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Mortgage Debt: The Good News

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Mortgage Debt: The Good News

Executive Summary

- The usual advice given to the public by financial planners and the popular press is that less debt is better and in particular owning your own house outright is a desirable goal.
- We show that this advice is often wrong because mortgage debt acts as an inflation hedge. Mortgage debt also has a valuable refinancing option in case interest rates fall and an abandonment option if the value of the property declines.
- Mortgage debt is often seen simply as necessary because of people's limited financial assets. Specifically, people can purchase a home only if they resort to borrowing. Employing a numerical model, we demonstrate that some level of mortgage debt is valuable to many individuals who do not face such a constraint.
- The model is able to simulate over a wide range of plausible assumptions the impact of mortgage debt on a household's wealth. Home ownership provides households a hedge against rental increases, but exposes them to the vagaries of the local real estate market. Our model shows that mortgage debt allows individuals to hedge against inflation and local market risk.
- The model allows an analyst to vary assumptions to examine the impact of the mortgage decision on a particular household.

Mortgage Debt: The Good News

The usual advice given to the public by financial planners and the popular press is that less debt is better and in particular owning your own house outright is a desirable goal. For example, Liz Pulliam Weston, in her syndicated column *Money Talk,* advises readers to purchase their homes without using a mortgage if they have the cash to do so.[1] This is commonly accepted advice based on the understandable temptation to borrow excessively to finance current consumption. In this paper we show that this advice can be seriously misguided, because mortgage debt is an inflation hedge. Mortgage debt also contains several valuable options that must be considered in determining a household's optimal level of debt. We present a simple but realistic model in which the consumer has a choice of the level of housing debt and show that in general the optimal choice is not zero.

Economists and financial advisors frequently view mortgage debt as necessary because of people's limited financial assets. Specifically, people can purchase a home only if they resort to borrowing. Without question, many households would be severely constrained in their housing choice if it were not for mortgage debt. But many households can choose the size of their mortgage. For them, the choice is a function of the amount of their financial wealth they decide to concentrate in their home.

A central element of this paper is to distinguish between the house as a hedge against increases in local market rental costs and the mortgage as a hedge against inflation.   A hedge can be defined as a position in a financial or real asset that offsets fluctuations in another asset, liability or commitment in an individual's total portfolio.

Monetary debt decreases in real value with inflation and can thus offset declines in the real value of the assets that are not fully responsive to inflation. These assets may include labor, portfolio or retirement income, and a home. While housing in general is a hedge against inflation, a particular house in a local housing market may not be. Owning a home outright protects the homeowner only against increases in the price of housing services in the local real estate market. Consider a simple example. Ms. Farrell has saved diligently and owns outright her home valued at $100,000. She plans to retire in 20 years and expects her income adjusted for inflation to stay constant over that time. Suppose now that inflation increases unexpectedly by an average of 2% per year over the next 20 years. Even this modest rate implies that the price level will be approximately 50% higher than it is today. Suppose that in 20 years Ms. Farrell finds that her house is located in a neighborhood where housing prices have stayed relatively flat. The real value of the house is now approximately 50% of what it was 20 years ago, and her plan to retire and buy a home in the Sunbelt may be derailed. In contrast, if Ms. Farrell had a mortgage, her mortgage liability would unambiguously decrease by an amount that matches the increase in the price level.

Housing prices in particular markets may not only fail to keep pace with national housing prices, or with inflation, but may actually decline. For example, if Ms. Farrell works for a firm in a town where that firm is the major employer, concentrating her wealth in a home is probably a bad idea. If the firm moves, downsizes or goes out of business, she will likely experience a substantial decrease in the value of her home in addition to a loss of labor income. The homeowner also faces the danger that the local neighborhood may deteriorate. A new road, zoning changes or crime in an area may

make a particular location undesirable. Mortgage debt allows the homeowner to capture the upside in local housing prices while allowing her to use the saved equity to diversify into other investments (possibly including real estate investment in other geographic regions) and thus cushions the blow if local real estate conditions deteriorate.

The fixed rate mortgage is a particularly attractive form of debt because of the relatively low rates typical of home mortgages, favorable tax treatment, typically long life, and embedded options. The tax deductibility of mortgage interest is valuable to middle and higher income households that often have a choice as to the mortgage amount. The long term nature of mortgages is an advantage because it maximizes the wealth transfer of unanticipated inflation to debtors. In addition, the ability to refinance a fixed rate mortgage provides a valuable imbedded option. An option gives the owner the right to buy or sell an asset at a pre-agreed upon price. Refinancing is just such an option. Should disinflation occur and interest rates drop sufficiently, it will pay to exercise that option by paying off the mortgage and refinancing at the lower interest rate. Another less commonly exercised option embedded in many home mortgages is the ability of the homeowner to abandon the house if the value of the house should fall sufficiently below the remaining principal balance of the mortgage (although some state laws on deficiency judgments may limit the value of this option). Obviously, unlike the refinancing option, this would only be exercised in extreme cases. Overall, mortgage debt can provide a hedge against inflation and downside protection against disinflation and the vagaries of the local housing market.

Literature Review

The academic literature, personal finance textbooks and investment advice in the popular press generally recognize that home ownership is a hedge against increases in local rental prices (Sinai and Souleles, 2001) or inflation in housing prices (Fama and Schwert (1977). There is also a substantial body of research on the relationship between returns on various real estate investments and returns on stocks and bonds, and on real estate investments generally and inflation. See Benjamin, Sirmans and Zietz (2001) for a review of 128 academic papers on risk and return on real estate and other investments. They conclude based on their reading of the literature that real estate is generally a hedge against inflation but that the results vary based on location and type of real estate and on the methodology and sample period employed.

An extensive body of literature exists on life cycle implications for consumption, asset allocation and risk management (see, for example, Gomes and Michaelides (2002)). The usual advice is that given shorter investment horizons, older people should invest less in risky stocks and more in bonds. Malkiel (1999) states: "The longer the time period over which you can hold on to your investments, the greater should be the share of common stocks in your portfolio." (p. 355)

This literature recognizes that many people in retirement are living on fixed incomes and that this is an important factor in asset allocations. Jagannathan and Kochrlakota (1996) show that a person's labor income correlation with stock returns is important in determining the optimal life cycle portfolio allocation to stock.

While the literature clearly recognizes that a fixed income stream exposes individuals to inflation risk, and that retirement planning requires a calculation of

expected inflation (Gitman and Joehnk, 2002, p. 607) there is little recognition that mortgage debt can serve as a hedge against unanticipated inflation. In fact, owning a home "free and clear" is often explicitly stated as a goal by financial planners and advisors. They often recommend making extra, perhaps bi-weekly, mortgage payments (Rejda and McNamara 1998, pp. 246-7) or shortening the maturity upon refinancing to pay off the mortgage sooner. In an article in the *Wall Street Journal*, August 20, 2003, Jonathan Clements cautions homeowners against extending the maturity of their mortgages when they refinance. He quotes Chris Mayer of Columbia University as saying "There are a lot more people who are going to reach retirement age with mortgages outstanding, rather than a paid-off house. These people are either going to have to find some way of paying off their mortgage or they're going to have to work longer or work part-time in retirement." Richard P. Halverson (2003) states: "Do not stretch your refinanced mortgage out as far as possible. For example, if you currently have 20 years remaining on your original 30-year mortgage resist the temptation to extend your refinanced mortgage back out to 30 years, even though you will reduce your new monthly payments."

Analysis and advice on reverse mortgages appear to be an exception. But even here, this mortgage is usually presented as a means of unlocking illiquid equity that has accumulated in owner-occupied houses. Because of transactions costs, moving costs and discontinuities, homeowners find it difficult to liquidate their housing investments on the spot market. The goal of the reverse mortgage is to enable retired persons to continue to live in their own homes while simultaneously drawing down their housing investment and maintaining a desired consumption level (Clauretie and Sirmans, 1999, p. 114). The

literature analyzing or advocating the use of reverse mortgages does not generally recognize the hedge against unanticipated inflation that mortgage debt provides.

The Model

We employ a numerical model in which the relationship between inflation and the mortgage decision can be analyzed with actual numbers under various scenarios. This technique is sometimes referred to as Monte Carlo simulation. We refer to it as a numerical model because initially a simple analysis is done on a spreadsheet. The simple model also lends itself to sensitivity and scenario analysis because the parameters can be changed to examine alternative scenarios.

Monte Carlo simulation is particularly valuable when the relationships are complex. An additional advantage of the Monte Carlo simulation is that we can model uncertainty in key input variables and obtain a quantitative estimate of the likely effect on either a particular household or a representative homeowner.

The model can provide guidance to households in realistic situations where a theoretical model can at most indicate a general interaction among the variables. The model can incorporate reasonable assumptions about a typical household or be tailored to a specific household. In the application presented here, we incorporate actual past statistical behavior of the various variables and their cross-correlations in the model.

The model assumes that a household must decide whether to own their home outright or to use a mortgage to finance it. We first develop an Excel spreadsheet that can be easily replicated to analyze the impact of unexpected inflation on a homeowner with or without a mortgage. The model can also be used to examine the consequences of

different levels of mortgage debt. Unfortunately, the spreadsheet model cannot capture the interaction of variables under risk and uncertainty. We therefore make the model more realistic by incorporating uncertainty using a software package called *@Risk Professional*. This adds considerable complexity to the model, but allows us to analyze uncertainty in each variable and the correlations between variables simultaneously.

While the theory of how inflation affects a household and interacts with mortgage debt is quite straightforward, providing practical guidance to a household is complex. First of all, the mortgage decision is only relevant when a household has a choice about the amount of their mortgage debt. Second, the decision depends upon a household's tax status. Third, the appropriate mortgage level is a function of the household's inflation exposure and optimism or pessimism about the local real estate market.

Clearly if a household has no choice about the mortgage level due to an income or wealth constraint, the size of the mortgage becomes irrelevant to their decision. For those that have a choice, and many households have some flexibility, the higher the household's tax bracket, the greater the advantage to the tax deductibility of mortgage interest. If a household is concerned that their income, or their non-human assets (in particular their home), may not keep up with inflation, a mortgage becomes much more attractive. On the other hand, if a household is very optimistic about the local real estate market, then the main advantage to mortgage debt is that it would enable them to speculate in the local real estate market either by investing in another property, or by buying a more expensive home. A household that borrows in order to buy "more house" in the belief that this is a good investment is actually speculating in the local real estate market.

There are two ways to demonstrate the effect of inflation as a function of the mortgage decision: One is to show the effect in real or base year's dollars, the other is to show the effect in current dollars. We take the latter approach. The impact of inflation shows up because not all assets respond equally to inflation, thus affecting the nominal wealth an individual has at retirement.

The Excel Spreadsheet Model

We model the investment decision by assuming that an investor begins with an initial endowment of wealth that is sufficient to purchase a home. We assume that the investor chooses to purchase the home outright, or alternatively, uses a fixed-rate, 30-year mortgage. If the mortgage option is selected, the investor will invest an amount equal to the initial mortgage in an alternative investment.

We consider three investment choices for the equity freed up by the mortgage. In the first scenario, the investor chooses to invest an amount equal to the initial mortgage in an inflation-protected investment vehicle such as Treasury Inflation-Protected Securities (TIPs). In the second scenario, the mortagor invests in a market index such as the S&P500, while in the third scenario the investment choice is a real estate investment trust (REITs).   The three investment choices are designed to model plausible alternative investments. A conservative, highly risk-averse investor interested in hedging inflation risk could invest in TIPs. The S&P500 may be an appropriate choice for investors desiring a diversified equity portfolio. Finally, an individual with plans to relocate at retirement may be interested in hedging against an increase in national housing prices and may therefore be interested in a REIT investment.   It should be noted that the model is

flexible enough to accommodate other investment alternatives, or combinations of investments.

For illustrative purposes, we model an individual with 20 years to retirement. We assume an initial wealth allocation of $250,000, a home price of $200,000, and initial income and non-housing consumption of $100,000 and $50,000, respectively. All of these assumptions can be altered to reflect the circumstances of a particular household.

If the individual decides to purchase the house outright, he/she is assumed to hold two equity accounts: a housing equity account and a non-housing equity account. In any period, the balance in the housing equity account is equal to the current market value of the home. If a mortgage is used, the balance in the housing equity portfolio is calculated by subtracting the remaining principal balance of any outstanding mortgage from the current period market value of the house. Under the mortgage alternative, an amount equal to the initial mortgage is deposited in either TIPs, the S&P500, or REITs. The return on the appropriate investment vehicle is added to this account, and mortgage principal and interest payments are paid out of this account.

For both the outright ownership and the mortgage option, any remaining initial wealth is deposited in TIPs. Additions to savings (income minus non-housing consumption minus housing maintenance costs) are also deposited in the TIPs account for both the mortgage and outright ownership options. The purpose of this specification is to provide a benchmark case in which the homeowner is already taking full advantage of opportunities to hedge against inflation by investing in TIPs. We can then quantify the additional hedging contribution provided by the mortgage. This assumption can easily be altered to allow investment in alternative vehicles. It is important to note, however, that

since this account is the same for both the mortgagee and the owner, changes in the investment alternative would affect both the mortgagor and the owner equally, and would therefore not change the incremental result.

Inflation does not affect all assets equally. The model therefore allows for separate consumption, income and housing inflation rates. These annual inflation rates can be thought of as anticipated or expected inflation rates. In addition, the model includes a one-time additional unexpected inflation shock, occurring in year 3 of the model. This additional inflation shock is assumed to immediately affect consumer prices, but is incorporated into income inflation with a three year lag. For many individuals, income does not immediately reflect changes in general inflation.

Local housing also is assumed to be unaffected by the inflation shock. This is consistent with a scenario where the local housing market does not follow national housing inflation trends because of a poor local economy, loss of a key employer, or deterioration of a particular neighborhood.

Incremental taxes are incorporated into the model by including taxes on investments and the tax savings associated with mortgage interest deductibility. Interest paid on the TIPs for a given year is assumed to be equal to the real interest rate at the time of the initial investment, plus the consumption inflation rate for that year. This interest is taxed in the year received at a marginal tax rate of 28%.[2] The return on the REIT or S&P500 investment is split into a dividend component and a capital gain component. The dividend component (assumed to be 30% of the S&P500 return and 45% of the REIT return) is taxed in the year received at the marginal tax rate. Taxes on the remaining capital gain portion is deferred until a withdrawal is made from the

investment account. To approximate the capital gains tax assessed against each withdrawal, we first calculate the ratio of cumulative deferred capital gains (less any gains taxed in a previous period), and divide this total by the account balance prior to the withdrawal. This ratio is then multiplied by the amount of the withdrawal to find the portion of the withdrawal that would be classified as capital gains.   The capital gain amount is then taxed at the capital gains rate (assumed to be 20%).   The interest portion of the mortgage payment is assumed to be fully deductible in the year paid, so the net interest payment is calculated as the interest payment due on the mortgage less the tax savings associated with the interest deduction.   The house is assumed to be a personal residence and therefore any capital gain on the house is exempt from taxation.

We allow refinancing of the mortgage if mortgage interest rates drop by more than 1%. We do not extend the term of the mortgage with refinancing, and we do not allow refinancing if fewer than 5 years remain on the mortgage debt. A transaction fee of 1% of the principal balance is assessed when a household refinances.

The assumptions underlying the Excel spreadsheet model are summarized in Exhibit 1.   As with any spreadsheet model, the inputs can be easily changed at the discretion of the user to reflect individual circumstances and beliefs about future inflation and investment returns.

To compare the purchase outright and purchase with mortgage alternatives, we examine the ending equity value as of the retirement date of the investor. This ending equity value is calculated by summing the market value of the investor's house and the value of any non-housing investments and subtracting the remaining principal balance on any outstanding mortgage.   The use of retirement date instead of equity value at death

was selected because it eliminates the need to introduce assumptions on life expectancy, social security or pension income. In addition, many individuals naturally relocate at retirement, and are interested in hedging against housing price increases that would occur at the time of relocation.

The Excel model is a static model, and therefore has the same limitations found in all such models. We use historical average risk premiums for the period from 1973 to 2003 to determine the returns on alternative investments, and we use historical inflation rates for the same period. However, the basic Excel model does not allow us to adequately model the uncertainty associated with inflation rates and investment returns. For example, although on average the risk premium associated with REIT investments has been positive, the realized risk premium for a particular period is frequently negative. Use of just the average risk premium to calculate the REIT return masks this uncertainty. If the uncertainty associated with the outright purchase of the house is less than the uncertainty associated with using a mortgage, the outright purchase may be preferred even if the average return on the non-housing equity portfolio is higher than the housing return. Therefore, after obtaining preliminary results using the simple Excel model, we develop a more sophisticated model that incorporates uncertainty in inflation and investment returns.

[Insert Exhibit 1 here]

Model with Uncertainty

The simple Excel spreadsheet can model static what-if analysis, but cannot fully capture the simultaneous uncertainty of many of the variables included in our model. Risk premiums on investments, anticipated inflation rates and the amount of future

unanticipated inflation shocks are all uncertain variables. To realistically model this uncertainty, we use *@Risk Professional*, a commercially-distributed Excel add-in software program. *@Risk Professional* allows the user to specify the value of any input cell as a random draw from a particular distribution. For example, the risk premium on the S&P500 could be modeled as a draw from a normal distribution with mean and variance equal to historical averages.   We specified distributions for the following input cells: the additional inflation shock, real interest rates, anticipated inflation rates for income, consumption and local housing, and risk premiums for mortgages, REITs, and the S&P500.   In general, normal distributions were used and means and variances for each variable were set equal to historical means and variances for the period from 1973 to 2003, as calculated by Ibbotson and Associates and reported in the *NAREIT Real Estate Chart Book*. It is important to note, however, that *@Risk Professional* is flexible enough to allow the user to input any distribution parameters.

In addition, *@Risk Professional* allows uncertain inputs to be correlated. For example, in our model we wanted income inflation and consumption inflation to be two separate inputs, because wages often change at a different rate than consumption inflation. However, we wanted the movements in these two variables to be positively correlated, as it would be unusual for a large increase in consumption inflation to be accompanied by a large decrease in income inflation. *@Risk Professional* allows the user to specify the degree of correlation between input variables; draws from distributions are conditioned upon the specified correlations. For our model, we correlated investment returns using historical correlation coefficients calculated by Ibbotsen and Associates and reported in the *NAREIT Real Estate Chart Book*. Distributional assumptions for each

input variable and the correlation matrix used to correlate inputs are shown in Appendices 1 and 2, respectively.

After specifying the distributions for uncertain variables (and any correlations between inputs), a simulation can be run under *@Risk Professional*. For each iteration in the simulation, *@Risk Professional* performs a random draw from the specified distributions, and places the value of each draw in the corresponding input cell. After drawing a value for each of the uncertain inputs in the spreadsheet, *@Risk Professional* calculates the spreadsheet. This process is repeated up to 10,000 times (the number of iterations is specified by the user). The user can then look at the distribution of values obtained for a particular cell. In our simulations, we are interested in the total equity available to the investor at retirement. We compare the distribution of this value under the mortgage alternative with the distribution of the value under the outright purchase alternative.

Results

Excel Spreadsheet Model

Results for each of three representative scenarios are shown in Table 1. For illustrative purposes, each scenario is based on an individual with 20 years until retirement. The model incorporates a one-time unanticipated inflation shock of 4% in year 3. In the first scenario, the individual invests an amount equal to the initial mortgage in TIPs. In the second and third scenarios, an amount equal to the initial mortgage is invested in the S&P500 and REITs, respectively. While all of the scenarios are based on an individual with 20 years until retirement, the model can be easily altered to accommodate shorter or longer investment horizons. As shown in Table 1, all of the

mortgage scenarios dominate the outright purchase option. Note that this is true even when the initial mortgage amount is invested in a relatively conservative investment such as TIPs. The TIPs results are particularly interesting because this result shows that the mortgage benefit is not due solely to a leverage effect. Even when the initial mortgage is invested in a vehicle with a low return, the mortgage alternative outperforms outright ownership.

[Insert Table 1 here]

Results from Model Incorporating Uncertainty

For the model incorporating uncertainty, we again use as an illustrative case an individual with 20 years to retirement. As in the basic Excel model, the differences in the scenarios reflect differences in the investment vehicle chosen for the mortgage proceeds. In the first scenario, the individual invests an amount equal to the initial mortgage in TIPs, while in the second and third scenarios, the selected investment vehicle is the S&P500 and REITs, respectively. For each scenario, 1,000 iterations were completed. A graph of the cumulative probability distribution of the ending equity value of all investments (as of the retirement date) was then generated for the purchase outright and purchase with mortgage options (see Figure 1). Note that for a particular point on the cumulative probability distribution, the y-axis value represents the probability of obtaining an ending equity value that is at least as great as the x-axis value.

Figure 1 shows that, for the particular scenarios chosen, the mortgage alternative in each case dominates the outright ownership alternative. The distribution of outcomes for the mortgage alternatives always lies to the right of the no-mortgage outcome. In other words, since the ending equity value for the mortgage case is always to the right of

the no-mortgage case, the individual is unambiguously better off. This is a case of first degree stochastic dominance.

[Insert Figure 1 here]

We conduct sensitivity analysis on our results by examining the impact of changes in the size of the additional inflation shock and in the size of the mortgage. In Figure 2, we assume an individual with 20 years to retirement, and assume that an amount equal to the initial mortgage proceeds is invested in REITs. We then re-run the *@Risk Professional* simulations eight times. The first simulation assumes that the additional inflation shock is zero. Each subsequent simulation increases the additional inflation shock by 1%. This sequential simulation allows us to examine the impact of an increase in the size of the inflation shock on the mean equity value at retirement. As expected, the larger the additional inflation shock, the larger the incremental benefit of the mortgage alternative.

[Insert Figure 2 here]

Figure 3 uses a similar approach to examine the incremental benefit to the mortgage alternative as the size of the mortgage is varied. We begin with the same set of assumptions used to generate Figure 2, except that the additional inflation shock has a mean of 4%. The first simulation assumes a mortgage equal to 20% of the cost of the home. In the second simulation, the mortgage is equal to 30% of the cost of the home. Subsequent simulations increase the size of the mortgage in 10% increments until the size of the mortgage is equal to 90% of the cost of the home. The incremental benefit of the mortgage alternative increases as the size of the mortgage increases.

[Insert Figure 3 here]

Implications and Conclusions

We have shown that under realistic circumstances mortgage debt totally dominates the no debt outcome. This is not a general conclusion because mortgage debt is not a costless position. There is an explicit cost to mortgage debt. Depending on the scenarios chosen the outcomes might not have been as favorable. It is also possible that the local real estate market outperforms the national market. In this case, using a mortgage as an inflation hedge will result in investment performance that is inferior to the no-mortgage option. A hedged position, of course, implies that some gains are foregone to avoid big losses. However, the central proposition that mortgage debt is an attractive inflation hedge for many households remains valid.

The chief advantage of our numerical model is that we can examine the likely outcome for a broad range of individuals and inputs. An individual can vary the inputs and distributional assumptions and converge to what is likely the optimal mortgage for that household. For example, the model can be used to examine the impact of life cycle or the term of the mortgage loan on the incremental benefit to the mortgage alternative. Moreover, the model can be further refined to consider a broader set of assets and combinations of assets.

Exhibit 1

Key Assumptions Used in Excel Spreadsheet Model

1)   Housing cost is exogeneous and is the same regardless of whether the house is purchased outright or financed with a mortgage.   An initial housing cost of $200,000 was used in the simulation model for all scenarios.

2)   For the mortgage alternatives, and amount equal to the initial mortgage proceeds is invested in one of the following: TIPs, the S&P500 index, or REITs. For both the mortgage and purchase outright alternatives, all other non-housing equity is invested in TIPs

2)   Rate assumptions for investment returns are determined as follows:

Investment return = real interest rate + consumption inflation
   + risk premium for particular investment

In the spreadsheet model, historical averages for the period from 1973-2003 were used as inputs for the real interest rate, consumption inflation, and the risk premiums on the S&P500 and REITs.

3)   Three separate inflation rates are incorporated in the model: consumption inflation, income inflation, and inflation in the local housing market. In addition, an additional inflation shock of 4% occurs in year 3 of the model. The additional inflation is incorporated immediately into consumption inflation, (and therefore into the non-housing investment returns), but is incorporated into income inflation only after a 3-year lag. The additional inflation shock is not incorporated into the local housing inflation rate.

4)   Initially, income is set at $100,000, and non-housing consumption is set at $50,000. Income increases annually at the income inflation rate, while consumption increases annually at the consumption inflation rate.

5)   The original mortgage term is assumed to be 30 years, (although the numerical model can accommodate any mortgage term). The original mortgage is refinanced if interest rates fall more than 1% below the original mortgage rate; multiple refinancings can occur. If a mortgage is refinanced, the term of the refinanced mortgage will match the remaining term of the original mortgage (i.e. no extension of the mortgage term occurs).   Regardless of the interest rate, refinancing will not occur if the remaining term on the mortgage is five years or less.

6)   Upon the retirement of the individual, any remaining mortgage principal balance is deducted from the sum of housing and non-housing accumulated wealth.

7)   The time to retirement is assumed to be 20 years (although the model can accommodate a time to retirement of a minimum of one year and a maximum of 50 years).

Table 1

**Total Equity Value at Retirement in 20 Years
Excel Results Without Uncertainty**

Without Mortgage	Scenario 1 With Mortgage (Investment in TIPs)	Scenario 2 With Mortgage (Investment in S&P500)	Scenario 3 With Mortgage (Investment in REITs)
4,182,603	4,262,279	4,911,805	5,120,026

Results are based on the assumptions shown in Exhibit 1. The individual is assumed to retire in 20 years. A one time unanticipated inflation shock of 4% occurs in year 3.

Figure 1
Ending Equity Value at Retirement
20 Years to Retirement
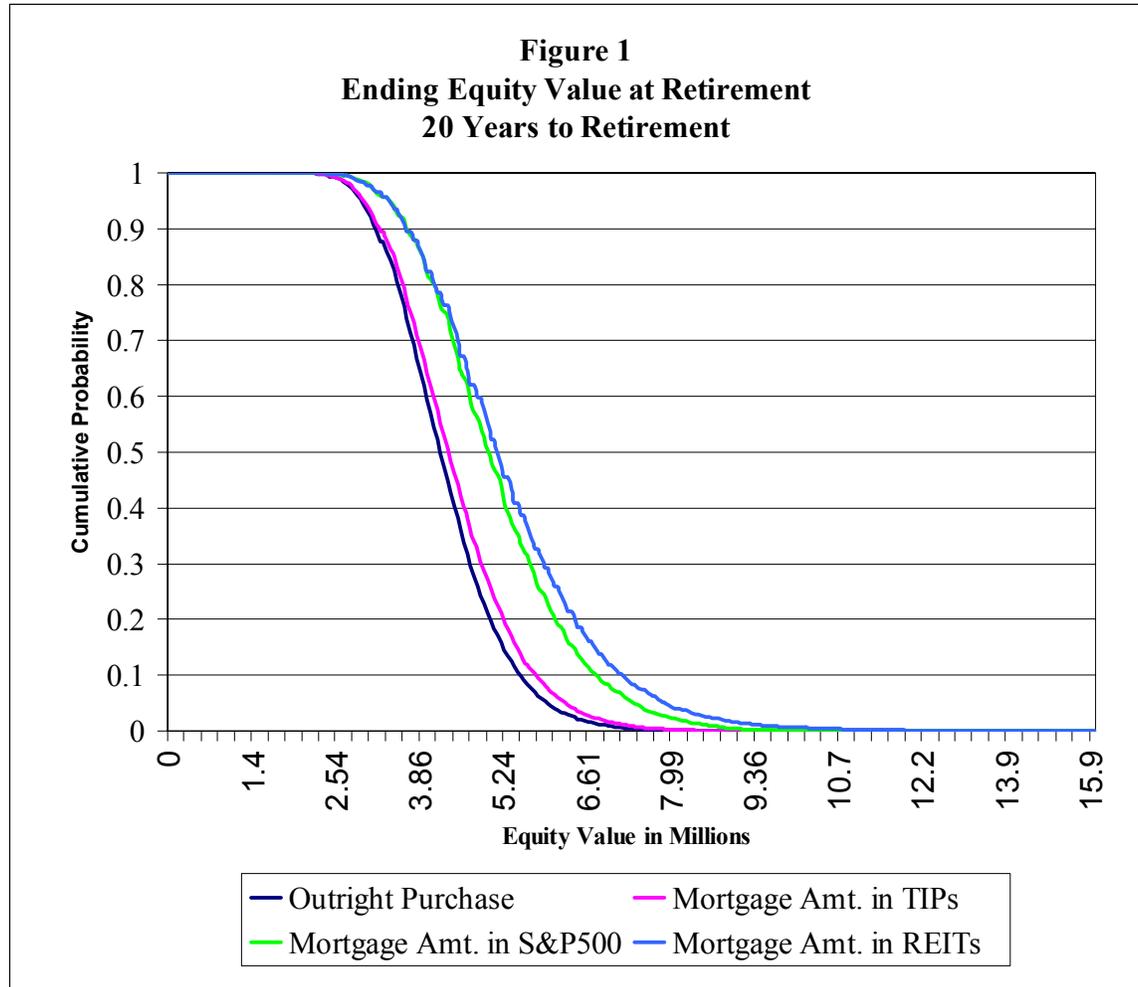
Simulation is based on assumptions detailed in Exhibit 1 and Appendix 1. Cumulative probability distributions are generated using @Risk Professional software and are based on 1,000 iterations for each simulation. For a particular point on the cumulative probability distribution, the y-axis value represents the probability of obtaining an ending equity value that is at least as great as the x-axis value.

Figure 2
Mean Value of Equity at Retirement Under Alternative Inflation Shocks
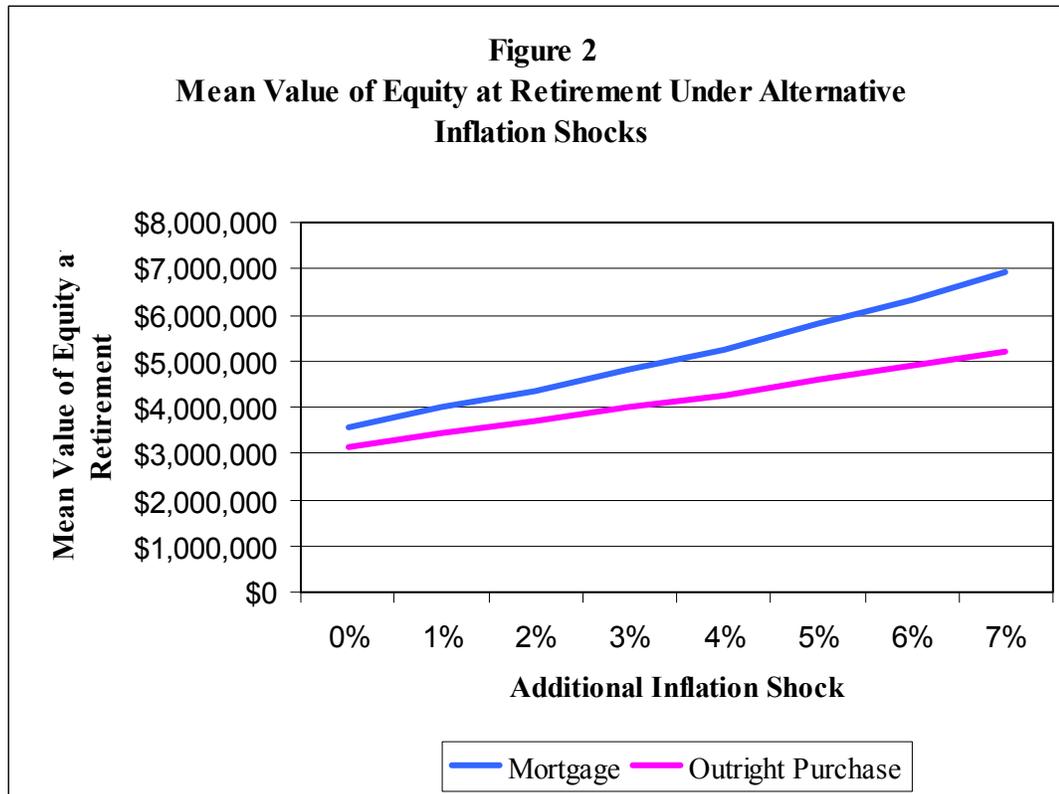
Simulation is based on assumptions detailed in Exhibit 1 and Appendix 1. Additional inflation shock is varied from 0% to 7% in 1% increments. For each additional inflation shock, @Risk Professional is used to generate the distribution of ending equity values at retirement. The mean ending equity value associated with each inflation shock is plotted for the mortgage alternative and the outright purchase alternative. The mortgage alternative assumes that an amount equal to the initial mortgage proceeds is invested in REITs.

Figure 3
Mean Value of Equity at Retirement Under Alternative Levels of Mortgage Debt
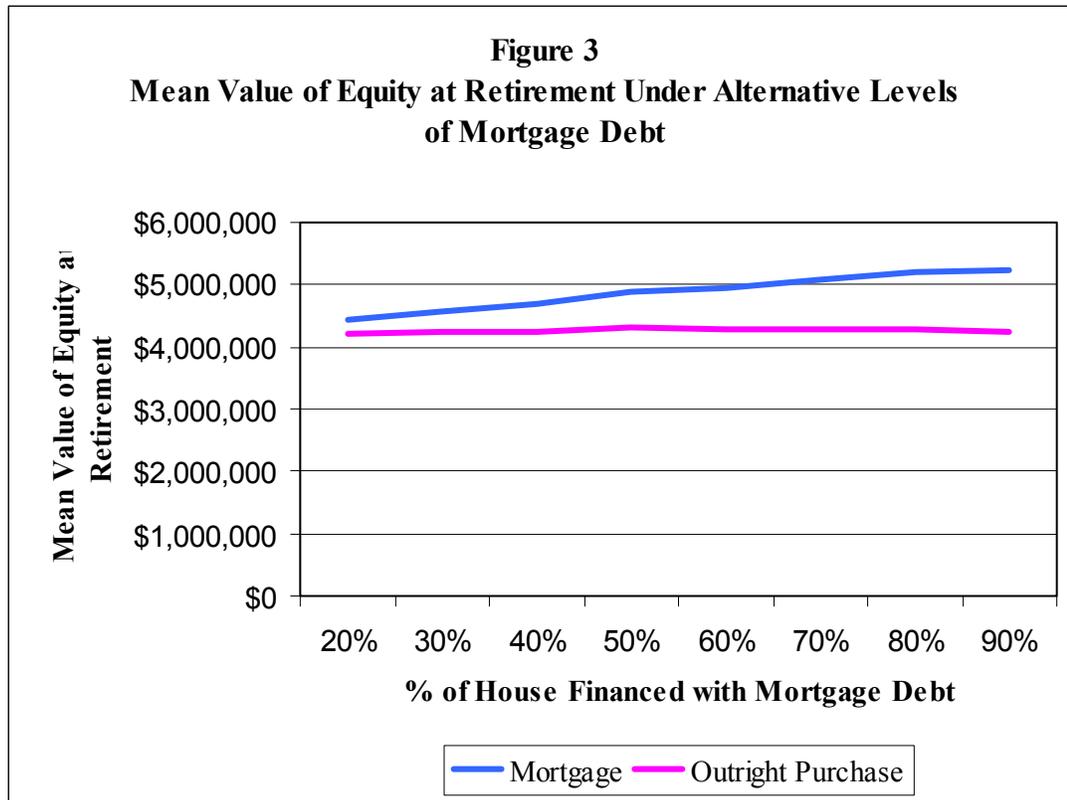
Simulation is based on assumptions detailed in Exhibit 1 and Appendix 1. The percentage of the house financed with mortgage debt is varied from 20% to 90% in 10% increments. For each mortgage debt amount, @Risk Professional is used to generate the distribution of ending equity values at retirement. The mean ending equity value associated with each mortgage debt amount is plotted for the mortgage alternative and the outright purchase alternative. The mortgage alternative assumes that an amount equal to the initial mortgage proceeds is invested in REITs. The additional inflation shock is assumed to have a mean of 4%.

Appendix 1
Distributional Assumptions Used in @RISK Simulations

Real Rate - Normal Distribution

        Mean (historical mean difference between 10 yr. Treasury and mean CPI (1973-2002)   4.588%

        Std. Deviation   0.001%

Anticipated Consumption Inflation – Normal Distribution

        Mean (historical mean CPI for 1978-2002)   4.492%

        Std. Deviation (historical standard deviation of CPI for 1978-2002)   3.146%

Unanticipated Inflation Shock – Beta Distribution

        Minimum   0%

        Most Likely   4.250%

        Mean   4.000%

        Maximum   7.000%

Risk Premium for Mortgage Expense - Lognormal Distribution

        Mean (historical mean difference between mean mortgage rate and 10 yr. Treasury

            (1973-2002)   0.130%

        Variance   0.010%

Risk Premium for Non-Housing Investment (S&P500) – Normal Distribution

        Mean (historical mean difference between S&P500 and 10 yr. Treasury (1973-2002)   2.230%

        Variance   3.096%

Risk Premium for Non-Housing Investment (REITs) – Normal Distribution

        Mean (historical mean difference between NAREIT Index and 10 yr. Treasury   3.760%

        Variance   3.950%

Income Inflation Rate - Uniform Distribution

        Minimum = Anticipated Consump. Inflat. + Unanticipated Consump. Inflat. - 1%

        Maximum = Anticipated Consump. Inflat. + Unanticipated Consump. Inflat. + 1%

Local Housing Inflation Rate - Normal Distribution

        Mean   4.000%

        Std. Deviation   3.000%

Appendix 2
Correlation Matrix for @Risk Inputs

year2 (6x6)	Rent!H13 Risk Premium for REIT Investment	Rent!C13 Anticipated Inflation Rate	Rent!G13 Mortgage Rate Risk Premium	Rent!I13 Risk Premium for Non-Housing Investment	Rent!N13 Income Inflation Rate	Rent!U13 Housing Inflation Rate
Rent!H13 Risk Premium for REIT Investment	1					
Rent!C13 Anticipated Inflation Rate	0.5	1				
Rent!G13 Mortgage Rate Risk Premium	0.15	0	1			
Rent!I13 Risk Premium for Non-Housing Investment	0.55	0	0.23	1		
Rent!N13 Income Inflation Rate	0	0.75	0	0	1	
Rent!U13 Housing Inflation Rate	0	0	0	0	0	1

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[1] Response to question appearing in Money Talk syndicated column on December 15, 2002 in the Orlando Sentinel and other newspapers.

[2] In reality, only the base interest rate on TIPs is paid annually. The face value of the TIP is increased by the inflation rate for the year, but is not paid until the maturity of the TIP. However, investors must pay tax on the increase in the face value in the year the increase occurs.