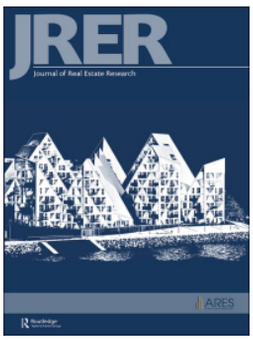

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Housing Ownership Decision Making in the Framework of Household Portfolio Choice

Authors

Eli Beracha, Alexandre Skiba, and Ken H. Johnson

Abstract

While it is well documented that homeowners have greater total wealth than renters, it is not clear that homeownership causes this wealth differential. We consider the buy versus rent decision in the framework of household portfolio choice. This allows us to determine whether owning a home increases the utility of households by improving the performance of their portfolio compared with households that rent. We determine that while renting is superior to ownership in isolation, homeownership as a part of the household portfolio often improves wealth creation on a risk-adjusted basis. Our findings suggest significant policy changes that currently favor levered homeownership strategies for households with minimal wealth.

The academic literature provides evidence for the many economic and social benefits associated with homeownership. Less crime, better familial environment, higher educational outcomes, and not bearing children as teenagers are only a few examples of the social benefits found to be associated with homeownership. Other benefits that homeownership brings to society include, but are not limited to, enhanced civic pride and improved voter turnout.

From an economic perspective, the literature provides evidence that homeowners are financially better off than renters and have better access to affordable financing of other goods and services. However, due to the potential for selection bias that is associated with homeownership, it is still unclear whether homeownership causes wealth creation or whether the two are merely correlated. Beracha and Johnson (2012) examine the causality of this link and show that when all costs and opportunities are considered, renting results in higher wealth accumulation. While their controversial results are interesting, they ignore the important issue that households should not necessarily focus on the performance of a single asset in their portfolio, but rather on the performance of their complete portfolio. Since housing is typically just one part of households' wealth portfolio, it is arguably more important to look at the decision between owning and renting a home in the

framework of households' portfolio choice rather than in a strict ''horserace'' comparison in terms of future expected wealth accumulation.

We address this issue in this paper and consider housing as one of three (in addition to stocks and bonds) possible asset classes in which households can invest. Thus, we compare the return and the risk-adjusted return on households' wealth conditioned on whether their primary residence is a part of their portfolio. When housing is one of the asset classes included in the households' portfolio, we consider different levels of leverage employed by households to finance their primary residence and a range of initial households' wealth levels. The households' leverage and wealth levels indirectly determine the portion of wealth these households invest in housing.

Our results show that when the costs and benefits of homeownership are balanced against those of renting, renters' wealth is likely to grow faster than homeowners' wealth in unadjusted terms. However, homeownership quite often provides households with superior risk-adjusted wealth growth. This is particularly true for relatively wealthy households, which are able to purchase a home with a substantial down payment and, at the same time, apply a modest, but not overwhelming, portion of their total wealth toward that down payment.

This paper contributes to the homeownership-related literature by shedding light on the importance of homeownership from a portfolio wealth creation perspective. While previous papers in the literature document numerous benefits that stem from homeownership, we are the first to document the extent to which homeownership benefits household portfolio performance by applying a mean-variance approach to homeownership with respect to renting.

The remainder of this paper is organized as follows. We review the literature in the next section and provide additional motivation for our research question. In the following two sections, we describe the data and present the model. Finally, in the last two sections we report the results and provide concluding comments.

Literature Review and Additional Motivation

A variety of social and economic benefits that are the results of owning rather than renting are highlighted within the real estate literature. For example, Haurin, Parcel, and Haurin (2002) show that homeownership contributes to better societal outcomes—lower criminal activity, better familial environment, and higher levels of educational achievement. Along similar lines, Green, Painter, and White (2013) link homeownership to a higher likelihood of staying in school and not bearing children as teenagers, while Rohe, Van Zandt, and McCarthy (2002a), Dietz and Haurin (2003), and Holian (2011) note that homeownership enhances civic pride and improves voter turnout. Additionally, Holian (2011) documents that dissatisfied homeowners are far more likely to participate in elections than any other state of tenure. Thus, there appear to be many non-financial reasons to favor ownership over renting.

While some researchers question the validity of the benefits associated with owning a home, mostly due to self-selection issues (Holupka and Newman, 2012), homeownership is still often referred to as the ''American Dream'' (e.g., Tu and Eppli, 1998; Painter and Redfearn, 2002; Phillips and Vanderhoff, 2004; Cauley, Pavlov, and Schwartz, 2007; Matthews and Turnbull, 2007). From a pure economic standpoint, it can be casually argued, that unlike renters, homeowners build wealth through home price appreciation and a steady reduction of mortgage debt, while simultaneously receiving a beneficial tax treatment not awarded to renters. This argument, however, ignores the fact that in many cases the total cash outflow required by homeowners to hold and maintain their home as well as pay down their mortgage debt is higher than the cost to rent a comparable property. Therefore, renters have the discretion to invest any such cash flow differential in order to create wealth.

Haurin, Hendershott, and Wachter (1996) document the financial benefits associated with homeownership. Specifically, homeowners have, on average, greater total household wealth than renters. Moreover, the household wealth of new homeowners increases at a faster pace than that of renters in the first few years of ownership. The correlation between wealth and homeownership, however, can clearly be attributed, at least in part, to selection biases. For example, homeowners tend to be older and wealthier than renters (Haurin, Hendershott, and Wachter, 1996) and owning a home requires some initial wealth in the form of a down payment[1] and once individuals become homeowners they rarely revert back to renting (Sinai, 1997). Di, Belsky, and Liu (2007) attempt to control for some of these factors and conclude that homeownership leads to greater overall wealth accumulation. Nevertheless, it remains an open question whether homeownership causes greater wealth creation or is merely correlated with greater wealth.

Rohe, Van Zandt, and McCarthy (2002b) recognize that homeownership provides a ''ready'' mechanism for families to borrow money in less expensive forms, such as home equity loans. The authors suggest that the line of credit made available to owners through equity build up allows them to make purchases and invest in education or the financial markets resulting in greater wealth creation, all else being equal. The authors also note that asset accumulation through house price appreciation is the main financial benefit of homeownership and that the declining real monthly payment over time protects homeowners against unanticipated increases in rental costs. Hence, ownership is a hedge against rent increases, a source of credit, and a wealth creator through property appreciation.

The real estate literature includes many studies that attempt to determine the optimal amount of real estate that should be included within a diversified mixed-asset portfolio. Webb and Rubens (1987) and Webb, Curcio, and Rubens (1988) are among the earlier papers that concentrate on the risk-reward benefits that stem from inclusion of real estate within investment portfolios. Seiler, Webb, and Myer (1999) provide a comprehensive review on this stream of research and highlight the divergence in the findings that exists in the literature. Similarly, the portfolio benefits from exposure to global investment in real estate is also explored. While

a detailed review of this literature is outside the scope of this paper, Gallo, Lockwood and Zhang (2013) provide a review of the literature and conclude that global real estate exposure is vital for institutional investors and portfolio managers.

A more targeted branch of this literature includes a stream of papers that focus on housing (rather than real estate in general) in the context of a household's portfolio choice. For example, Flavin and Yamashita (2002) study the impact of portfolio constraint imposed by housing consumption on the household's holdings of financial assets. The authors show that the incentive to reduce debt rather than invest in stocks or bonds is higher for households that hold a large portion of their wealth in housing because they are forced into a high risk (and high expected return) situation. Allocation to equities increases as the household's net worth increases relative to the value of the home it owns. Kishor and Kumari (2014) show that observable returns on assets, such as equities, as well as households' consumption and income can be used to estimate return on housing, which in turn affects households' wealth. Cocco (2005) and Hu (2005) investigate portfolio choice in the presence of housing and find that, especially for low net-worth individuals, house price risk crowds out stockholdings. Similarly, Yao and Zhang (2005) demonstrate a substitution effect between owning a home and the portion of the investors' net worth that is allocated to stocks. Silos (2007) explores wealth distribution and portfolio contribution with the inclusion of housing under different macroeconomic conditions. While these researchers examine housing ownership within a complete household portfolio, they do not simultaneously explore the housing buy versus rent decision and its impact on optimal portfolio outcomes.

Shelton (1968) is one of the first to quantify the cost of renting versus owning a home. Shelton concludes that the duration of tenancy plays a major role when comparing costs, such that individuals with short tenancy plans should rent and those with longer tenancy plans should own. Henderson and Ioannides (1983) provide evidence that under perfect certainty, owning dominates renting, but renting becomes more attractive as capital gains from housing become more random. Fu (1991) shows that regardless of the cost of owning versus renting, when the income elasticity of investment is greater than the elasticity of consumption, homeownership increases in likelihood with household wealth.

Beracha and Johnson (2012) question the causality of the link between wealth and homeownership. The authors compare the wealth accumulation associated with buying or renting a home over the 1978–2010 period. They find that homeowners accumulate wealth through equity in the home, while renters accumulate wealth through investing the initial down payment, closing costs, and any differential cash flows between ownership cash flows and rents. The show that under a fair and inclusive comparison, renting results in greater wealth accumulation, on average. In the light of consistently high ownership rates and higher overall homeowners' wealth, the findings from Beracha and Johnson's study provide motivation for this study to examine, in greater detail, the economic benefits that can be attributed to homeownership. Specifically, we explore the possible benefits

from homeownership in the framework of household portfolio performance rather than the direct financial benefits associated with owning a home in isolation.

Data

We employ a few different datasets. First, in order to identify the average U.S. rent-to-price ratio through time, we rely on a dataset constructed by Davis, Lehnert, and Martin (2008) for the stock of owner-occupied housing. This rent-to-price index is based on five micro datasets from the Decennial Censuses of Housing (DCH) surveys with price indices for housing prices and rents between 1960 and 2000. To improve the quality of these indices, Davis, Lehnert, and Martin use hedonic modeling to control for the size, age, number of bedrooms, and property location, among other property characteristics. The authors use rent and house price indices to interpolate rent-to-price ratios between the DCH surveys and to extrapolate them beyond the year 2000. The original dataset includes rent-to-price ratios for the 1978–2007 period on a semiannual basis.[2] For our analysis, we extrapolate the data to include rent-to-price index values through the end of 2012. The data extrapolation is done using the same methodology described by Davis, Lehnert, and Martin and based on the relative rate of change in rent and purchase prices. Rent and purchase price changes are derived from the Bureau of Labor Statistics (BLS) rent indices (*RentIDX*) and from the Federal Housing Finance Agency (FHFA) home price indices (*PriceIDX*), respectively. More specifically, for every six months between 2007 and 2012 we derive the rent-to-price (*RentToPrice*) as the following:

$$RentToPrice_t = RentToPrice_{t-1} * \frac{1 + \frac{RentIDX_t}{RentIDX_{t-1}}}{1 + \frac{PriceIDX_t}{PriceIDX_{t-1}}}. \quad (1)$$

This allows us to work with a rent-to-price time series that spans the 1978–2012 period. Home price indices from the FHFA for the U.S. are also employed to calculate housing price appreciation and volatility. The average 30-year fixed mortgage rates are obtained from Freddie Mac and converted from a monthly to a six-month average rate that was offered to borrowers during the first and second half of each year of the sample period. To proxy for the return and risk associated with the stock portion of the portfolio, the broad stock market returns from Ken French's data library are obtained.[3] Finally, the risk and return associated with the bond portion of the portfolio is based on a 50/50 blend of Aaa and Baa corporate bonds with long maturity. These data were obtained from the Federal Reserve Bank of St. Louis.[4]

Exhibit 1 provides descriptive statistics of the major data series we employed. The rate of annual housing price growth is similar to housing rent growth during

Exhibit 1 | Descriptive Statistics

	Avg.	Std. Dev.	Min.	Max.
Housing Price Growth	4.18%	4.36%	−6.75%	13.75%
Housing Rent Growth	4.03%	2.00%	0.31%	8.95%
Rent-to-Price Ratio	4.70%	0.44%	3.62%	5.22%
Mortgage Rate	8.68%	3.17%	3.45%	17.58%
Stocks Return	11.37%	17.02%	−36.75%	36.81%
Bonds Return	8.14%	6.87%	−2.92%	32.62%

Notes: Exhibit 1 reports the average (Avg.), standard deviation (Std. Dev.), minimum (Min.), and maximum (Max.) values of the key variables affecting households' wealth creation in the context of a buy versus rent decision. The reported values are based on our dataset, which spans the 1978–2012 period.

the 1978–2012 period and averaged 4.18% and 4.03%, respectively. The similar rate of growth associated with purchase and rent prices is not surprising given the fundamental economic link between purchase and rent prices. However, the volatility of housing purchase prices were materially larger compared with the volatility of rent prices as indicated by the respective standard deviation of their growth rates (4.36% vs. 2.00%). The rent-to-price ratio over the examined period averaged 4.70%, with a low of 3.62% (in 2006) and a high of 5.22% (in 1985). Rates for a traditional 30-year mortgages mostly trended down during the 35-year period we explore. Rates peaked at 17.58% in 1981 and reached a low of 3.45% in 2012. As for the rates of return on financial assets, stocks averaged 11.37% annual return with a standard deviation of 17.02%, while bonds yielded 8.14%, on average, with a standard deviation of 6.87%.

Given the descriptive statistics provided in Exhibit 1, it should be noted that the mean mortgage rate in our sample is slightly lower than mean property appreciation rate plus property income rate (rent-to-price ratio). The relative lower cost of mortgages combined with homeowners' ability to receive tax deductions on their mortgage interest expenses implies that higher leverage modestly boosts households expected wealth growth at the expense of higher volatility. That said, the buy versus rent decision and the optimal level of leverage depend on a combination of different factors that we consider in our analysis.

The Model and General Procedures

We explore the likely households' wealth portfolio performance under the consideration of the buy versus rent decision. We compare the portfolio

performance of households that own their primary residence with households that rent. Below, we provide details on the methodology employed and the assumptions made.

The Household Portfolio

We evaluate the likely performance of portfolios for different kinds of households. Specifically, we consider a range of households in terms of their total wealth, which is reflected in the amount of equity they have in their home and the value of their home relative to their total wealth. We consider households with initial wealth of 20% to 500% of the value of the home in which they live. The households' equity in their primary residence also varies with respect to the total value of the home. The equity households' invest in their home is as low as 0% for renters and in the range of 20% to 100% for homeowners. This implies that homeowners' initial loan-to value (LTV) ranges can be as high as 80% and as low as 0% (no mortgage). We initially assume that any portion of the household wealth that is not reflected in their home equity is invested using a 60%/40% stocks/bonds allocation that is rebalanced annually. We later relax this allocation assumption and allow for different asset allocations.

It is important to note that the household portfolio methodology described above improves on the methodology employed in the literature in at least two major ways. First, we consider a wide range of households in terms of their overall wealth relative to the price of their home, as well as a range of LTV ratios used for the financing of their home. This contrasts with studies that do not consider household wealth and typically only employ a single conventional LTV for the purpose of home financing. The second improvement is that the decision of whether households should buy or rent their primary residence is made within the households' portfolio, which is an important consideration from diversification and risk-reward perspectives. This is a major contribution to the literature that evaluates the buy versus rent decision in isolation.

The Performance of Households' Portfolios

In order to evaluate the likely performance of a specific household portfolio given its housing situation, we consider the full costs and benefits of ownership relative to the costs and benefits of renting. In our model, households are endowed with a periodic housing allowance. The housing allowance is an annual cash flow that equals to the market rent amount required to live in the households' home. To level the plain, all households, regardless of whether they choose to rent or own, are endowed with the same housing allowance. This means that while renters' housing expenses are precisely covered by the housing allowance they receive, homeowners' housing expenses can be higher or lower compared with the housing allowance, depending on their assumed initial LTV, market rent-to-price ratio, and mortgage interest rates, among other factors.

For households that own their primary residence, the expected growth in wealth comes from three different sources. The first source is the expected appreciation of their three-asset portfolio, which includes housing, stocks, and bonds. The second source that contributes to the growth in households' wealth is the reduction in housing debt that equals to the principal portion embedded within the regular mortgage payments. The third source of the households' wealth growth is any surplus (or shortage) from the housing allowance compared with the cash outflow associated with homeownership. The difference between homeowners' housing allowance and the homeownership cash outflow is added or withdrawn to or from their investment portfolios. Therefore, the total expected growth of the household wealth for households that own a home $E(G_{HHW_{Owners}})$ is calculated as per equation (2):

$$E(G_{HHW_{Owners}}) = \frac{E(R_H) * HV + (E(R_S) * SV + E(R_B) * BV) * (1 - \tau_I) + P + (HA - HCO)}{HHW}, \quad (2)$$

where $E(R_H)$, $E(R_S)$, and $E(R_B)$ are the expected return on housing (housing appreciation), expected returns on stocks, and expected returns on bonds, respectively. *HV*, *SV*, *BV*, and *HHW* are the initial housing value, stocks value, and bonds value included in the households' portfolio and the total value of households' wealth, respectively. τ_I is the tax rate the households are expected to pay on the return they earn from investments in stocks and bonds.[5] *P* is the amount of principal applied by households during that year toward its 30-year mortgage balance. Finally, *HA* and *HCO* are the periodic housing allowance and housing cash outflow amounts, respectively.

The estimation of the total amount of cash outflow associated with homeownership (*HCO*) first includes the average homeowner's costs proposed by DiPasquale and Wheaton (1996). DiPasquale and Wheaton estimate housing closing costs from acquisition to be 2.13% of the mortgage amount and ''other costs'' to be 4%. Since closing costs are not a repetitive annual expense, we translate this estimation into an annual cost by converting its present value to an eight-year cash flow stream with a required return that equals the mortgage rate. The eight-year cash flow stream is based on our assumed holding period, which is the approximate average homeowner's housing tenure (in years) in the U.S. (Hansen, 1998). DiPasquale and Wheaton include hazard insurance, maintenance, property taxes, heating fuel, and utilities as other costs. Since heating fuel and utilities are costs that a renter-household would also bear, these expenses are netted out, allowing a renter-household and an owner-household to pay the same amounts for these items. We assume the cost of the remaining items to be 3% of owner-household value.[6] Because property tax can be tax deductible, we split this 3% estimate into

1.75% for hazard insurance and maintenance and 1.25% for property tax, which we adjust by the owner-household's marginal tax rate. We include the cost of housing disposition as well, which is assumed to be 6% of the final disposition price, as a part of the total homeowner equity. Because, like closing costs, costs associated with dispositions are not repetitive annual expenses, we, again, convert the value of the disposition amount into an eight-year cash flow stream discounted at the mortgage rate. Finally, we include the tax-adjusted interest portion of mortgage payment and the principal associated with the mortgage debt, assuming a 30-year mortgage. Formally, the total periodic homeowner cash outflow (*HCO*) is estimated as the following:

$$HCO = CC * MB + (DC + MI) * HV + (E(Int) + PT) * (1 - \tau_M) * HV + P, \quad (3)$$

where *CC*, *DC*, and *MI* are the annualized rates of closing costs, disposition costs, and the costs associated with maintenance and insurance, respectively. $E(Int)$ is the expected interest rate the household is expected to pay on its mortgage debt, *PT* is the property tax rate, and *MB* is the initial mortgage balance. Additionally, because mortgage interest and property tax can be tax deductible expenses, we reduce these costs by a marginal tax rate (τ_M), which is set to 25%. All other variables are as described earlier.

To capture the value of the default option embedded in nonrecourse mortgages, we also allow owner-households to default on their mortgages if the value of their residence falls below their mortgage balance.[7] We do this by subjecting equation (2) to equation (4), which does not allow negative housing appreciation to yield negative housing equity.

$$[1 + E(R_H)]^{hp} - 1 \geq -\left(\frac{HV - (PV - HHW)}{HV} + \sum_{t=1}^{hp} \frac{P_t}{HV}\right), \quad (4)$$

where *hp* represents our holding period and *PV* is the total household portfolio value. We set *hp* equal to eight years for our analysis.[8] All other variables are as described earlier.

As for renter-households, we assume that they invest their wealth and allocate it between stocks and bonds. Because renters' housing allowance precisely covers their housing expenses, no additional cash surplus or shortage needs to be accounted for. As a result, the expected growth in wealth for renter-households depends on a single source, which is the expected return on their two-asset portfolio. Therefore, the total expected renter-households wealth growth $E(G_{HHW_{Renters}})$ is estimated using the following equation:

$$E(G_{HHW_{Renters}}) = \frac{(E(R_S) * SV + E(R_B) * BV) * (1 - \tau_I)}{HHW}. \quad (5)$$

Portfolio Simulations

We employ a Monte Carlo simulation procedure in order to generate the expected wealth growth distributions for renter-households and owner-households. Specifically, the expected return on stocks, bonds, and housing as well as the interest rate, which serve as inputs for equations (2)–(5) are drawn from the historical (1978–2012) annual distribution for each asset class. Moreover, to capture the full diversification benefits that stem from these holdings, the historical correlations between the values of these four asset classes are considered before the expected returns associated with each iteration are calculated. The consideration of the return correlations between the four asset classes is crucial for our analysis, since without it the interrelation between the values of the components that affect household wealth are ignored. Each Monte Carlo simulation procedure is performed with 10,000 iterations.

The distribution output of the 10,000 iterations from each Monte Carlo simulation procedure provides an estimation of the expected return on the households' portfolio and the standard deviation of its returns for different households. The ratio between the expected wealth growth and its standard deviation is used as our proxy for the risk-adjusted growth of households' overall wealth portfolio. Moreover, the expected wealth growth distribution outputs for renter-households and homeowner households allow us to observe the probability that homeowner-households outperform renter-households in terms of wealth accumulation. The initial scenarios include stock/bond allocations of 60%/40%. However, we also explore scenarios where allocation to stocks and bonds range from 0% to 100% of the portfolio portion that is not invested in housing.

The Efficient Frontiers of Households' Wealth Portfolios

One of the first lessons about asset allocation from the finance literature is that investors should care about their overall portfolio performance rather than the performance of an individual asset class within the portfolio. In order to illustrate the relation between risk and return for mixed-assets portfolios, we draw the efficient frontiers of hypothetical households that rent their home and hold a two-asset wealth portfolio (stocks and bonds) and for homeowner households that hold a three-asset wealth portfolio (housing, stocks, and bonds). This approach provides a visual illustration of whether households are better off as renters or homeowners from a risk-reward perspective with respect to their overall wealth.

To generate the values of the efficient frontiers, we apply Monte Carlo simulation procedures to households with a range of initial wealth and LTV levels, as we do

in the earlier part of this paper. The expected rate of wealth growth and the standard deviation of expected wealth growth from the Monte Carlo simulations are recorded and plotted. Homeowners' efficient frontier that is positioned to the upper (higher expected growth) left (lower standard deviation) of the renters' efficient frontier serve as an additional indication that owning a home can provide overall portfolio benefits compared with households that rent their home from a risk-reward perspective.

Results

The Performance of Households' Wealth Portfolio

Exhibit 2 offers a side-by-side comparison of the overall expected growth in wealth and its standard deviation for homeowners and for renters with different wealth levels. As per the model described in the methodology section, homeowners hold a three-asset portfolio that contains housing, stocks, and bonds,[9] while renters hold a two-asset portfolio that only contains stocks and bonds. Both renters and homeowners are endowed with a periodic housing allowance that equals to the rent amount that would be required to live in the housing unit under consideration. This implies that the renter households spend the housing allowance on rent and their wealth growth is generated from the return on their stocks and bonds portfolio. The homeowner-households, however, use their housing allowance to pay mortgage payments and other housing-related expenses (maintenance, insurance, and property taxes), which are not necessarily equal to their housing allowance. The higher the initial down payment (the lower the LTV) made by households toward the purchase of their home, the lower the mortgage payment they are required to make. Therefore, households that supply a sufficiently high down payment are more likely to have housing expenses that are smaller than their housing allowance. These types of households are able to apply a portion of their housing allowance toward their portfolio of stocks and bonds.

In Panel A of Exhibit 2, we consider relatively affluent households with an initial wealth that equals to five times the value of their home. The results show that the eight-year annual expected wealth growth for households that own their home and pay for it in cash (0% LTV) is 8.01%, with an annual standard deviation of 9.79%. The expected wealth growth and standard deviation both increase with the LTV for homeowners and reach 8.39% and 11.42%, respectively, for households with 80% LTV. For renter-households, the expected wealth growth is 8.60%, with a standard deviation of 12.07%. The difference between the expected wealth growth for renters compared with owners ranges between 0.21% (statistically significant at the 10% level) and 0.59% (statistically significant at the 1% level). While the expected wealth growth is higher for renters compared with owners, the ratio of expected growth to standard deviation, which is a proxy for risk-adjusted return, is 0.71 for renters and higher for owners (between 0.73 and 0.82 in Panel A) and increases as the LTV decreases.

Exhibit 2 | Owners vs. Renters Wealth Portfolio Performance

	Owner					
LTV	0%	20%	40%	60%	80%	Renter
Panel A: Initial wealth of 5 times housing value						
E(*G*)	8.01%	8.11%	8.20%	8.30%	8.39%	8.60%
SD	9.79%	10.20%	10.60%	11.01%	11.42%	12.07%
E(*G*)/*SD*	0.82	0.80	0.77	0.75	0.73	0.71
Diff: *E*(*G*)	−0.59%***	−0.49%***	−0.40%***	−0.30%**	−0.21%*	
Diff: *SD*	−2.28%	−1.87%	−1.47%	−1.06%	−0.65%	
Diff: *E*(*G*)/*SD*	0.11	0.08	0.06	0.04	0.02	
Panel B: Initial wealth of 2 times housing value						
E(*G*)	7.06%	7.32%	7.58%	7.83%	8.07%	8.60%
SD	6.61%	7.57%	8.55%	9.54%	10.54%	12.07%
E(*G*)/*SD*	1.07	0.97	0.89	0.82	0.77	0.71
Diff: *E*(*G*)	−1.54%***	−1.28%***	−1.02%***	−0.77%***	−0.53%***	
Diff: *SD*	−5.46%	−4.50%	−3.52%	−2.53%	−1.53%	
Diff: *E*(*G*)/*SD*	0.36	0.25	0.17	0.11	0.05	
Panel C: Initial wealth of 1 time housing value						
E(*G*)	5.13%	5.77%	6.37%	6.94%	7.47%	8.60%
SD	4.07%	4.66%	5.95%	7.60%	9.42%	12.07%
E(*G*)/*SD*	1.26	1.24	1.07	0.91	0.79	0.71
Diff: *E*(*G*)	−3.47%***	−2.83%***	−2.23%***	−1.66%***	−1.13%***	
Diff: *SD*	−8.00%	−7.41%	−6.12%	−4.47%	−2.65%	
Diff: *E*(*G*)/*SD*	0.55	0.53	0.36	0.20	0.08	
Panel D: Initial wealth of 0.5 times housing value						
E(*G*)	N/A	N/A	N/A	4.54%	5.91%	8.60%
SD	N/A	N/A	N/A	7.42%	8.94%	12.07%
E(*G*)/*SD*				0.61	0.66	0.71
Diff: *E*(*G*)				−4.06%***	−2.69%***	
Diff: *SD*				−4.65%	−3.13%	
Diff: *E*(*G*)/*SD*				−0.10	−0.05	

Exhibit 2 | (continued)
Owners vs. Renters Wealth Portfolio Performance

	Owner					
LTV	0%	20%	40%	60%	80%	Renter
Panel E: Initial wealth of 0.2 times housing value						
E(*G*)	N/A	N/A	N/A	N/A	1.45%	8.60%
SD	N/A	N/A	N/A	N/A	18.51%	12.07%
E(*G*)/*SD*					0.08	0.71
Diff: *E*(*G*)					−7.16%***	
Diff: *SD*					6.44%	
Diff: *E*(*G*)/*SD*					−0.63	

Notes: Exhibit 2 reports the expected annual growth, standard deviation, and growth/standard deviation on homeowners' three-asset portfolio (housing and remaining in 60%/40% stocks/bonds) and on renters' two-asset portfolio (60%/40% stocks/bonds), as well as the differences between these two portfolios. The wealth portfolio performance assumes that renters and owners are endowed with a periodic cash flow that equals to the market rent of the property in which they reside and estimated using Monte Carlo simulation with 10,000 iterations as per equations (2)–(5). In Panels A–E, we assume initial households' wealth in the range of 0.2 to 5 times the value of the home in which the households reside. Homeowner households finance their residences with an initial LTV in the range of 0% to 80%.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

In Panels B and C of Exhibit 2, we consider less affluent households with initial wealth that equals to two times and one time the value of the home in which they reside, respectively. The results are qualitatively similar to the results presented in Panel A. Renter-households are expected to outperform homeowners in terms of wealth growth, but the risk-adjusted return for homeowners is higher than it is for renters. The difference between the expected wealth growth for owners and renters is higher for less wealthy households (Panel C in this case) and households with lower LTVs. This implies that the expected wealth growth for homeowners is boosted, to some extent, by the leverage they use to purchase their residences. The expected wealth growth rates for homeowners in these two panels are all lower than the expected wealth growth for renters at the 1% level of statistical significance.

In Panels D and E of Exhibit 2, we consider households with initial wealth equal to 0.5 and 0.2 times the value of the home in which they reside, respectively. These particular scenarios resemble less wealthy and often young households that,

if they choose to become homeowners, must invest all or the majority of their wealth in housing in order to satisfy some minimum level of down payment. Due to the limited wealth of these households, they are only able to purchase their home with a relatively high LTV and allocate little to none of their wealth to stocks and bonds. Because a high LTV ratio increases the likelihood that homeowners' housing cash outflow exceeds their housing allowance, these homeowners are likely to borrow[10] some of their housing expenses given their little or nonexistent investment portfolio. As a result, Panels D and E report materially lower expected wealth growth *and* lower risk-adjusted wealth growth for homeowners compared with renters.

Overall, the results presented in Exhibit 2 are consistent with the results of Beracha and Johnson (2012) and suggest that, on average, renters are expected to grow their wealth faster than homeowners. However, these results highlight that owning a home is often preferable to renting when the risk-adjusted wealth growth is considered. These findings are analogous to more common portfolio situations where, for example, stocks are expected to outperform bonds in terms of absolute return, but a portfolio of stocks and bonds is preferred to a portfolio that only includes stocks from a risk-reward perspective. That said, homeowners with low net worth, who are forced to purchase a home with a low down payment and invest a large portion of their wealth in housing, expose themselves to lower performance in terms of unadjusted and risk-adjusted wealth creation. This strongly suggests that public policies favoring all-in wealth and minimum down payment financing should be abandoned, as they provide less favorable financial opportunities for these types of households. These outcomes provide new insight into the literature that does not consider the buy versus rent decision in the context of the households' portfolios and therefore is unable to account for the effect of the decision on the overall risk-reward expectations of households.

The Performance of Households' Wealth Portfolio with Different Asset Allocations

In Exhibit 3, we replicate the results from Exhibit 2, with the exception that households who own their primary residence treat their home as a bond (since it provides a constant stream of utility) and invests all their remaining wealth in stocks. Overall, the results suggest that while eliminating bonds from the homeowners' portfolio increases their expected rate of wealth growth, it decreases the risk-adjusted wealth growth rate of these households. These results are particularly evident for wealthier households (Panel A, for example) where homeowners are expected to grow their wealth faster than renters (9.07% to 9.55% vs. 8.60%, differences that are statistically significant at the 1% level), but exhibit lower risk-adjusted wealth growth ($E(G)/SD$ of 0.59 to 0.66 vs. 0.71). The difference is not as noticeable for less wealthy households because the portion of their wealth that is invested in stocks (rather than stocks and bonds) is relatively small and hence less material for their overall portfolio performance. These results

Exhibit 3 | Owners vs. Renters Wealth Portfolio Performance: Housing-for-Bonds Substitution

	Owner					
LTV	0%	20%	40%	60%	80%	Renter
Panel A: Initial wealth of 5 times housing value						
E(*G*)	9.07%	9.19%	9.31%	9.43%	9.55%	8.60%
SD	13.71%	14.33%	14.94%	15.55%	16.17%	12.07%
E(*G*) / *SD*	0.66	0.64	0.62	0.61	0.59	0.71
Diff: *E*(*G*)	0.47%**	0.59%***	0.71%***	0.83%***	0.95%***	
Diff: *SD*	1.64%	2.26%	2.87%	3.48%	4.10%	
Diff: *E*(*G*) / *SD*	−0.05	−0.07	−0.09	−0.11	−0.12	
Panel B: Initial wealth of 2 times housing value						
E(*G*)	7.86%	8.21%	8.55%	8.87%	9.18%	8.60%
SD	8.91%	10.40%	11.90%	13.42%	14.94%	12.07%
E(*G*) / *SD*	0.88	0.79	0.72	0.66	0.61	0.71
Diff: *E*(*G*)	−0.74%***	−0.39%***	−0.05%	0.27%**	0.58%***	
Diff: *SD*	−3.16%	−1.67%	−0.17%	1.35%	2.87%	
Diff: *E*(*G*) / *SD*	0.17	0.08	0.01	−0.05	−0.10	
Panel C: Initial wealth of 1 time housing value						
E(*G*)	5.25%	6.19%	7.02%	7.78%	8.48%	8.60%
SD	4.07%	5.16%	7.49%	10.23%	13.14%	12.07%
E(*G*) / *SD*	1.29	1.20	0.94	0.76	0.65	0.71
Diff: *E*(*G*)	−3.35%***	−2.41%***	−1.58%***	−0.82%***	−0.12%*	
Diff: *SD*	−8.00%	−6.91%	−4.58%	−1.84%	1.07%	
Diff: *E*(*G*) / *SD*	0.58	0.49	0.22	0.05	−0.07	
Panel D: Initial wealth of 0.5 times housing value						
E(*G*)	N/A	N/A	N/A	4.73%	6.69%	8.60%
SD	N/A	N/A	N/A	7.59%	10.91%	12.07%
E(*G*) / *SD*				0.62	0.61	0.71
Diff: *E*(*G*)				−3.87%***	−1.91%***	
Diff: *SD*				−4.48%	−1.16%	
Diff: *E*(*G*) / *SD*				−0.09	−0.10	

Exhibit 3 | (continued)

Owners vs. Renters Wealth Portfolio Performance: Housing-for-Bonds Substitution

	Owner					
LTV	0%	20%	40%	60%	80%	Renter
Panel E: Initial wealth of 0.2 times housing value						
E(*G*)	N/A	N/A	N/A	N/A	1.45%	8.60%
SD	N/A	N/A	N/A	N/A	18.51%	12.07%
E(*G*)/*SD*					0.08	0.71
Diff: *E*(*G*)					−7.15%***	
Diff: *SD*					6.44%	
Diff: *E*(*G*)/*SD*					−0.63	

Notes: Exhibit 3 reports the expected annual growth, standard deviation, and growth/standard deviation on homeowners' two-asset portfolio (housing and remaining in stocks) and on renters' two-asset portfolio (60%/40% stocks/bonds), as well as the differences between these two portfolios. The wealth portfolio performance assumes that renters and owners are endowed with a periodic cash flow that equals to the market rent of the property in which they reside and estimated using Monte Carlo simulation with 10,000 iterations as per equations (2)–(5). In Panels A–E, we assume initial households' wealth in the range of 0.2 to 5 times the value of the home in which the households reside. Homeowner households finance their residences with an initial LTV in the range of 0% to 80%.

*Significant at the 10% level.

**Significant at the 5% level.

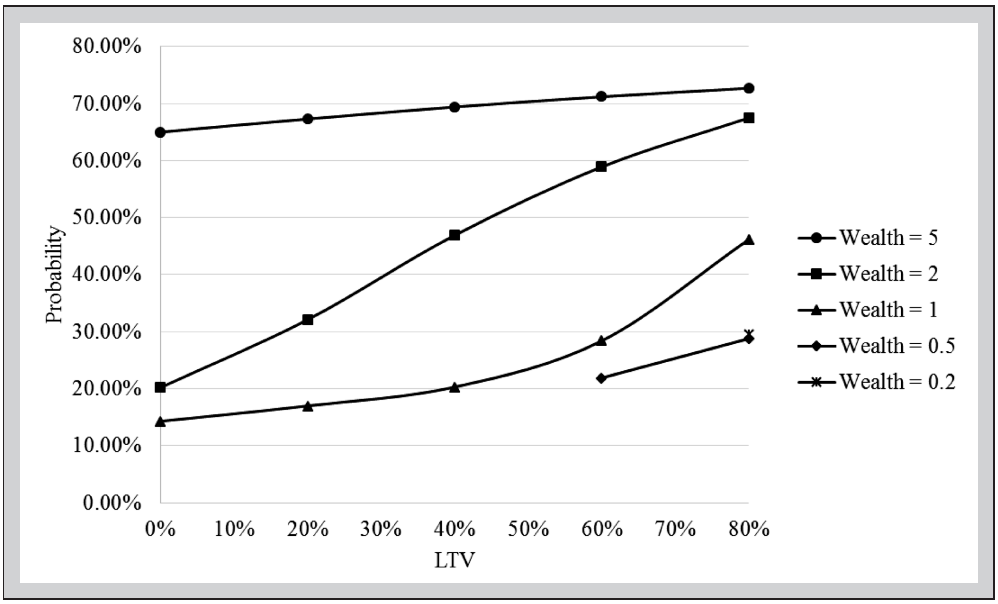
***Significant at the 1% level.

indicate that many homeowners should include both stocks and bonds in their portfolio, rather than treating their primary residence as a bond and avoiding investments in bonds.

Exhibit 4 complements Exhibit 3 and provides a visual illustration of the probability that homeowners wealth growth is expected to exceed renters' wealth growth under the scenarios presented in Exhibit 3. These results are consistent with the results from Exhibit 3 and show that homeowners have a higher probability of outpacing renters in terms of wealth growth as they employ higher LTV levels. At the same time, the probability that homeowners' wealth growth will outpace renters' wealth accumulation is smaller for less wealthy households that are forced to allocate a large portion of their wealth toward their housing down payment and, as a result, hold a housing-dominated portfolio.

Exhibit 5 reports the unadjusted and risk-adjusted expected wealth growth for renters and homeowners with different asset allocations toward stocks and bonds.

Exhibit 4 | Probability of Higher Rate of Wealth Growth for Owners vs. Renters: Housing-for-Bonds Substitution



Notes: Exhibit 4 reports the probability that homeowners would grow their wealth at a higher rate than renters. Homeowners hold a two-asset portfolio (housing and remaining in stocks) and renters hold a two-asset portfolio (60%/40% stocks/bonds). The rate of wealth growth assumes that renters and owners are endowed with a periodic cash flow that equals to the market rent of the property in which they reside and estimated using Monte Carlo simulation with 10,000 iterations as per equations (2)–(5). The initial households' wealth is in the range of 0.2 to 5 times the value of the home in which the households reside. Homeowner households finance their residences with an initial LTV in the range of 0% to 80%.

In this exhibit, we consider households with initial wealth that equals to one times the value of the home in which they reside and allocation in the range of 100%/0% to 0%/100% into stocks/bonds of any portion of their wealth that is not invested in housing. This allows us to observe households' expected wealth growth and its standard deviation with different asset allocations. The results show that renters' households are expected to grow their wealth faster than homeowners in each of the asset allocation scenarios. However, consistent with the results presented in the previous exhibits, homeowner-households are expected to achieve a higher risk-adjusted wealth growth compared with renters. As expected, the rate of expected wealth growth is generally decreasing as the households allocate less of their assets to stocks (and more to bonds). At the same time, the ratio between expected wealth growth and its standard deviation is generally increasing as smaller portion of households' wealth is allocated toward stocks. While we do not intend to investigate a particular asset allocation into stocks and bonds, it is important to note that homeownership contributes to higher risk-adjusted wealth growth regardless of the asset allocation of the households' remaining wealth.

Exhibit 5 | Owners vs. Renters Wealth Portfolio Performance: Varying Asset Allocations

	Owner					
LTV	0%	20%	40%	60%	80%	Renter
Panel A: 100/0 stocks/bonds allocation						
E(*G*)	5.25%	6.19%	7.02%	7.78%	8.48%	9.81%
SD	4.07%	5.16%	7.49%	10.23%	13.14%	17.03%
E(*G*)/*SD*	1.29	1.20	0.94	0.76	0.65	0.58
Diff: *E*(*G*)	−4.56%***	−3.62%***	−2.79%***	−2.03%***	−1.33%***	
Diff: *SD*	−12.96%	−11.87%	−9.54%	−6.80%	−3.89%	
Diff: *E*(*G*)/*SD*	0.71	0.62	0.36	0.18	0.07	
Panel B: 80/20 stocks/bonds allocation						
E(*G*)	5.19%	5.97%	6.69%	7.35%	7.97%	9.21%
SD	4.07%	4.89%	6.67%	8.85%	11.20%	14.49%
E(*G*)/*SD*	1.28	1.22	1.00	0.83	0.71	0.64
Diff: *E*(*G*)	−4.02%***	−3.24%***	−2.52%***	−1.86%***	−1.24%***	
Diff: *SD*	−10.42%	−9.60%	−7.82%	−5.64%	−3.29%	
Diff: *E*(*G*)/*SD*	0.64	0.59	0.37	0.19	0.08	
Panel C: 60/40 stocks/bonds allocation						
E(*G*)	5.13%	5.77%	6.37%	6.94%	7.47%	8.60%
SD	4.07%	4.66%	5.95%	7.60%	9.42%	12.07%
E(*G*)/*SD*	1.26	1.24	1.07	0.91	0.79	0.71
Diff: *E*(*G*)	−3.47%***	−2.83%***	−2.23%***	−1.66%***	−1.13%***	
Diff: *SD*	−8.00%	−7.41%	−6.12%	−4.47%	−2.65%	
Diff: *E*(*G*)/*SD*	0.55	0.53	0.36	0.20	0.08	
Panel D: 40/60 stocks/bonds allocation						
E(*G*)	5.08%	5.59%	6.08%	6.54%	6.98%	8.03%
SD	4.07%	4.49%	5.38%	6.54%	7.86%	9.85%
E(*G*)/*SD*	1.25	1.24	1.13	1.00	0.89	0.82
Diff: *E*(*G*)	−2.95%***	−2.44%***	−1.95%***	−1.49%***	−1.05%***	
Diff: *SD*	−5.78%	−5.36%	−4.47%	−3.31%	−1.99%	
Diff: *E*(*G*)/*SD*	0.43	0.43	0.31	0.18	0.07	

Exhibit 5 | (continued)

Owners vs. Renters Wealth Portfolio Performance: Varying Asset Allocations

	Owner					
LTV	0%	20%	40%	60%	80%	Renter
Panel E: 20/80 stocks/bonds allocation						
E(*G*)	5.03%	5.42%	5.80%	6.17%	6.52%	7.46%
SD	4.07%	4.39%	4.99%	5.79%	6.71%	8.02%
E(*G*)/*SD*	1.24	1.23	1.16	1.07	0.97	0.93
Diff: *E*(*G*)	−2.43%***	−2.04%***	−1.66%***	−1.29%***	−0.94%***	
Diff: *SD*	−3.95%	−3.63%	−3.03%	−2.23%	−1.31%	
Diff: *E*(*G*)/*SD*	0.31	0.30	0.23	0.14	0.04	
Panel F: 0/100 stocks/bonds allocation						
E(*G*)	4.98%	5.27%	5.54%	5.82%	6.08%	6.89%
SD	4.07%	4.35%	4.86%	5.47%	6.20%	6.87%
E(*G*)/*SD*	1.22	1.21	1.14	1.06	0.98	1.00
Diff: *E*(*G*)	−1.91%***	−1.62%***	−1.35%***	−1.07%***	−0.81%***	
Diff: *SD*	−2.80%	−2.52%	−2.01%	−1.40%	−0.67%	
Diff: *E*(*G*)/*SD*	0.22	0.21	0.14	0.06	−0.02	

Notes: Exhibit 5 reports the expected annual growth, standard deviation, and growth/standard deviation on homeowners' three-asset portfolio (housing and remaining stocks and bonds) and on renters' two-asset portfolio (stocks and bonds), as well as the differences between these two portfolios. The wealth portfolio performance assumes that renters and owners are endowed with a periodic cash flow that equals to the market rent of the property in which they reside and estimated using Monte Carlo simulation with 10,000 iterations as per equations (2)–(5). In Panels A–F, we assume allocation of 100%/0% to 0%/100% into stocks/bonds. Homeowner households finance their residences with an initial LTV in the range of 0% to 80%.

*Significant at the 10% level.

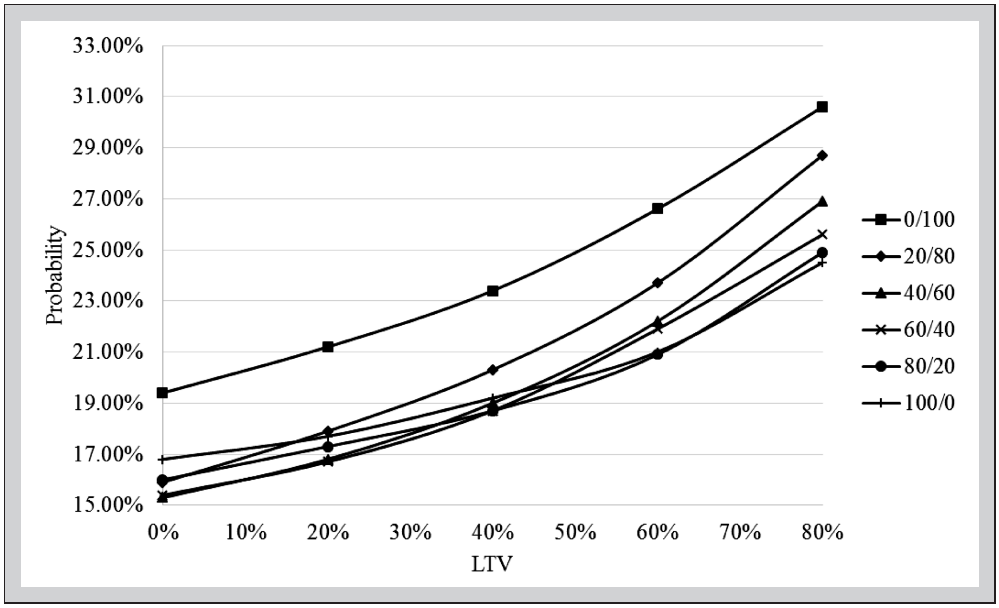
**Significant at the 5% level.

***Significant at the 1% level.

Moreover, for homeowners with higher LTVs, it appears that the difference in risk-adjusted wealth growth between renters and homeowners is maximized when households allocate their non-housing investment to a more traditional stocks/bonds allocation of about 60/40. For example, given an LTV of 60%, the $E(G)/SD$ difference between homeowners and renters is 0.20 with allocations of 60/40 and ranges between 0.06 and 0.19 for other asset allocations.

Exhibit 6 complements Exhibit 5 and illustrates the probability that homeowners are expected to grow their wealth faster than renters given the six asset allocation

Exhibit 6 | Probability of Higher Rate of Wealth Growth for Owners vs. Renters: Varying Asset Allocations



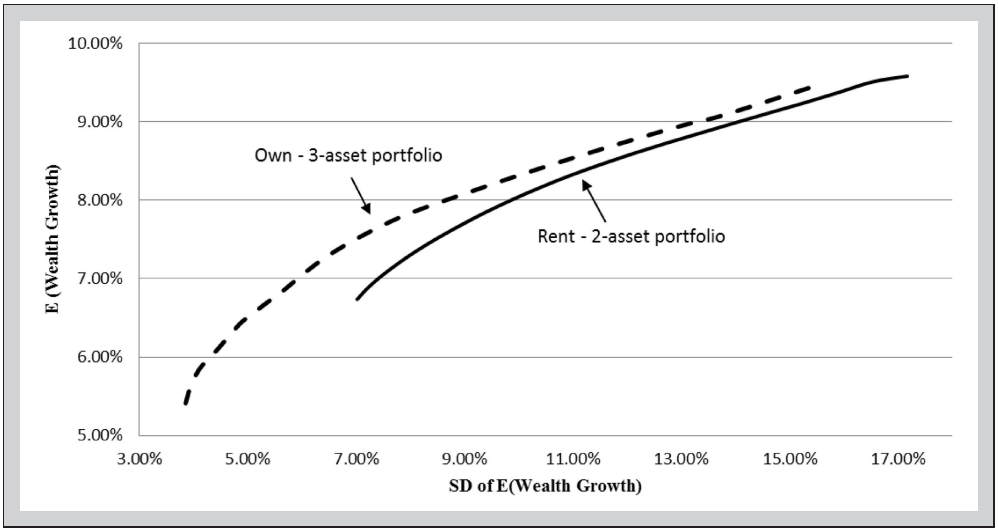
Notes: Exhibit 6 reports the probability that homeowners would grow their wealth at a higher rate than renters. Homeowners hold a three-asset portfolio (housing and remaining in x%/100%–x% stocks/bonds) and renters hold a two-asset portfolio (x%/100%–x% stocks/bonds). The rate of wealth growth assumes that renters and owners are endowed with a periodic cash flow that equals to the market rent of the property in which they reside and estimated using Monte Carlo simulation with 10,000 iterations as per equations (2)–(5). The initial households' wealth is set to one times the value of the home in which the households reside. Homeowner households finance their residences with an initial LTV in the range of 0% to 80%.

scenarios presented in Exhibit 5 and a range of LTV levels. The results suggest that homeowner-households have less than 50% probability of growing their wealth faster than renters regardless of the choice of asset allocation and LTV level. However, the probability of growing the wealth of homeowners faster than renters increases with the level of LTV and the percentage allocation into bonds. The positive relation between leverage and the probability of outperforming renter-households stems from the fact that the average mortgage cost during the examined period (8.68%) is lower than the sum of the average housing price growth (4.18%) and rent-to-price ratio (4.70%). Additionally, homeowners do not pay taxes on the wealth they create via housing price growth[11] and at the same time are allowed to deduct mortgage interest expenses.

The Efficient Frontiers of Households' Wealth Portfolios

Exhibit 7 presents the efficient frontiers for renters and homeowners. The solid and the dashed lines represent the efficient frontiers for renters and owners, respectively. As described in the methodology section, households that rent hold

Exhibit 7 | Efficient Frontiers of Households' Wealth Portfolios



Notes: Exhibit 7 illustrates the efficient frontiers for households that rent or own their primary residence with different asset allocations. The solid curve represents households that rent a home and invest all their wealth in stocks and bonds. The dashed curve represents households that own a home and invest their remaining wealth in stocks and bonds.

two-asset portfolios (stocks and bonds) while households that own their primary residence hold three-asset portfolios (housing, stocks, and bonds). Similar to the previous analyses, households' initial wealth and LTV vary in order to explore the possible effect of homeownership on a wide range of households.

A glance at Exhibit 7 reveals that the efficient frontier for owners is located to the upper left of the renters' efficient frontier. This implies that it is possible for homeowners to be exposed to an overall preferred risk-reward scenario compared with renters. Specifically, homeowners can achieve a given level of expected wealth growth with a lower level of assumed risk (standard deviation) or a higher level of expected wealth growth for a given level of risk. These results are consistent with our previous analysis and expected when an additional asset that is not perfectly correlated with the other assets is included in the portfolio mix.

Given that that the return on stocks is higher in raw terms than the expected housing price appreciation, the upper end of the renters' efficient frontier is associated with slightly higher returns than the upper end of the owners' efficient frontier. The risk-reward benefit for owners over renters, which can be viewed as the gap between the two efficient frontiers, is relatively small for higher levels of expected wealth growth and widens as the expected rate of wealth growth decreases. This is a result of the high concentration of stocks both homeowners and renters are required to hold in order to reach the higher spectrum of the curves. These results imply that the benefit from homeownership is particularly

pronounced for households that seek modest levels of wealth growth while accepting a relatively low risk level.

The lower end of the three-asset efficient frontier is associated with a high proportion of housing holding and a low proportion of stock holding. For example, to reach an expected portfolio return of 5.40% with standard deviation of 3.85% homeowners should hold 80% of their wealth in the form of housing while only about 10% of their remaining wealth should be allocated to stocks and the rest invested in bonds. As we move up along this efficient frontier, households should reduce their exposure to housing and increase their exposure to stocks in order to achieve higher expected return at optimal risk levels. For example, to achieve an expected return of 7.75% (9.10%) with a standard deviation of 7.70% (13.90%), households should hold about 50% (slightly less than 10%) of their wealth in the form of housing and allocate about 80% (90%) of their remaining wealth to stocks and invest the rest in bonds.

The results suggest that homeowners can allocate a substantial portion of their wealth toward housing and still remain on the efficient frontier. However, households strive to reach higher expected returns must allocate the majority of their portfolio to stocks and materially shrink their asset allocation toward housing. Given that only conservative households would like to invest in the lower end of the efficient frontier in terms of expected return, it would be fair to assume that the main beneficiaries from homeownership are the wealthier households. This is due to the fact that only wealthier households are able to own a home and at the same time allocate a relatively small portion of their wealth toward housing. Less wealthy households that are unable to own the house they desire while allocating the majority of their wealth to stocks must either accept lower expected returns on their wealth portfolio or opt to rent their primary residence.

Conclusion

In this paper, we analyze the buy versus rent decision in a framework of households' portfolio choice. A few papers in the literature explore the social and economic benefits associated with homeownership while other papers explore housing in the context of household portfolios. However, this is the first paper, to our knowledge, that considers the buy versus rent decision and housing as a part of a household's portfolio simultaneously. This contribution is material because the buy versus rent decision is not an independent decision from the selection of an optimal household's portfolio holding.

When all of the costs and benefits of ownership are balanced against renting, the results suggest that portfolios that exclude housing/ownership as one of their assets (i.e., renter) generally outperform the homeowners' portfolios in terms of the raw expected rate of wealth creation. However, in terms of risk-adjusted wealth creation, we show that homeownership can improve the households' portfolios, but only for households for which the down payment they apply toward housing

is substantial and, at the same time, not an overwhelmingly high portion of their overall wealth.

Our results also carry lessons for policymakers who seem to currently favor the use of leverage to create homeownership often via ''all-in'' wealth and highly leveraged financing strategies. According to our analysis, households that follow such a strategy are likely to grow their wealth more slowly on both a raw and risk-adjusted basis. Most interestingly, when nearly 100% of overall households' wealth is invested in housing, households are likely to end up facing inferior raw and risk-adjusted returns.

It is important to re-emphasize that within our construct, individuals that choose to rent must re-invest down payment monies and monthly rent differentials. We do this to provide a more fair investment comparison between buying and renting. However, is it realistic to assume that most individuals will follow such a strategy with monastic vigor? Might not many individuals fall short on this requirement? How would this failure to follow through with this modeling requirement impact our results? It is not clear at this point. Further research, therefore, seems warranted.

Endnotes

[1] During some short time periods, however, when credit requirements are relaxed, most notably the housing boom of the early 2000s, purchasing a home with no down payment was not an uncommon practice.

[2] The data are available on Morris A. Davis' website: http://morris.marginalq.com/.

[3] Data are available through Ken French's data library: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

[4] The St. Louis Federal Reserve calculates the yield on long-term bonds using bonds with remaining maturities as close as possible to 30 years. (http://research.stlouisfed.org/fred2/categories/119).

[5] Throughout the paper we set the tax rate on returns from stocks and bonds to 20%.

[6] We thank an anonymous referee for suggesting this reference as a guideline for estimating the cost of homeownership.

[7] Our model triggers default in cases that housing equity turns negative. However, recent studies by Seiler and Walden (2014) and Seiler (2015) provide evidence that the decision to default is often also affected by behavioral factors.

[8] We set *hp* to eight years, which is the average tenure U.S. households remain in the primary residence they own (Hansen, 1998). For robustness, we vary *hp* through a range of alternative lengths without any substantive change in the results.

[9] There is one exception, of course, and that is when 100% of wealth is in the form of home equity. In that case, the homeowner's portfolio includes only one asset. This is true here as well as in all other three-asset scenarios.

[10] We assume that homeowner households borrow funds at their mortgage interest rate.

[11] Except in extreme cases where housing price appreciation exceeds $500K for a household with a married couple that files jointly.

References

Beracha, E. and K.H. Johnson. Lessons from over 30 Years of Buy versus Rent Decisions: Is the American Dream Always Wise? *Real Estate Economics*, 2012, 40, 217–47.

Cauley, S.D., S.D. Pavlov, and E.S. Schwartz. Homeownership as a Constraint on Asset Allocation. *Journal of Real Estate Finance and Economics*, 2007, 34, 283–312.

Cocco, J.F. Portfolio Choice in the Presence of Housing. *Review of Financial Studies*, 2005, 18, 535–67.

Davis, M., A. Lehnert, and R. Martin. The Rent-Price Ratio for the Aggregate Stock of Owner-Occupied Housing. *Review of Income and Wealth*, 2008, 54, 279–84.

Di, Z.X., E. Belsky, and X. Liu. Do Homeowners Achieve More Household Wealth in the Long Run? *Journal of Housing Economics*, 2007, 16, 274–90.

Dietz, R.D. and D.R. Haurin. The Social and Private Micro-Level Consequences of Homeownership. *Journal of Urban Economics*, 2003, 54, 401–50.

DiPasquale, D. and W. Wheaton. *Urban Economics and Real Estate Markets*. Englewood Cliffs, NJ: Prentice-Hall, 1996.

Flavin, M. and T. Yamashita. Owner-Occupied Housing and the Composition of the Household Portfolio. *The American Economic Review*, 2002, 92, 345–62.

Fu, Y. A Model of Housing Tenure Choice: Comment. *The American Economic Review*, 1991, 81, 381–83.

Gallo, J.G., L.J. Lockwood, and Y. Zhang. Structuring Global Property Portfolios: A Cointegration Approach. *Journal of Real Estate Research*, 2013, 1, 53–81.

Green, R.K., G.D. Painter, and M.J. White. Measuring the Benefits of Homeowning: Effects on Children Redux. Research Institute for Housing America, 2013.

Hansen, K.A. Seasonality of Moves and Duration of Residence. U.S. Census Bureau Current Population Reports. *Household Economic Studies*, October, 1998, 70–66.

Haurin, D.R., P.H. Hendershott, and S.M. Wachter. Wealth Accumulation and Housing Choices of Young Households: An Exploratory Investigation. *Journal of Housing Research,* 1996, 7, 33–58.

Haurin, D.R., T.L. Parcel, and R.J. Haurin. Does Homeownership Affect Child Outcomes? *Real Estate Economics*, 2002, 30, 635–66.

Henderson, J.V. and Y.M. Ioannides. A Model of Housing Tenure Choice. *The American Economic Review*, 1983, 73, 98–113.

Holian, M.J. Homeownership, Dissatisfaction and Voting. *Journal of Housing Economics*, 2011, 20, 267–75.

Holupka, S. and S.J. Newman. The Effects of Homeownership on Children's Outcomes: Real Effects or Self-Selection? *Real Estate Economics*, 2012, 40, 566–602.

Hu, X. Portfolio Choices for Homeowners. *Journal of Urban Economics*, 2005, 58, 114–36.

Kishor, N.K. and S. Kumari. Consumption-Wealth Ratio and Expected Housing Return. *Journal of Real Estate Research*, 2014, 36, 87–108.

Matthews, J.W. and G.K. Turnbull. Neighborhood Street Layout and Property Value: The Interaction of Accessibility and Land Use Mix. *Journal of Real Estate Finance and Economics*, 2007, 35, 111–42.

Painter, G. and C.L. Redfearn. The Role of Interest Rates in Influencing Long-Run Homeownership Rates. *Journal of Real Estate Finance and Economics*, 2002, 25, 243–67.

Phillips, R.A. and J.H. VanderHoff. The Conditional Probability of Foreclosure: An Empirical Analysis of Conventional Mortgage Loan Defaults. *Real Estate Economics*, 2004, 32, 571–88.

Rohe, W.M., S. Van Zandt, and G. McCarthy. Social Benefits and Costs of Homeownership. In *Low Income Homeownership*, P. Retsinas and E.S. Belsky (eds.). Cambridge, MA: Joint Center for Housing Studies, Brookings Institution Press, 2002a, 381–406.

——. Home Ownership and Access to Opportunity: A Review of the Research Evidence. *Housing Studies*, 2002b, 17, 51–61.

Seiler, M.J. Do as I Say, Not as I Do: The Role of Advice versus Actions in the Decision to Strategically Default. *Journal of Real Estate Research*, 2015, 37, 191–215.

Seiler, M.J. and E. Walden. Lender Characteristics and the Neurological Reasons for Strategic Mortgage Default. *Journal of Real Estate Research*, 2014, 36, 341–62.

Seiler, M.J., J.R. Webb, and N. Myer. Diversification Issues in Real Estate Investment. *Journal of Real Estate Literature*, 1999, 7, 163–79.

Shelton, J.P. The Cost of Renting Versus Owning a Home. *Land Economics*, 1968, 59–72.

Silos, P. Housing, Portfolio Choice and the Macroeconomy. *Journal of Economic Dynamics and Control*, 2007, 31, 2774–2801.

Sinai, T. Taxation User Cost and Household Mobility Decisions. Mimeo. The Wharton School, University of Pennsylvania, 1997.

Tu, C.C. and M.J. Eppli. Valuing New Urbanism: The Case of Kentlands. *Real Estate Economics*, 1998, 27, 425–52.

Webb, J.R., R.J. Curcio, and J.H. Rubens. Diversification Gains from Including Real Estate in Mixed-Asset Portfolios. *Decision Sciences*, 1988, 19, 434–52.

Webb, J.R., and J.H. Rubens. How Much in Real Estate? A Surprising Answer. *Journal of Portfolio Management*, 1987, 13, 10–14.

Yao, R. and H.H. Zhang. Optimal Consumption and Portfolio Choices with Risky Housing and Borrowing Constraints. *Review of Financial Studies*, 2005, 18, 197–239.

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