"-type payout within a pool might or might not be superior to a constant growth rate.

depends in a somewhat complicated way on the extent of the annuity enhancement, the gap between the rates of interest and appreciation, and the volatility of that difference.

In all cases, some annuity enhancement reduces the shortfall option costs. When there is almost no volatility, we are close to the baseline case where the annuity enhancement eliminates the possibility of a shortfall, so it is not surprising that the percentage change in option losses appears to be largest with low volatility (the first row of each column). Because the magnitude of expected losses is quite low with low volatility, however, larger absolute reductions in losses may be found in cases with higher volatility. At sufficiently high levels of annuity enhancement in the scenarios with high volatility, further enhancement, by increasing loan-to-value ratios early in the loan's life, can increase option value.

Figure 4 repeats the exercise in Figure 3, but the vertical axis now measures the necessary spread above the investors' discount rate required to recover enough interest to make up for the option cost. In the same intermediate case described above, the required rate spread falls from 40 basis points to 12 basis points. The analogous empirical rate is the Federal Housing Finance Agency (FHFA)'s mortgage insurance premium of 50 basis points per year.
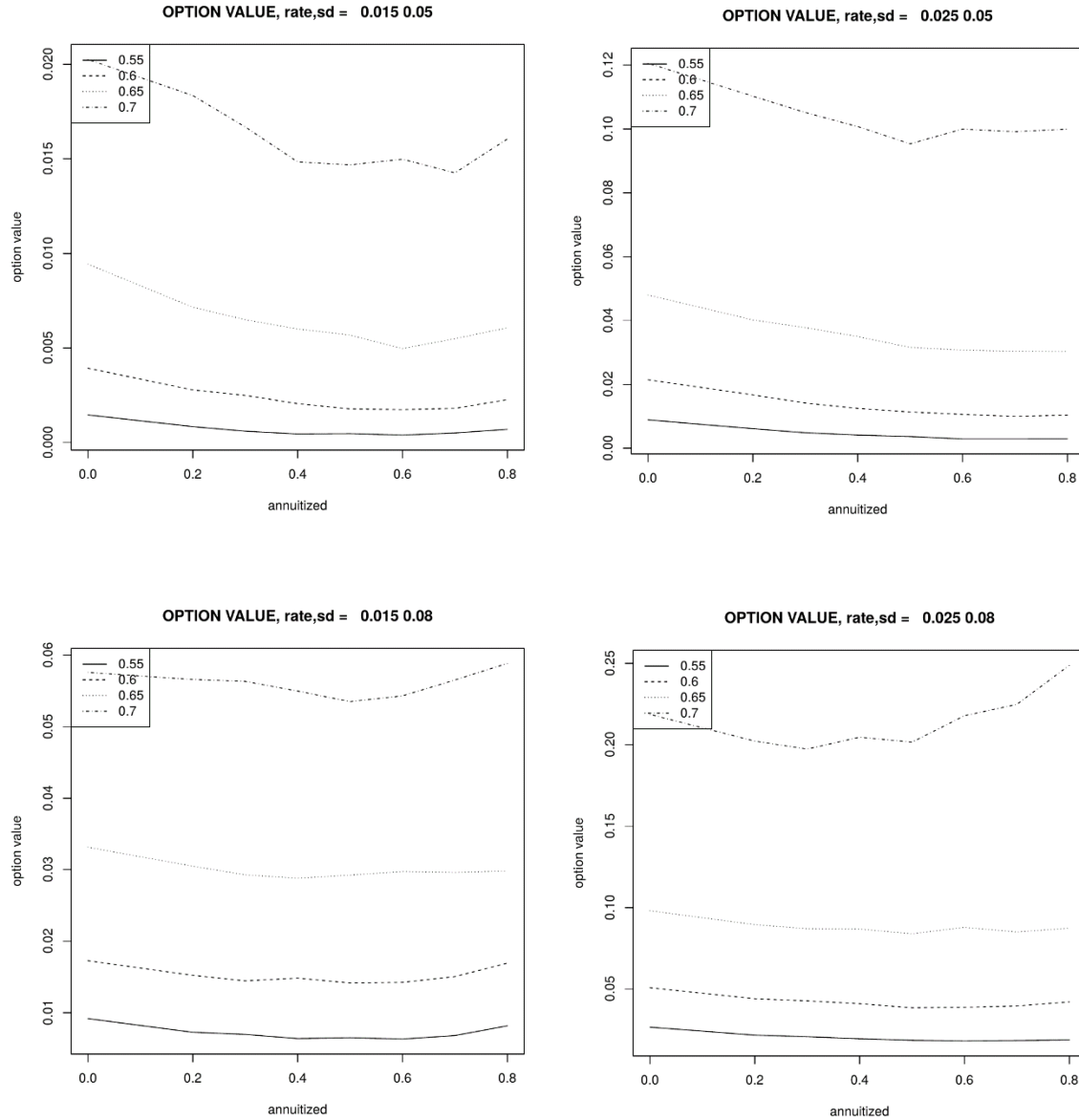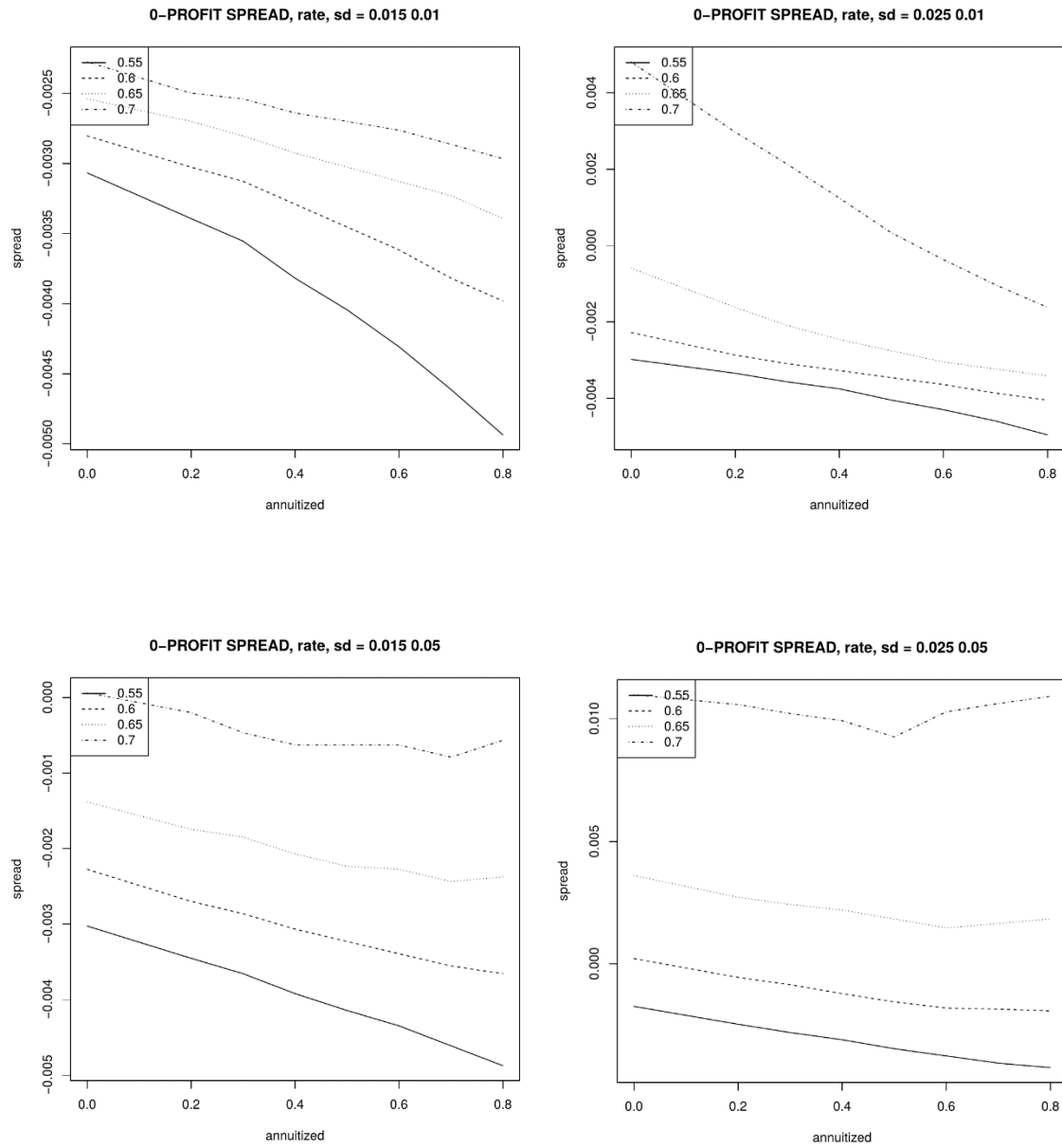
Figure 3

Figure 3: Expected "put option" losses to the lender as a function of investors' discount rate spread above expected price growth, volatility, initial loan-to-value ratio, and annuity enhancement from Davidoff (2019). Horizontal axis measures enhancement, vertical axis measures option value, different lines represent loan-to-value ratios.
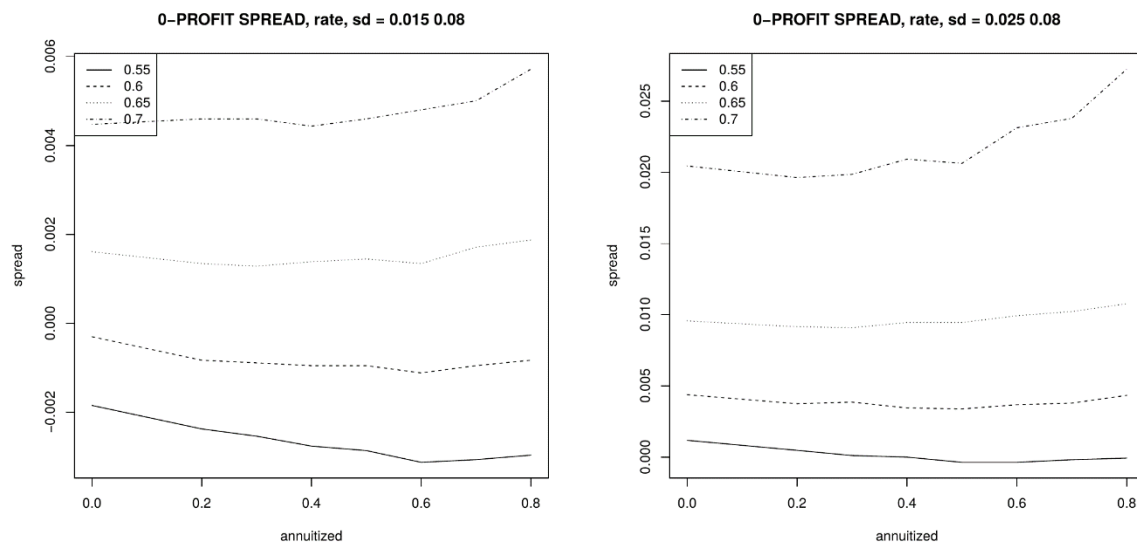
Figure 4

Figure 4: Necessary interest rate spread above investors' discount rate for zero profit to lenders as a function of investors' discount rate spread above expected price growth, volatility, initial loan-to-value ratio, and annuity enhancement from Davidoff (2019). Horizontal axis measures enhancement, vertical axis measures option value, different lines represent loan-to value ratios.

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