“The Impact of Asset Correlations on the Mortgage Term Decision?”

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Earlier studies reported that better financial results accrue to some borrowers when they select a 30-year mortgage coupled with a simultaneous investment plan rather than selecting a 15-year mortgage term and a subsequent investment plan. These earlier results were derived from computer simulations utilizing the historical average asset returns and standard deviations; however, the randomized returns were not constrained by the asset correlations. This limitation resulted in a slight understatement of the accumulated benefits associated with the 30-year mortgage term with a much greater understatement of the associated level of risk in earlier studies. However, the 30-year mortgage term accompanied with an investment strategy still provides superior financial results to a wide range of potential mortgagors and mortgage market conditions.

Key words: Mortgage, Retirement Planning, Retirement, Debt Planning

Introduction

The selection of a mortgage is both basic and complex**.** The mortgage decision is considered basic since most middle-class American's face this decision at some point in their life. Campbell and Cocco (2003) describe the complexities associated with this basic decisions as involving "many considerations that are at the frontier of finance theory: uncertainty in inflation and interest rates, borrowing constraints, illiquid assets, uninsurable risk in labor income, and the need to plan over a long horizon." Although the purchase of a home is often the largest single purchase and one of the most significant and complex financial decisions an individual will make, Talaga and Buch (1998) report that few homebuyers expend as much time on searching for a home mortgage as on the home search.

The mortgage financing decision has far reaching financial implications for a household. For example, the commitment of funds to the repayment of a mortgage result in a significant opportunity cost for the household and place a constraint on other household savings and consumption. In addition to the decrease in household budgetary flexibility, the household also is exposed to greater financial or default risk as a result of the increased debt servicing requirement associated with the mortgage. Given the significance of the household mortgage decision, Campbell and Cocco (2006) observation that "there has been surprisingly little work in mortgage decisions from the perspective of the household" is surprising.

Although mortgage instruments vary widely and can be very complex, consumers have minimal guidance on the mortgage selection process. In fact, the advice a borrower receives on how to optimize their mortgage financing decision is oftentimes conflicting. For example, a recent paper by Basciano and Grayson (2007) concludes that the opportunity costs associated with a 15-year contracted mortgage term exceeds the realized financial benefits and suggests that the 30-year mortgage is a better financing product for a wide cross-section of borrowers. Contrary to these findings, Orman (2005) suggests that mortgage borrowers are better off accelerating their mortgage principal payments even if it involves diverting contributions from their deferred retirement savings accounts.

The research findings presented in this paper are intended to assist financial planners in determining the "optimal strategy" a client should use to identify the proper mortgage financing. Further, the presented results provide a framework to evaluate the "optimal strategy" across a wide range of client characteristics and mortgage market conditions.

Literature Review

One way to view the mortgage financing decision is from the perspective of the lifecycle hypothesis. Ando and Modigliani's (1963) basic lifecycle hypothesis is characterized by a pattern of borrowing in the early years, saving in middle high earning years, and dissaving in the retirement years of a finitely lived individual. From this perspective, a household would select the mortgage that enables their earlier consumption needs while optimizing their ability to save and subsequently dissave during retirement.

Chen and Jensen (1985) suggest that the use of a mortgage results in a form of "forced savings". However, they also contend that households are either unable or unwilling to use their accumulated home equity for consumption in their later years. The selection of a 30-year mortgage as opposed to a 15-year mortgage may result in an increased ability for a household to diversify their wealth into other financial assets as a result of the lower commitment to this "forced savings". Consequently, a household may experience an increase in either or both their willingness or ability to accumulate and subsequently consume the invested assets outside of their home equity.

The decision whether or not to prepay a mortgage may offer additional insights applicable to the original mortgage term decision. Edleman (2001), Johnson (2000) and Storms (2000) all share a common conclusion that households are better off if they place their funds in an alternative investment than to prepay a mortgage as long as the after-tax rate of return on the financial investment exceeds the after-tax interest rate paid on the mortgage. By extension, a similar argument could be made concerning the original mortgage term if one views the decision to select a 15-year mortgage as a way to "pre-pay" a 30-year mortgage. It is important to also note that while the rate of return on mortgage prepayment is risk-free to the household, given that it is contractually set at origination, the rate of return on the alternative investment in financial assets is uncertain and therefore involves a greater level of risk. Also, a mortgage is oftentimes secured by an individual's personal residence and therefore is in part an emotional decision as well as a financial decision.

Marshall (1989) and McCartney (1989) begin by framing the mortgage term decision as an opportunity cost. More particularly, they contend that the decision involves a tradeoff between the decreased financing costs associated with selecting a 15-year mortgage term as compared to the 30-year mortgage term and the increased budgetary flexibility that would accrue as a result of selecting a 30-year mortgage term. Vrunik and Fisher (1995) indicate that the relative financial benefits associated with the 15-year or 30-year mortgage depend on the mortgagor's marginal tax rate and prevailing mortgage interest rates. They conclude that the 30-year mortgage provides greater financial benefits to individuals subject to higher marginal tax rates. Contrary to these findings, in practice, Dhillon, Shilling and Sirmans (1990) indicate that well-to-do individuals, the best candidates for a 30-year mortgage given their high relative marginal tax rates, are more likely to select a 15-year mortgage.

Kistner (1998) investigates the impact of interest, dividends and portfolio turnover on the mortgage term decision and reports that a 30-year mortgage offers potential advantages over a 15-year mortgage. Goff and Cox (1998) investigate the impact of tax deferred savings accounts on the financial results associated with selecting a 30-year mortgage term. They conclude a 30-year mortgage coupled with a tax-deferred savings account provides a significant benefit over a 15-year mortgage.

Tomlinson (1995) extends the discussion by introducing simulation methodology to analyze the risk associated with a 30-year mortgage with simultaneous investment account outperforming a 15-year mortgage. The results of the Tomlinson (1995) study indicate that the probability of a 30-year mortgage strategy outperforming a 15-year mortgage increase with the associated investment rates of return and the time horizon considered. Basciano (2003) and Basciano and Grayson (2007) extend the analysis of the 30-year mortgage and simultaneous investment plan to consider various mortgage rate environments, mortgage rate spreads, marginal tax rates, and investments asset classes. The results indicate that the 30-year mortgage and simultaneous investment plan outperforms the 15-year alternative across most marginal tax rates, investment classes and mortgage rate environments.

Palmer and Lown (2006) raises questions concerning the rate of return that a household could expect to earn on their alternative investments given recent research findings. The prior 15-year versus 30-year mortgage term studies use some measure of average historical return associated with equities, or other asset classes, and assume that households would experience this rate of return in future time periods e.g. the Ibbotson historical returns. According to Dalbar, Inc. (2001) over the 19-year period ending December 2002, the average annual return on equity mutual fund investments was 11.8%; however, the average return for equity mutual fund investors over the same time period was reported as only 2.6%. The large divergence between these averages is attributed to the short average holding period of investors (approximately 2.6 years) indicating a propensity to trade much more frequently than an assumed buy-and-hold strategy. Clements (2004) contends that there was a potential error in the calculation of equity mutual fund returns in Dalbar, Inc. (2001) and provides a revised average return for equity mutual fund investors of 8.2% during the identical time period. Assuming under the best case that the 8.2% reported by Clement (2004) is correct, this is still significantly lower than the rate of return assumed in the prior literature. It is important to note that the earlier contended benefits of the 30-year mortgage term were predicated upon an assumption of a "buy and hold" strategy either with no rebalancing or rebalancing under precisely dictated rules.

An additional concern raised by Palmer and Lown (2006) centers on the assumed portfolio allocation models employed in prior studies. They note that many of the earlier studies assumed a 100% equity investment by the household in the calculation of the opportunity costs associated with the selection of the 15-year mortgage term. Obviously, this assumption is tenuous at best as most households will hold various asset classes in their portfolio weighted appropriately to correspond with their degree of risk aversion. For a more detailed discussion of the household portfolio allocation decision and risk tolerance see Gutter (2000), Grable and Lytton (1998), Schooley and Worden (1996), Wang and Hanna (1997) and Sung and Hanna (1996).

Palmer and Lown (2006) also contend that the prior studies "inadequately address the long-term consequences of keeping or eliminating mortgages, since neither method addresses actual household behavior, nor provides a means for retrospective analysis of the decision." Based upon data from the Health and Retirement Survey covering the period 1992 through 2002, they assert that leveraged households appear ineffective in their ability to achieve higher asset gains relative to unleveraged households. They further contend that the elimination of mortgages prior to retirement may be a more "prudent recommendation," given the decrease in defined benefit plans as compared to recommending a longer mortgage term and investing the after-tax payment

Using a similar methodology to Tomlinson (1995) and Basciano and Grayson (2007), this paper extends the prior research by incorporating asset correlations into the simulation in order to obtain more accurate measures of the relative risk and returns associated with selecting a 30-year mortgage term as opposed to a 15-year mortgage term. Failure to specify correlations between the assets would imply an assumption of $r_{x,y} = 0$. As a result, if the return series had a higher degree of positive correlation, the earlier simulation results would be based upon a greater diversification benefit than actually available and result in an understatement of the observed levels of portfolio risk. For comparability to the earlier studies in this area various portfolio allocation models, portfolio rebalancing rules, transaction costs, marginal tax rates, and mortgage market environments are also considered.

Methodology

The optimal decision concerning selecting between a 30-year or 15-year mortgage is predicated upon an accurate calculation of the potential opportunity costs associated with the higher monthly payment associated with the 15-year mortgage term. The methodology employed in this paper to determine the associated opportunity costs is based upon the prior research of Goff and Cox (1998) and Basciano and Grayson (2007).

Specifically, a borrower is assumed to have two mortgage financing alternatives: a 15-year or 30-year mortgage term. It is assumed that an individual has the financial capacity to meet the higher monthly mortgage payment associated with the 15-year mortgage. Next, in order to evaluate the potential opportunity costs an investment account is coupled with the 30-year mortgage. Each month, an individual would either make the required payment on the 15-year mortgage or make the 30-year mortgage payment plus an investment. The amount of the monthly investment in the coupled account is determined by the monthly mortgage payment differential:

$$(PMT_{15} - PMT_{30}) \tag{1}$$

Given the tax deductibility of the mortgage interest, the incremental difference in tax savings between the two financing options is determined. First, for each month (T) the incremental difference in interest is identified:

$$Interest_{30,T} - Interest_{15,T}; \tag{2}$$

where,

$Interest_{30,T} = Balance_{30,T} * Interest\ Rate_{30} / 12$

$Interest_{15,T} = Balance_{15,T} * Interest\ Rate_{15} / 12$

In each month, the resultant interest differential (2a) is positive given the higher remaining mortgage balance at every (T) and the higher contracted interest rate associated with the 30-year mortgage. Next, the incremental tax shield (ITS) for each month (T) is determined as follows:

$$ITS_T = TS_{30,T} - TS_{15,T}; \tag{3}$$

where,

$TS_{30,T} = Interest_{30,T} * t_F$

$TS_{15,T} = Interest_{15,T} * t_F$

Where, t_F equals the borrower's marginal federal income tax rate. Note that is assumed that the borrower is able to itemize their mortgage interest as a deduction for income tax purposes, that they invest the ITS (3a) each month, and that the borrower's marginal tax rate (t_F) is constant over the planning period. Further, only federal income taxes are considered in this paper. If state taxes are included, the ITS in each period would be higher predicated upon the borrower's ability to deduct mortgage interest in the determination of their state income taxes.

In each month, the borrower is assumed to either (a) make their required payment on the 15-year mortgage or (b) make the required payment on the 30-year mortgage plus make a monthly contribution into an investment account. The monthly contribution into the investment account (MI_T) is determined as follows:

$$MI_T = (PMT_{15} - PMT_{30}) + ITS_T \qquad (4)$$

In order to accurately quantify the potential benefit associated with the mortgage financing options, it is necessary to equalize the time periods under consideration. This is achieved by assuming that subsequent to paying off the 15-year mortgage, the borrower would begin to make monthly contributions to an investment account. The amount of the monthly contribution would be equal to PMT_{15}. Given the matched holding period, the accumulated savings under the (a) 15-year mortgage with subsequent 15-year investment plan can be compared to (b) the 30-year mortgage with coupled 30-year investment plan. The incremental difference between the savings accumulated under the 30-year mortgage and the savings accumulated under the 15-year mortgage is referred to as the Net Benefit (NB). A positive NB (accumulated savings under the 30-year mortgage and simultaneous investment option less the accumulated savings under the 15-year mortgage with subsequent investment option) would indicate that a borrower obtained a financial benefit in a given scenario by taking out the 30-year mortgage with simultaneous investment as compared to the 15-year mortgage and subsequent investment option. Conversely, a negative NB would indicate a better financial outcome associate with a 15-year mortgage alternative.

In the calculation of the NB amount, assumptions are made concerning the type of investment account utilized, the current mortgage interest rate environment, the borrower's marginal federal income tax rate, the asset allocation of the investment account, and investment performance. The NB results presented later in the paper are based upon an initial mortgage amount of $100,000. Note that any indicated NB amounts are scalable to the initial borrowed amount.

We begin by looking at five potential mortgage rate environments based on the historic levels of interest rates observed in the United States from September of 1991 through January of 2005 as reported by Freddie Mac[1]. A borrower's mortgage payment is calculated for each rate environment using the historic mortgage rates and average interest rate spread (48 basis points) associated with the 30-year and 15-year. Next the two mortgage financing strategies described above are compared. Given that the monthly tax shield is a function of an individual's marginal federal income tax rate three marginal tax rates are considered: 15%, 25% and 28%.

Once the MI_T is determined it is assumed invested in a tax-deferred savings account using an asset allocation model based on the borrower's level of risk tolerance. Four asset allocation models are considered ranging from "Conservative" to "Aggressive Growth". For each asset allocation model, target investment weights are assigned to five investment categories. Table 1 presents the target weights across the four asset allocation models.

Table 1: Portfolio Allocation Models and Asset Class Weights

Allocation Model	Small Co. Stock	S&P 500	LT Corp Bonds	LT Govt Bonds	IT Govt Bonds	Total
Conservative	5%	15%	30%	20%	30%	100%
Blended	20%	30%	30%	10%	10%	100%
Growth	30%	40%	15%	5%	10%	100%
Aggressive Growth	40%	45%	10%	5%	0%	100%

On a monthly basis, the returns on each of the investment asset classes are randomly determined based on an assumed normal distribution and the respective historical means and standard deviations. In contrast to the earlier studies, in the generation of each monthly return, the simulation incorporates the historical correlations between the asset return series. All of the monthly data is based upon the Ibbotson data and the correlations are derived from the monthly return series. Table 2 below reports the monthly performance measures associated with the individual asset classes and Table 3 below reports the associated correlations.

[1] Mortgage interest data was obtained from Freddie Mac at www.freddiemac.com.

Table 2: Asset Class Monthly Mean and Standard Deviations

Asset Class	Mean	Standard Deviation
Small Company Stock	1.342%	8.440%
S&P 500	0.982%	5.528%
LT Corporate Bonds	0.497%	2.001%
LT Government Bonds	0.465%	2.274%
IT Government Bonds	0.437%	1.264%

Table 3: Asset Class Correlations Between Monthly Returns

	Sm. Co. Stock	**SP 500**	**LT Corp**	**LT Gov**	**IT Gov**
Sm. Co. Stock	1	0.826553381	0.159258281	0.068412969	0.043037267
SP 500	0.826553381	1	0.204128771	0.138283148	0.10043108
LT Corp	0.159258281	0.204128771	1	0.859515948	0.778702695
LT Gov	0.068412969	0.138283148	0.859515948	1	0.848664935
IT Gov	0.043037267	0.10043108	0.778702695	0.848664935	1

To analyze the impact of portfolio rebalancing on the observed NB, three rebalancing frequencies and two rebalancing thresholds are considered. The rebalancing frequencies investigated are monthly, quarterly and annual assuming rebalancing thresholds of 5% and 10%. Consequently, the portfolio is rebalanced at a specified time intervals (months, quarters or annually) if the observed portfolio weights are +/- 5% or 10% percent from the specified target weights depending on the specified threshold. Since rebalancing may result in transactions costs, three levels of potential transaction costs are investigated: 0%, 2.5% and 5%. The transaction costs are applied to both sales (redemptions) and purchases.

To summarize, various combinations of factors, 1,080 in total, are considered in the calculation of the NB including: (a) four asset allocation models (Table 1), (b) three potential rebalancing frequencies, (c) two potential rebalancing thresholds, (d) three assumed levels of transaction costs, (e) three assumed household marginal income tax rates, and (f) five levels of assumed mortgage rates. In addition to the selected allocation model, rebalancing frequencies, transaction costs, marginal tax rates and mortgage rates, the observed NB is a function of the underlying investment performance. The estimated monthly investment performance is based on an assumed normal distribution using the historical mean and standard deviation of return for each asset class as reported by Ibbotson taking into consideration the historical correlations between the various investment options. A simulation is utilized to replicate the random draw of monthly returns and corresponding NB.

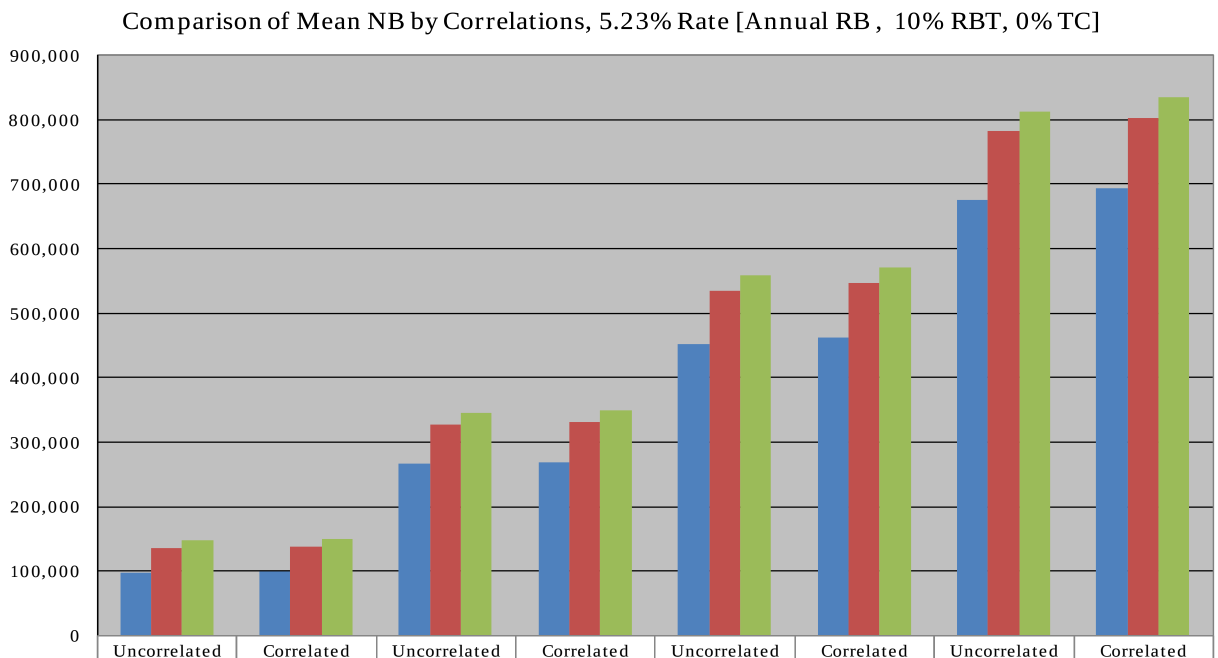
Results

Earlier studies reported that an individual could realize a positive net benefit, an increase in their terminal wealth, if they opted for a 30-year mortgage with a concurrent investment plan as opposed to opting for a 15-year mortgage with a subsequent investment plan. The earlier studies also reported that the net benefit associated with this 30-year strategy was negatively related to the level of the interest rate although a positive net benefit was reported even at historically high levels of mortgage rates. Further, the earlier studies indicated that the net benefit was also a function of the individual's marginal federal income tax rate, portfolio allocation model assumed, rebalancing frequencies, rebalancing thresholds and transaction costs.

To analyze the impact of the correlations between the assets on the performance measures associated with the 30-year strategy, two sets of simulations were conducted across all of the possible combinations of variables. The first set of simulations specified no correlations between the asset classes. These sets of simulations were conducted to reproduce the results utilizing the methodology employed in earlier studies. The second set of simulations specified the correlations between the various assets at their historical levels as calculated using the monthly returns reported by Ibbotson.

Figure 1 below reports the mean net benefit for the 30-year strategy assuming a 30-year mortgage rate of 5.23% assuming both correlated and uncorrelated asset return series. The mean net benefit is reported for each of the four hypothetical portfolio allocation models and three hypothetical levels of the individual's marginal federal income tax rates. In these simulation runs, the individual was assumed to rebalance their portfolio annually using a +/-10% rebalancing threshold and assuming that the individual would not incur any transaction costs.

Figure 1

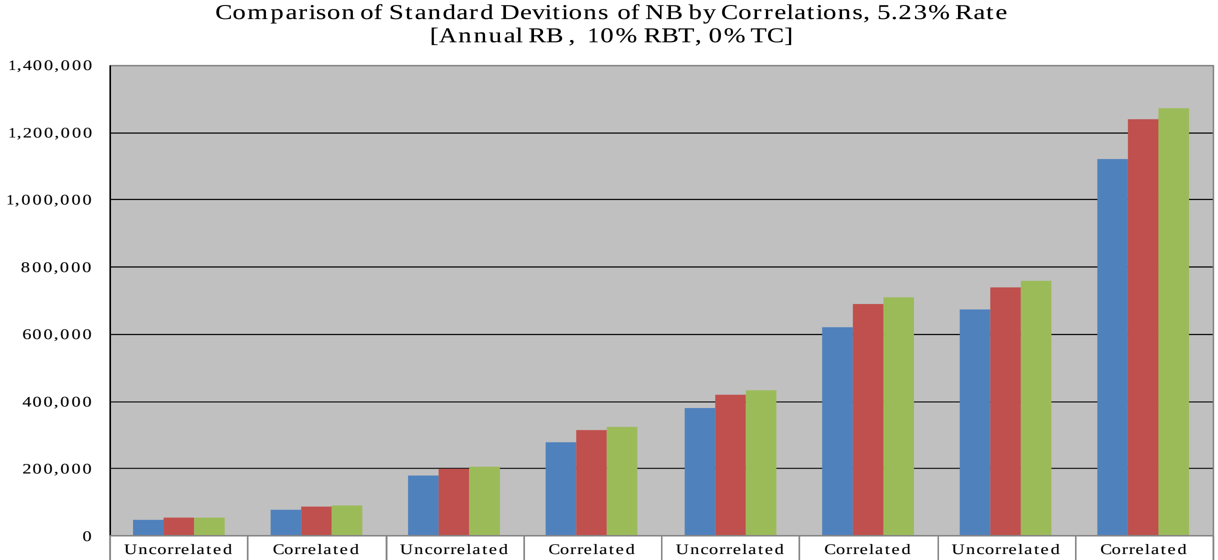


	Conservative		Blended		Gowth		Aggressive Growth	
	Uncorrelated	Correlated	Uncorrelated	Correlated	Uncorrelated	Correlated	Uncorrelated	Correlated
15%	99,126	100,057	268,489	270,103	453,184	463,469	676,680	695,093
25%	137,726	138,649	329,100	331,252	534,862	547,463	782,537	803,601
28%	149,173	150,390	347,081	349,657	559,404	572,540	814,216	836,215

The results reported in Figure 1 indicate that the mean net benefit is positively related to the individual's marginal federal income tax rate and that this result holds regardless of whether or not the correlations are specified. Further, as reported in earlier studies, the mean net benefit is related to the portfolio allocation model assumed and that the greater the proportion of the portfolio assumed invested in riskier asset classes the higher the observed net benefit. Interestingly, all of the reported net benefits are slightly higher when the correlations are specified in the simulation. This implies that the earlier reported net benefits had a slight downward bias.

Although the analysis of the mean net benefit is of some interest, asset correlations would not be expected to have any direct impact on the return dimension of performance. Rather, the more significant impact of the correlations is on the level of portfolio risk as measured by standard deviation. In a simulation where no correlation is specified between the assets, the imbedded assumption is that the correlation between the assets is zero. This assumption in turn would overstate the diversification benefits associated with a portfolio containing these assets in the case where there was a higher degree of positive correlation. Figure 2 below reports the corresponding standard deviations of the mean net benefits presented in Figure 1 for both the case where the assets are correlated and uncorrelated.

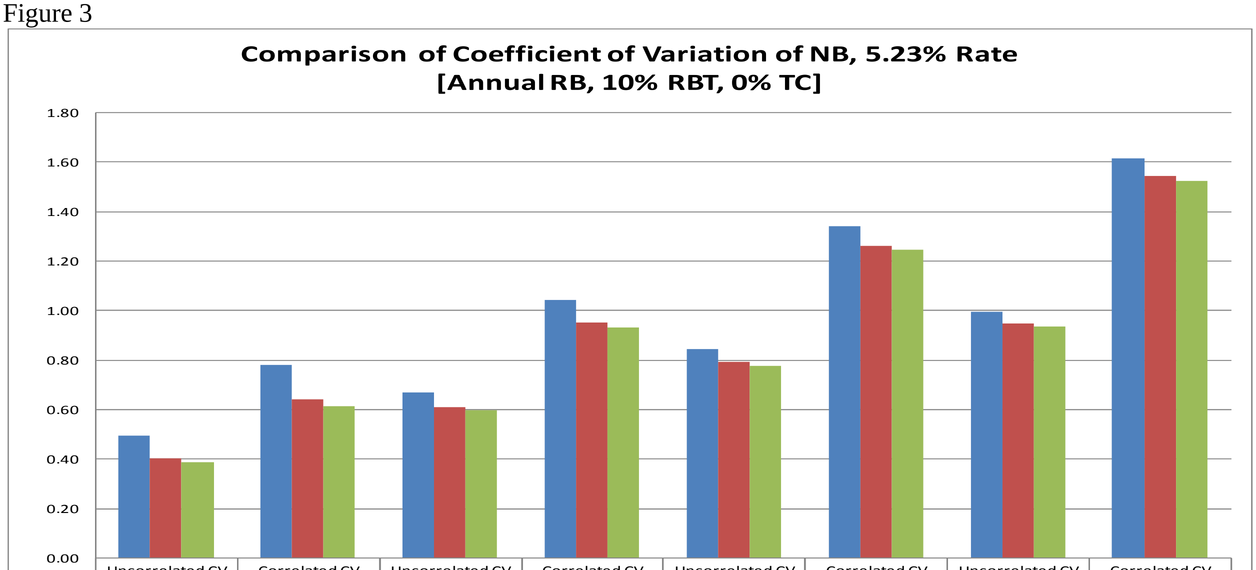
Figure 2



	Conservative		Blended		Gowth		Aggressive Growth	
	Uncorrelated	Correlated	Uncorrelated	Correlated	Uncorrelated	Correlated	Uncorrelated	Correlated
15%	48,702	77,935	179,541	280,709	382,096	620,208	672,951	1,121,541
25%	55,221	88,678	200,495	314,386	422,239	690,432	740,264	1,237,587
28%	57,240	92,220	206,956	324,693	434,502	711,306	760,509	1,272,599

The results in Figure 2 indicate that an assumption of uncorrelated returns between the assets within the various portfolios results in a rather large understatement of risk associated with the mean net benefit associated with the 30-year strategy. Taking into consideration both the risk and return dimensions, the coefficient of variations reported in Figure 3 indicate that the results in earlier studies vastly understated the amount of risk associated with the 30- year strategy.

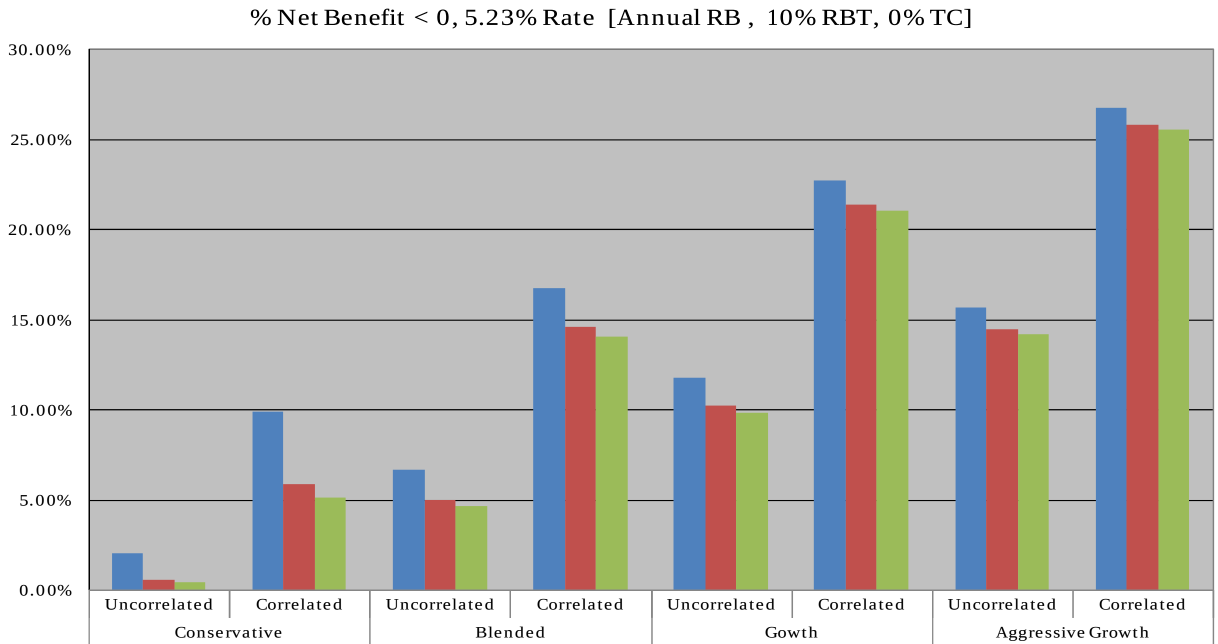
Figure 3



	Conservative		Balanced		Growth		Agressive Growth	
	Uncorrelated CV	Correlated CV	Uncorrelated CV	Correlated CV	Uncorrelated CV	Correlated CV	Uncorrelated CV	Correlated CV
15%	0.49	0.78	0.67	1.04	0.84	1.34	0.99	1.61
25%	0.40	0.64	0.61	0.95	0.79	1.26	0.95	1.54
28%	0.38	0.61	0.60	0.93	0.78	1.24	0.93	1.52

Another way to view the risk associated with the 30-year strategy is to consider the probability the resultant net benefit is actually less than zero. Figure 4 below reports the probability that the net benefit associated with the 30-year strategy is less than zero for both sets of simulation results. In the event that the net benefit is less than zero, an individual would have a higher level of terminal wealth if they had alternatively opted for a 15-year mortgage and subsequent investment program.

Figure 4

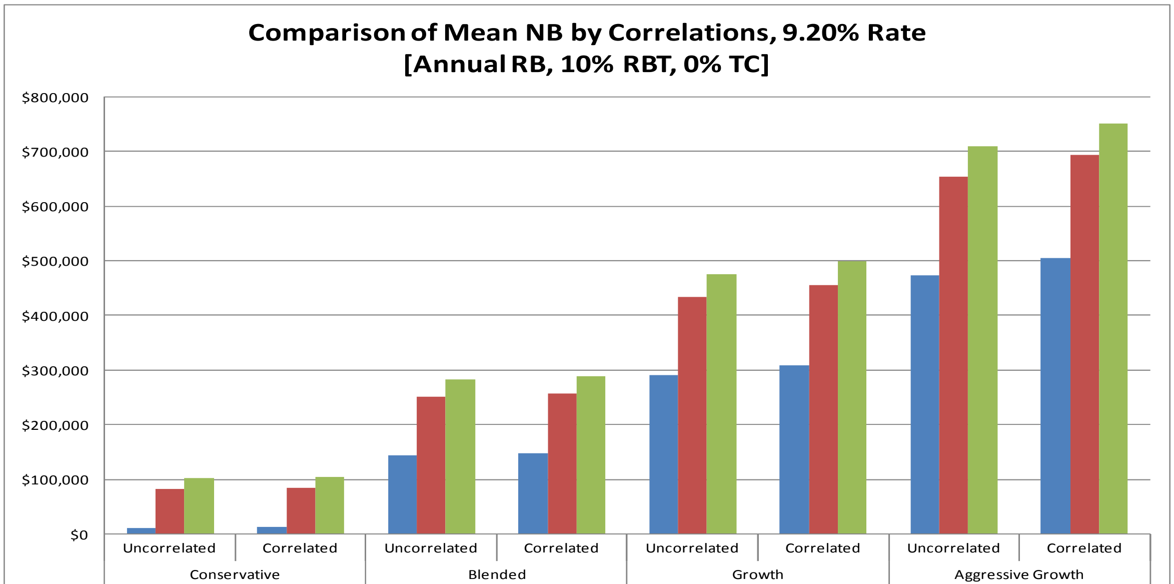


	Conservative Uncorrelated	Conservative Correlated	Blended Uncorrelated	Blended Correlated	Gowth Uncorrelated	Gowth Correlated	Aggressive Growth Uncorrelated	Aggressive Growth Correlated
15%	2.09%	9.96%	6.74%	16.80%	11.78%	22.74%	15.73%	26.77%
25%	0.63%	5.90%	5.04%	14.60%	10.26%	21.39%	14.52%	25.81%
28%	0.46%	5.15%	4.68%	14.08%	9.90%	21.04%	14.22%	25.56%

The results in Figure 4 indicate that in all cases, an assumption of uncorrelated returns results in a much lower probability that the net benefit associated with the 30-year strategy is less than zero. Although all of the correlated results indicate a higher level of risk, the relative increase in risk is much greater in the case of more conservative asset allocation models. For example the assumption of correlated returns resulted in a negative net benefit being about four times more likely in the case of an individual subject to a 15% marginal tax rate using a conservative allocation model while risk less than doubled for the same individual using an aggressive growth allocation model. It is also important to recognize that although the expected benefit associated with the 30-year strategy increases as the assumed allocation model changes from conservative to aggressive growth, the level of risk both in terms of standard deviations and probabilities of negative net benefits both increase. Further, both the standard deviations of the net benefits and the probabilities of negative net benefits are both significantly understated in the event the underlying assets are assumed uncorrelated.

All of the results discussed so far were associated with the 30-year strategy under a set of rather ideal conditions: low mortgage rates, relatively infrequent rebalancing, relatively high rebalancing thresholds and no transaction costs. To determine the impact of the level of the 30-year mortgage rate on the net benefit associated with the 30-year strategy and for comparability to earlier studies various historic levels of mortgage rates were analyzed. As the 30-year mortgage rate increased, the resultant net benefits decreased. Further, as was the case in Figure 1, all of the observed net benefits were higher for the correlated returns than the uncorrelated returns. Figure 5 presents the results associated with a 9.20% 30-year mortgage rate. This rate was selected for comparability to earlier studies and corresponds to the maximum in the historical mortgage rate data series.

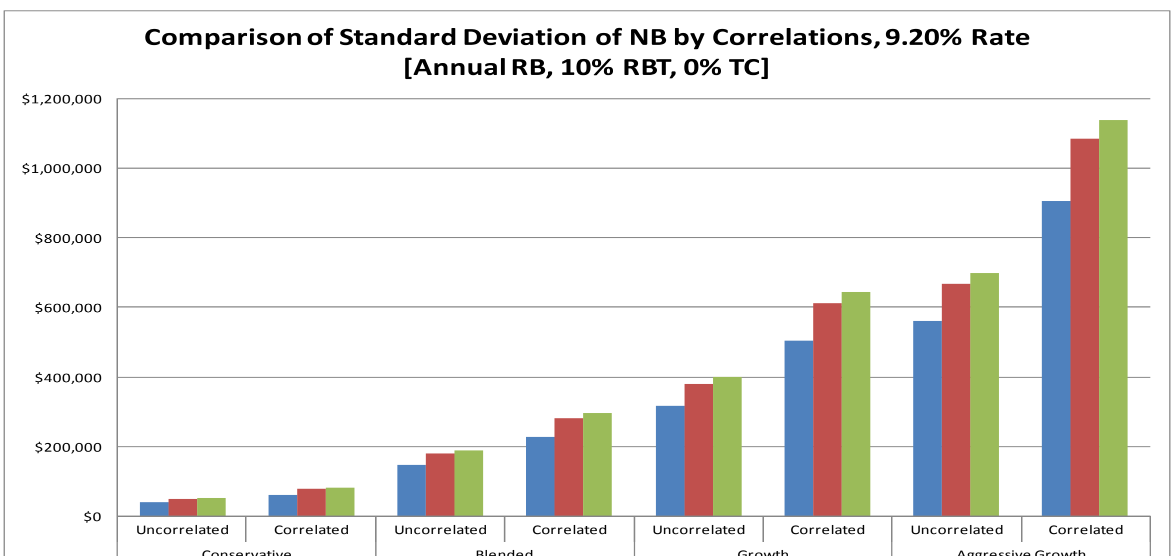
Figure 5



	Conservative		Blended		Growth		Aggressive Growth	
	Uncorrelated	Correlated	Uncorrelated	Correlated	Uncorrelated	Correlated	Uncorrelated	Correlated
15%	$12,304	$13,529	$143,748	$148,114	$291,808	$308,398	$474,112	$504,589
25%	$82,409	$84,297	$250,943	$257,234	$433,487	$454,691	$654,379	$693,868
28%	$103,250	$105,510	$283,169	$289,809	$476,047	$498,684	$708,317	$750,280

Similar to the results observed in the simulation runs corresponding to the 5.20% 30-year mortgage rate, the level of risk associated with the 30-year strategy was much greater for the simulations with correlated asset returns than the uncorrelated returns. Figure 6 indicates the observed standard deviations. In Figure 6, the same general relationships are observed as in Figure 2 including an increase in risk as the portfolio allocation shifts to portfolios containing proportionately more risky assets (move from conservative to aggressive growth), a positive relationship between the standard deviation of the net benefit to the individual's marginal federal income tax rate, and significantly higher risk associated with the simulation runs specifying correlated returns as compared to uncorrelated returns.

Figure 6

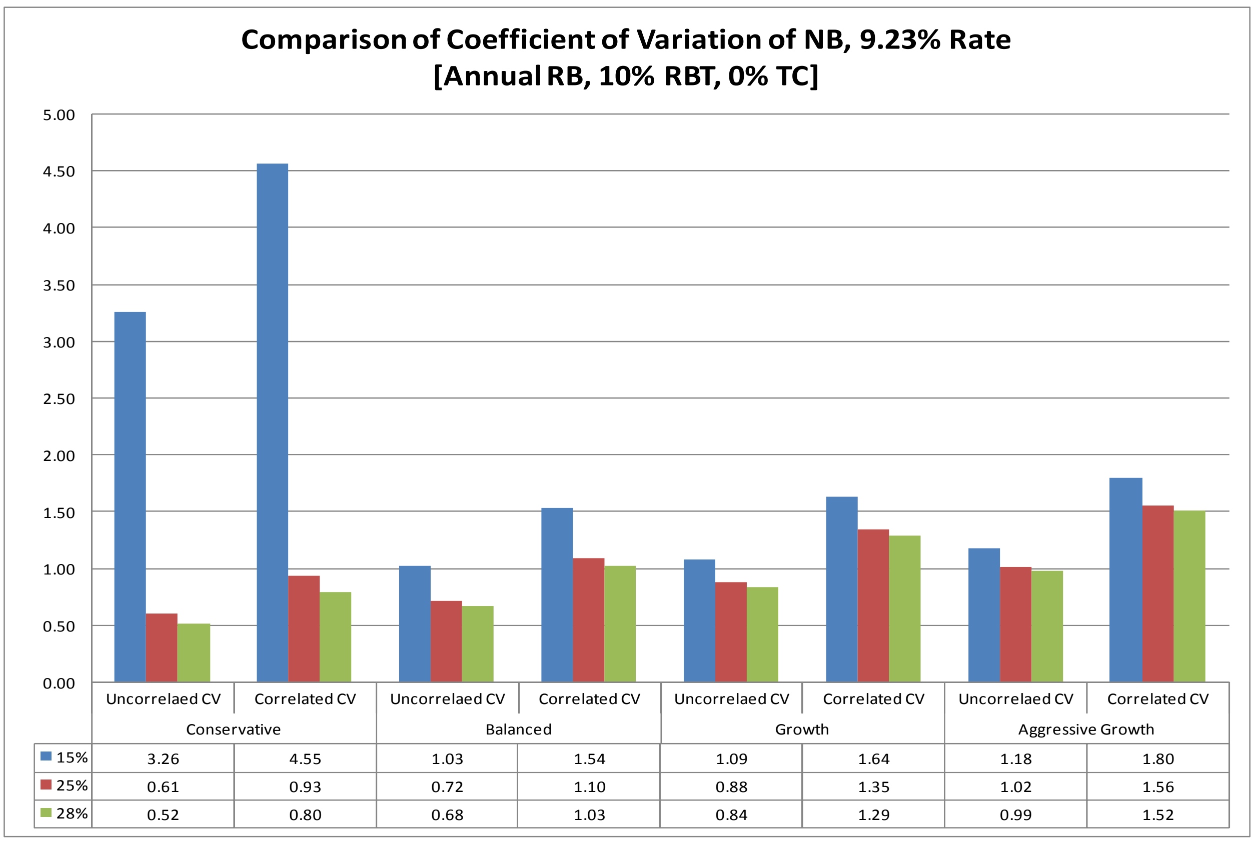


	Conservative		Blended		Growth		Aggressive Growth	
	Uncorrelated	Correlated	Uncorrelated	Correlated	Uncorrelated	Correlated	Uncorrelated	Correlated
15%	$40,123	$61,616	$147,471	$227,906	$316,653	$505,219	$560,942	$906,188
25%	$50,112	$78,785	$181,206	$281,785	$381,432	$612,185	$666,861	$1,083,406
28%	$53,298	$84,375	$191,532	$298,169	$401,343	$644,778	$698,921	$1,136,846

It is also interesting to note that all of the net benefit standard deviations are lower for the 9.20% results than their 5.23% counterparts although they are not scaled to the underlying mean net benefits.

Figures 1 and 5 presented the mean net benefits associated with the 30-year strategy for the 5.23% and 9.20% 30-year mortgage rate respectively. These results indicated that (a) there was a positive relationship between the mean net benefit and the individual's marginal federal income tax rate, (b) the mean net benefit increased as the proportion of risky assets in the assume portfolio increased, (c) all of the correlated results were slightly higher than the uncorrelated results and (d) the mean net benefits for the 5.23% rate were considerably higher than those associated with the 9.20% mortgage rate. Figures 2 and 6 presented the corresponding standard deviations in the mean net benefits. These results indicated that (a) there was a positive relationship between the risk associated with the mean net benefit and the individual's marginal federal income tax rate, (b) the standard deviations increased as the proportion of risky assets in the portfolio increased, (c) all of the standard deviations associated with the correlated returns were much greater than those associated with the uncorrelated returns and (d) the standard deviations associated with the 5.23% 30-year mortgage rate net benefits were greater than those associated with the 9.20% mortgage rate. Figure 7, presents the coefficients of variations for the net benefits associated with the 30-year strategy given a 9.20% 30-year mortgage. The results indicated in Figure 7 exhibit the same relationships as those presented for the 5.23% rates in Figure 3. Although the standard deviations in the net benefit associated with the 30-year strategy were lower for the 9.20% mortgage rate than their 5.23% rate counterparts, all of the coefficients of variation were higher for the 9.20% rate indicating a much greater level of relative risk associated with the 30-year strategy in a high mortgage rate environment.

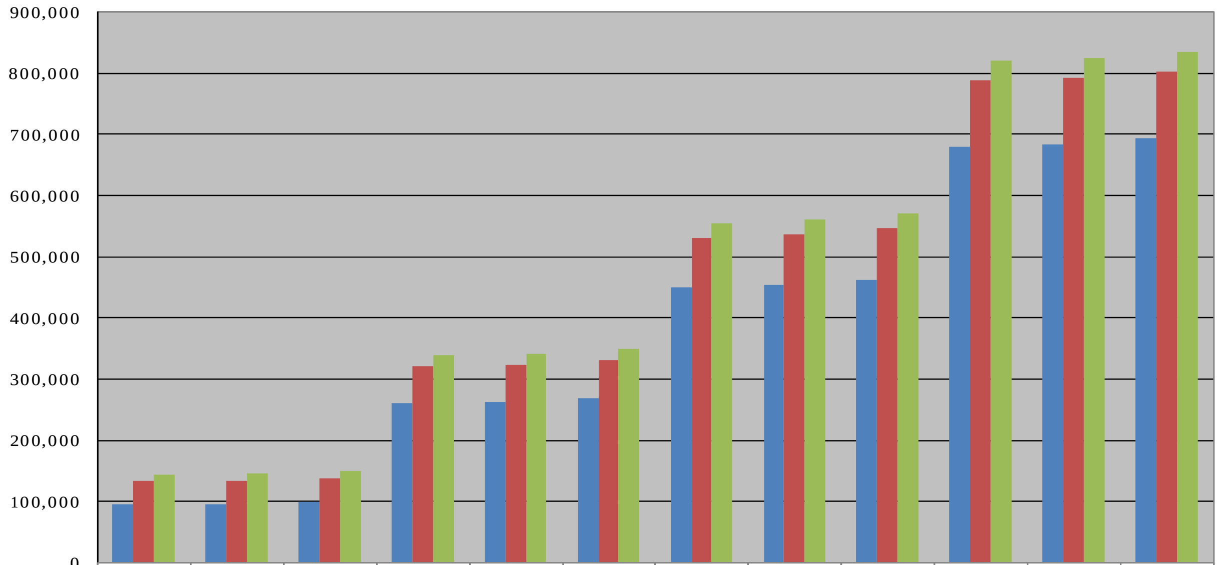
Figure 7



Earlier studies indicated that the risk associated with the 30-year strategy decreased as the rebalancing frequency increased. For comparative purposes, the mean net benefits and standard deviations associated with various rebalancing frequency assumptions a 5.23% 30-year mortgage rate was selected and it was assumed that a +/-10% rebalancing threshold was utilized and there were no transaction costs. In calculating the net benefits correlated asset returns were assumed. The 5.23% rate was used since it most closely corresponded to the prevailing 30-year mortgage rates at the time this paper was written. Figure 8 below presents the mean net benefits associated with the 30-year strategy assuming monthly, quarterly, and annual rebalancing for the three hypothetical marginal federal income tax rates and four hypothetical portfolio allocation models assuming a 5.23% 30-year mortgage rate. Figure 9 presents the corresponding standard deviations in mean net benefits.

Figure 8

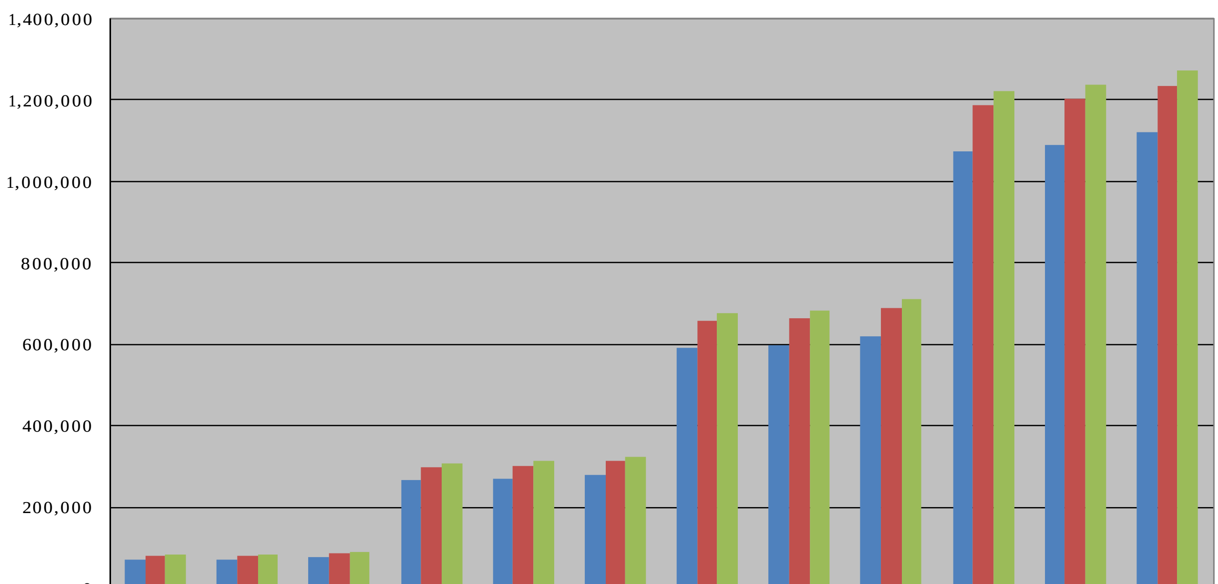
Mean NB by RB Frequency, 5.23% Rate [10% RBT, 0%TC]



	Conservative			Blended			Gowth			Aggressive Growth		
	Monthly	Quarterly	Annual	Monthly	Quarterly	Annual	Monthly	Quarterly	Annual	Monthly	Quarterly	Annual
15%	95,960	96,618	100,057	261,880	263,771	270,103	450,033	454,714	463,469	681,236	684,849	695,093
25%	134,060	134,808	138,649	321,990	323,867	331,252	532,231	537,169	547,463	788,754	792,697	803,601
28%	145,572	146,288	150,390	340,042	341,945	349,657	556,659	562,150	572,540	821,052	824,967	836,215

Figure 9

Standard Deviation of NB by RB Frequency, 5.23% Rate [10% RBT,0% TC]



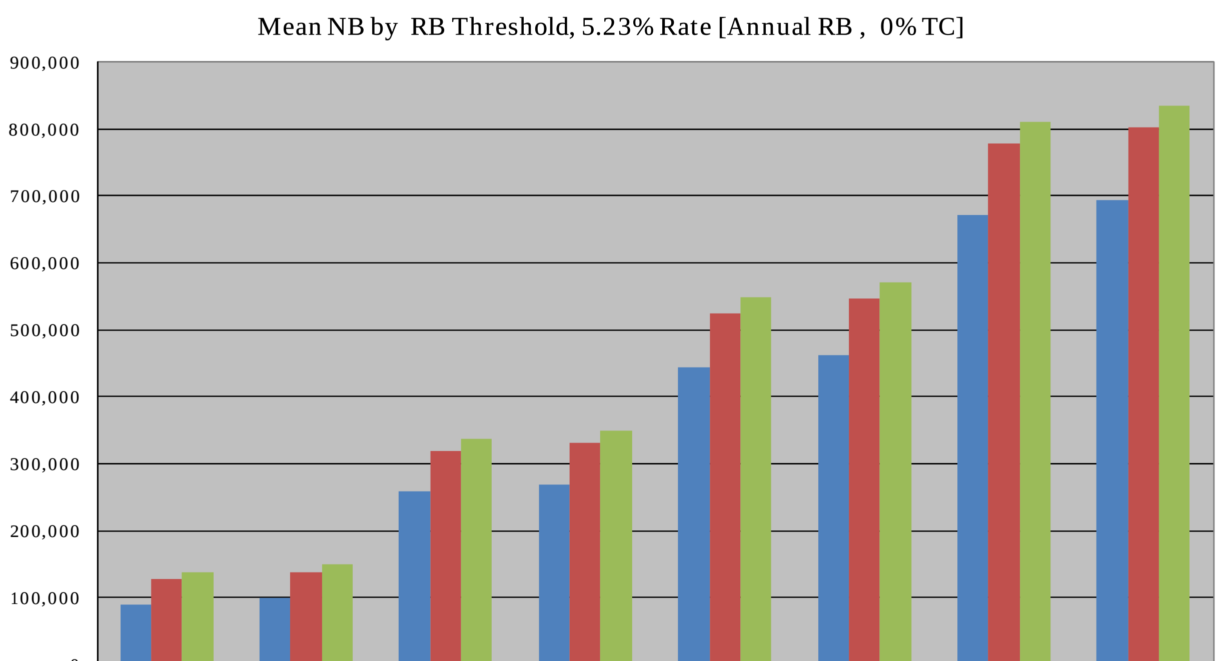
	Conservative			Blended			Gowth			Aggressive Growth		
	Monthly	Quarterly	Annual	Monthly	Quarterly	Annual	Monthly	Quarterly	Annual	Monthly	Quarterly	Annual
15%	72,560	73,079	77,935	266,754	271,447	280,709	591,364	598,790	620,208	1,075,6	1,091,8	1,121,5
25%	82,745	83,077	88,678	299,051	304,101	314,386	657,606	664,812	690,432	1,188,4	1,205,9	1,237,5
28%	85,818	86,195	92,220	308,815	314,174	324,693	677,624	684,877	711,306	1,222,2	1,240,2	1,272,5

Similar to the results presented in earlier research, the mean net benefits decrease slightly as the rebalancing frequency increases while the standard deviations decrease by a proportionately larger amount. In other words, the more frequent rebalancing results in a better risk return tradeoff across assumed marginal income tax rates and portfolio allocation models. It is important to remember that these results are based upon an assumption of no transaction costs.

In addition to the rebalancing frequency the rebalancing threshold will impact the number of times the portfolios are rebalanced in the simulations. Returning to 5.23% 30-year mortgage rate and annual rebalancing, the mean net benefits and the corresponding standard deviations for the 30-year strategy are simulated assuming 5% and 10% rebalancing thresholds. Correlated returns are once again assumed in these simulations. The results in Figures 10 and 11 present the mean net benefits and standard deviations for the 5% and 10% rebalancing thresholds.

The results in Figure 10 indicate that the mean net benefits associated with the 10% rebalancing threshold are greater than those associated with the 5% rebalancing threshold regardless of the assumed allocation model or individual's marginal federal income tax rate. Although the mean net benefit is lower for the 5% rebalancing threshold, the results in Figure 11 indicate that this lower rebalancing trigger results in less risk as indicated by the lower standard deviations. Although not directly reported in this paper, all of the coefficients of variation are lower for the 5% rebalancing threshold. Again it is important to note the assumption of zero transaction costs in the calculation of the net benefits. In a case where an individual does not enjoy costless rebalancing, the mean net benefit associated with the 10% rebalancing threshold indicated in Figure 10 is likely understated; however, the impact on the resultant risk return tradeoff is uncertain.

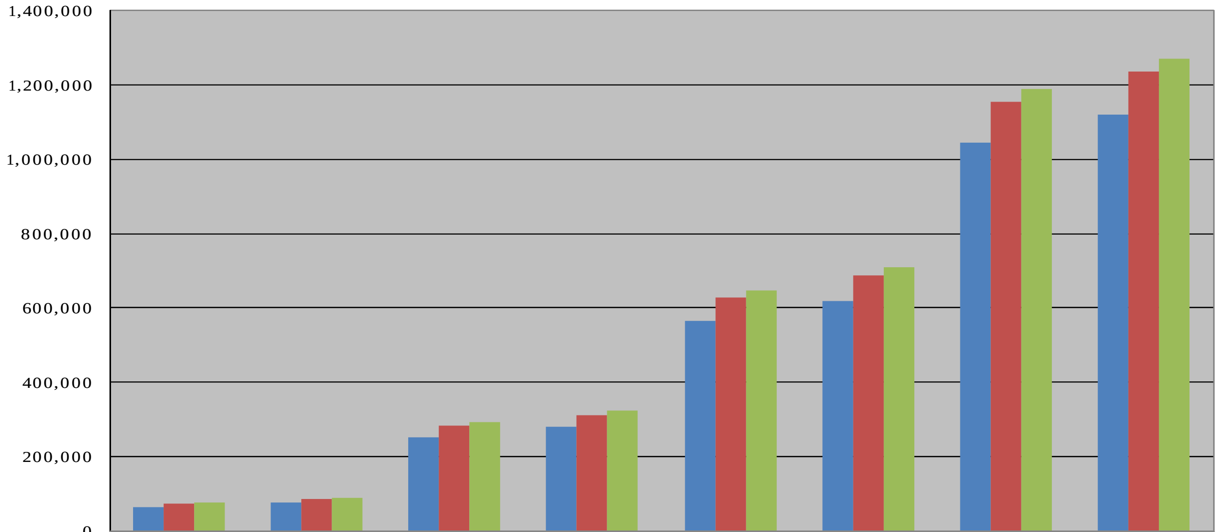
Figure 10



	Conservative		Blended		Gowth		Aggressive Growth	
	5%	10%	5%	10%	5%	10%	5%	10%
15%	90,966	100,057	259,784	270,103	444,380	463,469	673,273	695,093
25%	128,235	138,649	319,628	331,252	525,901	547,463	779,861	803,601
28%	139,383	150,390	337,452	349,657	550,329	572,540	811,796	836,215

Figure 11

Standard Deviation of NB by RB Threshold, 5.23% Rate [Annual RB , 0% TC]

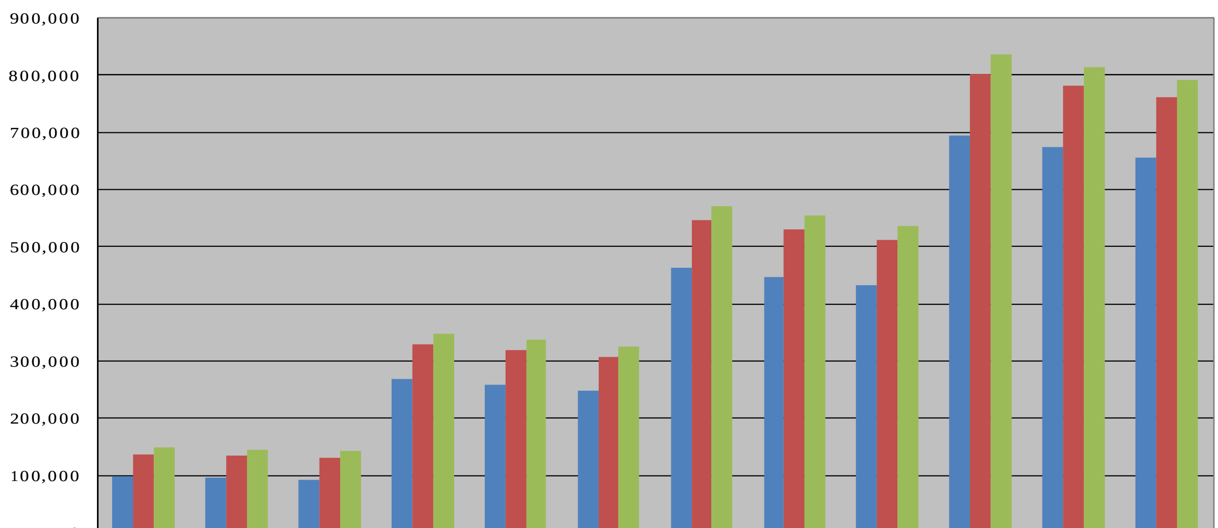


	Conservative		Blended		Gowth		Aggressive Growth	
	5%	10%	5%	10%	5%	10%	5%	10%
15%	65,301	77,935	254,798	280,709	566,076	620,208	1,046,823	1,121,541
25%	74,435	88,678	285,862	314,386	629,244	690,432	1,156,691	1,237,587
28%	77,267	92,220	294,963	324,693	648,212	711,306	1,189,694	1,272,599

Lastly, the assumption concerning zero transaction costs is removed. In calculating the net benefit associated with the 30-year strategy, it is now assumed that the individual has access to a 30-year mortgage with a 5.23% interest rate, that they will rebalance annually and that the rebalancing threshold is +/-10%. As in the earlier cases, correlated asset returns are assumed in calculating the mean net benefits. The results in Figure 12 indicate, as one would expect, that the higher the level of the associated transaction costs, the lower the resultant net benefit associated with the 30-year strategy. In interpreting these results, it is important to remember that the assumed cost is applied to both purchases and sales resulting from any assumed transaction whether they are related to periodic investments or rebalancing.

Figure 12

Mean NB by Transaction Costs, 5.23% Rate [Annual RB , 10% RBT]



	Conservative			Blended			Gowth			Aggressive Growth		
	0%	2.5%	5%	0%	2.5%	5%	0%	2.5%	5%	0%	2.5%	5%
15%	100,057	96,980	93,948	270,103	259,570	249,231	463,469	447,863	432,794	695,093	675,934	657,151
25%	138,649	135,200	131,804	331,252	319,458	308,272	547,463	530,214	513,533	803,601	782,526	761,901
28%	150,390	146,870	143,332	349,657	337,893	325,945	572,540	554,937	537,552	836,215	814,647	793,453

Conclusions

Earlier studies reported that better financial results accrue to some borrowers when they select a 30-year mortgage coupled with a simultaneous investment plan rather than selecting a 15-year mortgage term and a subsequent investment plan. The earlier results were derived from computer simulations utilizing the historical average asset returns and standard deviations; however, the randomized returns were not constrained by the asset correlations. This limitation resulted in a slight understatement of the accumulated benefits associated with the 30-year mortgage term and with a much greater overstatement of the associated diversification benefits.

The results of this study indicate that the 30-year mortgage term accompanied with a concurrent investment strategy still provides superior financial results to a wide range of potential mortgagors across various mortgage market conditions. This finding holds across various levels of individual marginal federal income tax rates, portfolio allocation models, rebalancing frequencies, rebalancing thresholds and transaction cost. In total 1,080 different simulations were conducted to determine the net benefit associated with the 30-year strategy assuming both correlated and uncorrelated investment returns. Consistent with the earlier findings, the 30-year mortgage remains the better financing option even with the incorporation of investment return correlations.

Of the various mortgage rates analyzed in this paper, the 5.23% rate most closely corresponds to the currently prevailing mortgage rates. In today's mortgage environment assuming a 5.23% rate, annual rebalancing, a 10% rebalancing threshold, no transaction costs and a 28% marginal federal income tax rate, our results indicate that the 30-year mortgage strategy remains the better mortgage alternative. Obviously, the mean net benefit and associated risk are dependent upon the assumed portfolio allocation model. In this study we found the mean net benefit slightly increased and the standard deviation greatly increased when the correlation of investment returns was specified. As compared to the results in the earlier studies, an individual utilizing a conservative asset allocation model was observed to have about ten times the likelihood of experiencing a negative net benefit associated with a 30-year strategy. Similarly for an individual utilizing an aggressive growth allocation model the study showed about two times the likelihood of a negative net benefit associated with a 30-year strategy when considering correlations between the asset return series.

As the results of earlier studies indicated, the mean net benefit is directly related to the individual's marginal federal income tax rate and the proportional investment in risky assets in their portfolio. Conversely the mean net benefit is inversely related to the rebalancing frequency, the rebalancing threshold and the level of transaction cost. Also consistent with the earlier results the risk associated with the net benefit is directly related to the individual's marginal federal income tax rate, the proportional investment in risky assets in their portfolio, the rebalancing frequency and the rebalancing threshold. However, in each of these scenarios all of the observed means are lower and all of the standard deviations are higher with the inclusion of the correlations between the asset return series.

At this point it is also worthwhile to comment on a few practical limitations associated with pursuing the 30-year alternative. It is assumed that on a monthly basis the individual will invest the payment differential between the mortgage payments plus any differential in the mortgage tax shields in a tax deferred account. Obviously this assumes two critical components: (1) that the individual has access to tax deferred accounts and (2) that the individual will have the financial discipline to follow the strategy for the full term of the mortgage. Although for most individuals the first assumption should not present much of a practical problem, the second assumption may be tenuous! In general the 30-year strategy analyzed in this research is very similar to the old "buy term and invest the rest" insurance strategy and as such has similar practical pitfalls. It is also important to note that in the case of the 15-year mortgage with subsequent investment option, the assumption of available tax deferred accounts becomes more problematic.

In summary, the 30-year alternative continues to be the best option in today's low mortgage rate environment and will continue to be the better option for the vast majority of borrowers as mortgage rates increase. Most critically, this conclusion is predicated upon an assumption that the individual exercises the required financial discipline. The one possible exception, to this general observation involves an individual subject to a low marginal tax rate, in a high interest rate environment, that would opt to select a conservative portfolio allocation model. However, even under this less than optimal combination of variables, there would still remain approximately a 58% probability that the 30-year strategy would outperform the 15-year mortgage combined with subsequent investment.

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