Determining the "glide path" for target-date funds

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Abstract

On June 16, 2010, the SEC proposed new guidelines for target date funds to follow regarding the explanation of glide paths. This paper presents a model that determines a "glide path" for individuals and target date funds. At some point in time individuals with diminishing human capital are no longer primarily concerned with maximizing wealth. Rather, their primary goal is to obtain a target retirement wealth level to sustain a constant level of consumption during retirement. A critical wealth level is defined that combined with a retirement goal provide a rational approach for reducing risky assets as an individual approaches retirement. © 2011 Academy of Financial Services. All rights reserved.

1. Introduction

On October 24, 2007, the Department of Labor (DOL) defined the final regulations regarding qualified default investment alternatives (QDIAs) that were subsequently added to ERISA and the Pension Protection Act of 2006. The target-date retirement funds (also often referred to as life-cycle funds) are one of the most popular and fastest growing QDIAs. The growth in target date funds (TDFs) reflects the trend of corporations switching from defined benefit to defined contribution funds. The number of defined contribution funds more than tripled since 1975, from 208,000 to 631,000 in 2006. While during this same time period the number of defined benefit plans decreased from 105,000 to 48,000.[1]

Because of the extreme volatility in the U.S. stock market in 2008, the performance for 2010 TDFs in 2008 ranged from −4% to −41%. This quickly drew the attention of the DOL

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and Securities and Exchange Commission (SEC) who announced a joint hearing to discuss the performance and possible regulation of TDFs. As a follow-up to this joint hearing on June 16, 2010, the SEC created a proposal that would require fund advisors to be more explicit in describing a fund's glide path and how asset allocation changes are made to target date funds over time.[2]

TDFs were originally designed as a simple solution to a complex problem. In concept, participants choose a TDF based on their anticipated retirement date. A TDF allocates its investments in various asset classes. Each TDF is managed to reduce the allocation to risky investments as the individual participants in the fund approach their desired retirement age. This reduction in risky assets is commonly referred to as a "glide path." Glide paths of most TDFs tend to use arbitrary reductions based on variations of the traditional rule of thumb allocating the percentage of risky assets at 100 minus the age of the individual (see Lewis, 2008, 2009; Shiller, 2005). The lack of any theoretical basis to define glide paths resulted in 20 to 30 year differences in time horizons for some TDFs and this was a major contributing factor in the wide variance of performance for TDFs in 2008.

In practice, TDFs assume the asset allocation process for individuals approaching retirement is a static process. The individual sets the target date and forgets it. Unfortunately, individuals are subject to numerous variables that may lead them to adjust their original target date. Merton (1980) was one of the first to demonstrate the consumption and asset allocation decision for a long-term investor is a dynamic process as opposed to a static one.[3] The implementation of the model defined in this paper allows for a dynamic process where the individual determines the glide path or asset allocation mix based on their human capital and financial capital.

Most economic and financial models assume individuals desire the maximization of wealth. The assumption of wealth maximization is reasonable for most institutions and some individuals. However, the behavior of most individuals approaching retirement reflects preferences with respect to time as well as wealth. Institutions typically have an infinite time horizon and are managed with the goal of maximizing wealth. This contradicts the observed behavior of most individuals who desire to optimize leisure time in retirement and maintain a standard of living as opposed to strictly maximizing wealth.

In addition, individuals are finite entities with limited time horizons or life expectancies that are much shorter than the typical institution. Historically, defined benefit plans allowed pensions to be grouped and managed as an entity. Conversely, the growing number of defined contribution plans gives rise to the importance of modeling the needs of unique individuals. Thus, because of the unique characteristics of individuals, portfolio theories and models designed for institutions are not necessarily easily implemented by individuals. For example a major objective of voluntary retirement is to optimize leisure time. Thus, a model that recognizes human capital is diminishing and optimizes both leisure time and wealth is more appropriate than one that strictly maximizes wealth without regard to an individual's limited time horizon.

The focus of this paper is on defining an asset allocation process for the glide path for target date funds. A primary objective of this study is to define a critical wealth level and explain a rational approach for the reduction of risky assets as an individual approaches retirement. As individuals age they become more cognizant of their diminishing human

capital and a growing desire for increased leisure time. At some point in time individuals are no longer primarily concerned with maximizing wealth. Their primary retirement goal is to obtain a target retirement wealth level to sustain a constant level of consumption during retirement. At retirement there is a dramatic reduction in human capital and individuals are increasingly concerned with longevity risk. The critical wealth level and target wealth level at retirement define the beginning and ending points for the glide path in the model.

2. Literature review

Prior literature examines the role of household choices on the portfolio decision process. Sundaresan and Zapatero (1997) provide a model related to defined benefit plans. An increasing more relevant topic is the role of portfolio choice under a defined contribution plan examined by Cairns, Blake, and Dowd (2006). Milewsky and Kyrychenko (2008) examine the role of variable annuities. Chen, Ibbotson, Milevsky, and Zhu (2006) include insurance over the life cycle for portfolio choices. Others discuss the role of housing and mortgage choices (Campbell and Cocco, 2003; Cocco, 2005; Goetzmann, 1993; Yao and Zahng, 2004. Koo (1998) and Davis and Willen (2000) discus the impact of labor income on portfolios. Dybvig and Liu (2004) and Bodie et al. (2004) relate the role of flexible retirement dates to the asset allocation process. Jagannathan and Kocherlakota (1996) specifically address the role of aging in the portfolio choice process.

A common theme of prior literature and practitioners focuses on determining the asset allocation of individuals as they age. The concept of changing portfolio allocation for individuals as they age is accepted by practitioners and academia. Practitioners have used rules of thumb based on setting the equity or riskier allocation percentage as 100the age of the investor. While age is an obvious important determinant for individuals, this paper suggests that perhaps a more important determinant is the relationship of human capital to financial wealth. Especially in times of increased volatility that is more prevalent in recent years.

Modigliani (1986) developed a life cycle hypothesis. Life cycle investing is an important aspect of individual asset allocation policies for individuals. It is common practice for financial planners to identify life cycles for individuals that identify important time horizons in the planning process. A model is defined where an individual's life cycle is based on three distinct time horizons. In the first time line the young individual is primarily concerned with maximizing wealth. Thus, common portfolio management or expected utility approaches provide rational models for meeting the objective of wealth maximization. A critical wealth level is defined that determines the starting point of a second critical time horizon or glide path for the individual. The ending point of this glide path and the beginning point of the third time line is when the individual reaches the target retirement wealth level. The third time horizon is the retirement time line where individuals are primarily concerned with sustaining a level of consumption or standard of living during retirement.

Retired individuals are more concerned with longevity, inflation, and sequence of return risks than more traditional risk measures such as standard deviation. The asset allocation is determined by different measures of risk at the start and end of the glide path. Essentially,

the glide path is shifting the allocation to less risky investments to reflect the change in risk tolerance that is associated with an individual's declining human capital and increasing financial wealth. When human capital and/or the desire to work diminish individuals must begin to shift their focus to risk measures that more appropriately reflect their retirement concerns.

Consistent with the notion of loss aversion, Stutzer (2004) suggests combining a shortfall minimization with expected utility theory to minimize some of the difficulties of applying the mean-variance framework of modern portfolio theory first presented by Markowitz. More recently, Levy and Levy (2009) identify a disaster level of wealth based on the notion of safety first with expected utility. Under safety first, individuals do not wish for wealth to drop below a certain disaster level that would require a significant lifestyle change. Under safety first individuals are more averse to losses at lower levels of wealth near the disaster level.

A critical wealth level is defined that is similar in nature to the disaster level. The critical wealth level reflects an individual's intersection of declining human capital and increasing financial wealth. Individuals must make reasonable and obtainable choices with respect to the amount of time and consumption desired in retirement. Bodie, Merton, and Samuelson (1992) and Boscaljon (2004) describe models for asset allocation based on diminishing human capital. As individuals approach retirement they are more cognizant of depleting human capital and time. Because individuals cannot replace human capital, they must be cognizant of a growing desire to preserve financial wealth as they approach retirement.

3. Defining critical wealth based on human capital and financial wealth

Individuals tend to behave in a manner consistent with their anticipated life expectancy and desired standard of living. Retirement is a rationale option for individuals as it illustrates their value of leisure time in addition to consumption or wealth. Therefore, defining a glide path based on declining human capital is more consistent with empirical observations that suggest most individuals are more concerned with sustaining standards of living during retirement as opposed to strictly building wealth.

The model implicitly assumes individuals reach a satiation level of consumption and no longer desire to strictly maximize wealth. The fact that individuals choose to voluntarily retire reflects their value of leisure time at the expense of reducing or limiting wealth and consumption. Individuals act in a manner that protects their critical wealth level and seek a target wealth level at the beginning of retirement that is expected to sustain consumption in retirement.

Total wealth = human capital + financial wealth

The individual life cycle model is built upon the definition of total wealth provided by Bodie et al. (1992). Total wealth for an individual is comprised of human capital and financial wealth. An individual enters the working years of life with virtually no financial wealth and a large amount of human capital, *HC*, defined as the present value of future
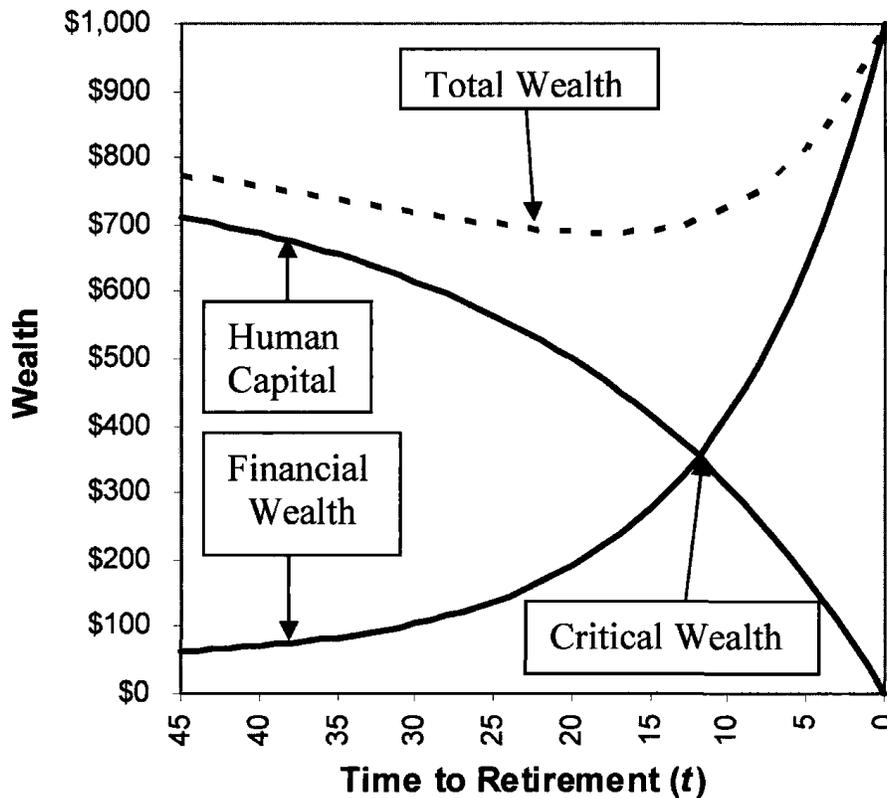
Total Wealth = Human Capital + Savings

Fig. 1. Determining an individual's critical wealth level based on the point of intersection where human capital is equal to financial wealth as defined by Eq. (3).

earnings (*EP*). Eventually human capital is depleted for individuals and total wealth is derived solely by financial wealth.

The amount of human capital, *HC*, throughout an individual's life is defined as the present value of all future earnings in Eq. (1). Bodie et al. (1992) and Boscaljon (2004) discount future wages or earnings power, *EP*, at the risk-free rate of return under the assumption that human capital is less risky than financial wealth.

$$HC = \sum_{i=1}^{t} \frac{EP_i}{(1 + r)^i} = \frac{EP}{r}\left(1 - \frac{1}{(1 + r)^t}\right)$$ (1)

Fig. 1 illustrates the decrease of human capital and increase of financial wealth over time as an individual approaches retirement. Some individuals are able to increase human capital by allocating more labor hours per year or extending the time to retirement. Some individuals are able to shift their human capital upward through education, promotions or wage increases. Alternatively, unfavorable events may cause an individual's human capital to shift downward such as a loss of a job or declining health. Individual's with a family history of

health issues or employed in more uncertain careers as described by Milewsky (2009) may estimate riskier human capital with a higher discount rate in Eq. (1).

Individuals convert human capital into financial wealth throughout their lifecycles. Individuals are also able to increase savings and financial wealth by reducing current consumption. The amount of current consumption an individual chooses is a function of the individual's desired current and future standard of livings. Financial wealth accumulates over time and a target wealth, *TW*, level is defined as the retirement goal less a savings annuity in Eq. (2).

$$TW = \frac{RG - S \dfrac{(1 + r)^t - 1}{r}}{(1 + r)^t} \tag{2}$$

The model assumes that individuals desire constant consumption during retirement and therefore determine a retirement goal based on a lump sum required to sustain a desired annuity at retirement. Earlier studies suggest a reasonable sustainable withdrawal rate is in the range of 4% to 6%, depending on age and asset allocation.[4] Thus, the target retirement goal is determined based on a desired sustainable standard of living divided by a sustainable withdrawal rate (i.e., $RG = C/0.04$).

Fig. 1 illustrates the accumulation of financial wealth over time. The top, dashed line in Fig. 1 represents total wealth as the sum of human capital and financial wealth. Human capital decreases at an increasing rate and financial wealth is increases at an increasing rate. Therefore, the lines must intersect and financial wealth, *TW*, is equivalent to human capital, *HC*. This critical point is used to define the start of the glide path

Individuals are cognizant of their diminishing human capital and therefore save for retirement. Individuals determine their retirement goal in terms of time and wealth based on individual preferences with respect to how much time and consumption they desire in retirement. In the wealth accumulation phase, individuals have more time than wealth. Initially, individuals focus on maximizing wealth to increase both current and future standards of living. However, beyond the critical point the individual desires to optimize both leisure time and wealth. At a critical level of wealth, the individual is indifferent between his or her value of time and wealth. Individuals, who value time more than wealth, reduce the percentage allocation in equities because they are more loss averse beyond the critical point and desire to protect an optimal standard of living in retirement.

$$\frac{RG - S \dfrac{(1 + r_i)^{t^*} - 1}{r_1}}{(1 + r_1)^{t^*}} = \frac{EP}{r_f}\left(1 - \frac{1}{(1 + r_f)^{t^*}}\right) \tag{3}$$

As illustrated by Boscaljon (2004) the point of intersection in Fig. 1 is defined by Equation (3) where the individual's human capital, *HC**, is equivalent to financial wealth. The retirement goal is consistent with their desired standard of living based on a sustainable withdrawal rate for a time period that is consistent with their desired amount of leisure time in retirement. Bodie et al. (1992) suggest as long as labor hours are flexible, individuals are

free to adjust their desired retirement goal and standard of living. Thus, as individuals approach retirement they may have some flexibility to increase human capital if labor hours are flexible. Eq. (3) defines the critical wealth level where an individual values human capital and financial wealth equally.

Critical wealth has important implications for TDFs regarding the start of glide paths. Conversely, the traditional approach for TDFs and financial planners is to arbitrarily reduce the allocation to equities based on the individual's age and a target retirement date. Under the traditional approach there is no theory to define when the glide path should begin. Traditional approaches do not quantify an individual's unique preference of leisure time versus consumption. Rather all individuals are strictly grouped together based on age and a desired target date.

Critical wealth is an important reference point that can be used by individuals to rebalance their portfolios consistent with their desired constant standard of living and leisure time. In Levy and Levy (2009) the disaster level is assumed to be 0. In this model the critical wealth level, where the individual is indifferent between the value of human capital and financial capital, is similar in nature to the disaster level. Because individuals have limited time horizons and human capital, they will protect critical wealth to insure drastic reductions in their standards of living are not required during retirement.

At levels of wealth less than critical wealth the individual values changes in wealth more than changes in leisure time. Thus, the individual is more concerned with maximizing wealth than leisure time to the left of critical wealth. To the right of critical wealth, the individual values changes in leisure time more than changes in wealth. Thus, the individual is more concerned with optimizing leisure time and sustainable consumption at levels of wealth greater than critical wealth. The model is consistent with the assumption that individuals with finite lives value leisure time more than wealth in later stages of life.

A target retirement date is a moving target. Individuals cannot simply "set it and forget it." Life is filled with major events that cause individuals to adjust their retirement plans. Traditional asset allocation models such as the Markowitz mean-variance model assume individuals strictly desire the maximization of wealth and make choices that reflect their risk tolerance for expected returns and risks. Conversely, Milewsky (2009) presents a model that emphasizes product allocation as opposed to asset allocation to address more relevant risks related to retirement ruin during an individual's retirement. During the glide path phase individuals are shifting from more traditional measures of risk such as variance of returns to longevity, inflation, and sequence of returns risks. Thus, the glide path is designed to smooth the asset allocation from the appropriate level using traditional wealth maximization functions to more conservative wealth preservation models in retirement.

Historically financial planners and TDFs have arbitrarily reduced allocations to risky investments based on their intuition that there is a shift in concern for individuals' risk tolerance. Individuals with large amounts of human capital who are primarily concerned with accumulating wealth have a greater risk tolerance than individuals with low levels of human capital in retirement. In addition, the retirement planning process is a dynamic process that is also impacted by changes in the financial market. For example, if an individual obtains larger than expected returns in the market, he or she may decide to retire at an earlier date or increase consumption. Regardless, of the choices made, the individual focusing on critical

wealth and target wealth is cognizant of the choices regarding the value of human capital versus financial capital.

Once individuals reach a critical wealth level they enter the second phase that represents the glide path for target date funds and they begin to reduce equities. Individuals no longer strictly maximize wealth to increase consumption. Rather, they adjust their investment allocations to reduce risk and optimize their tradeoff of time in retirement and sustainable consumption during retirement. The gradual reduction in risky securities reflects the notions of safety first, loss aversion, and diminishing human capital. The individual is assumed to desire a gradual reduction in risky securities starting with the critical wealth level until the retirement goal or target wealth level is obtained. The asset allocation to equities is adjusted during the glide path by the following formula:

$$Risky\ Securies\% = Min\% + (Max\% - Min\%)\frac{(TW - W)^2}{(TW - CW)^2} \qquad (4)$$

where

Min% = desired percentage in equities during retirement
Max% = percentage in equities before the critical wealth
TW = dollar amount of retirement goal
W = current dollar amount of wealth
CW = critical wealth dollar amount

The final phase is the retirement phase where the individual is assumed to maintain a constant sustainable payout rate on target or retirement wealth. The target mix of equities and annuities at the start of retirement is assumed to be the same for all individuals in this example. This is convenient in the application of TDFs for grouping individuals with similar goals. This assumption could be relaxed by implementing the methodology of Milewsky (2009) that provides detailed explanations regarding asset allocation during the retirement phase for individuals to set their target retirement asset allocations. Milewsky (2009) clearly demonstrates that in retirement the role of asset allocation is replaced with product allocation for individuals to minimize the increased risks of longevity, inflation, and sequence of returns that can lead to retirement ruin. The asset allocation at the target wealth level has important implications for the design of the glide paths. Fund managers should not continue glide paths 20 to 30 years into retirement because this fails to protect the individual against concerns of retirement ruin.

Furthermore, it is unrealistic in most circumstances to assume individuals could return to the work force full time with the same level of human capital that they had before retirement. The continuation of glide paths by some TDFs beyond the retirement date does not address any of these concerns or risks properly or prudently. A common practice of financial advisors is to use Monte Carlo simulations to estimate the probability of obtaining a minimum level of wealth in retirement. The Monte Carlo model is based on averaging 10,000 simulations. Unfortunately, individuals have finite lives and therefore are forced to live with the outcomes of a single course of events and returns. McCarthy (2002/2003) and Milevsky and Robinson (2005) summarize some of the shortcomings of applying Monte Carlo simulations to
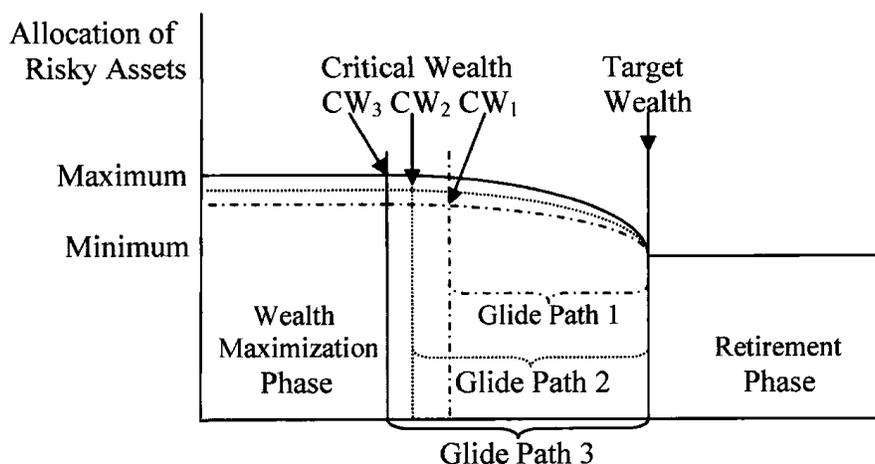
Fig. 2. Illustrates glide paths based on HC and FC. The glide paths are illustrated for three individuals who have similar goals and finanical situations, but different risk tolerance levels. Individuals go through three phases in life, wealth maximization, glide path, and retirement phase. Thus, the glide path phase is the asset allocation reduction phase as the individual approaches retirement and desires to optimize wealth and time, rather than strictly maximize wealth.

financial planning. Monte Carlo simulations are difficult to replicate and provide little pedagogical intuition regarding more relevant risks of during retirement such as longevity, inflation, and sequence of return risks.

4. Applying the model in practice

4.1. Practical examples of defining unique glide paths for individuals

Assume three individuals desire consumption of $40,000 in retirement, save $5,000 a year for retirement, and each have $50,000 annual earnings power. These initial assumptions are just used for illustrative purposes. Later in the paper a number of different scenarios are calculated and summarized with tables and figures. Assume the three individuals differ with respect to risk tolerance. Also, assume that all amounts are in real terms and are adjusted for inflation. The maximum amount of investments in risky assets before retirement is different for each individual and the expected returns reflect their appropriate level of risk aversion. Fig. 2 illustrates three time horizons for the three individuals' glide paths. Before acquiring a critical level of wealth individuals primarily desire to maximize wealth. Thus, asset allocation models such as the Markowitz mean-variance model combined with a risk tolerance measure are used to define the appropriate mix of equities and fixed income. The critical wealth level for each individual is unique because of the difference in risk tolerance. Individuals with greater risk tolerances, everything else being equal, will have smaller critical wealth levels.

Fig. 3 summarizes the model inputs for this example where three individuals are similar in every aspect except risk tolerance. In the first stage the individuals have a desired

Model Assumptions	
Retirement Consumption	$40,000
Sustainable Withdrawal Rate	4%
Retirement Goal	$1,000,000
Expected Return on Equities	0.12
Expected Return on Fixed Income	0.06
Risk-free Rate of Return	0.03
Annual Savings Amount	$5,000

Fig. 3. Assumptions of model input parameters.

maximum allocation 100%, 80%, and 60% to equities with an expected return of 12%. The remaining allocation is comprised of fixed income with an expected return of 6%. A sustainable withdrawal rate of 4% and a retirement goal of $1,000,000 are assumed to be sufficient to generate a consumption level of $40,000 per year in retirement. The $40,000 in addition to other sources of income from social security and other possible resources is expected to be sufficient for the individuals to maintain their desired standards of living. For all cases it is assumed that the desired minimum allocation to equities at the start of retirement is 50%. The assumption of converging risk tolerances retirement is plausible if we assume that human capital is almost completely diminished for all individuals at the start of retirement and the life expectancy for all individuals is equal. The example also assumes the primary objective is strictly to maintain a standard of living and all individuals do not desire to leave a legacy goal or inheritance to benefactors.[5]

Table 1 illustrates the expected growth in financial wealth or target wealth, TW, and the decrease in human capital, HC, as the individuals approach retirement based on the assumptions summarized in Fig. 3. The amounts of human capital are determined by Eq. (1) assuming a risk-free rate of return of 3%. The amounts of financial wealth or target wealth are determined by Eq. (2) and the appropriate expected return based on the asset allocation of equities and fixed income. In Table 1 the approximate critical wealth level individuals 1, 2, and 3 are TW_1 = $398,528, TW_2 = $380,216, and TW_3 = $362,684, respectively. Table 2 summarizes the solution time horizon, t, for each case where the human capital is equivalent to financial wealth as defined in Eq. (3).

The results of Tables 1 and 2 identify a direct relationship for risk aversion and critical wealth levels, all other things being equal. More risk averse individuals will have a higher critical wealth level and longer critical time horizon because of the fact that lower expected returns require a longer time and more wealth to build up to the retirement goal.

Figs. 4 and 5 illustrate the results for three individuals who differ with respect to earnings power while holding all other things equal. The three individuals are assumed to have equal risk tolerances, expected returns, asset allocations, retirement goals, withdrawal rates, and desired consumption in retirement. Individuals with higher earnings power have greater human capital as defined by Eq. (1). Thus, the critical wealth levels are also greater for individuals with greater human capital and earnings power as illustrated in Fig. 4. Assuming the individuals have equal retirement goals, sustainable withdrawal rates, and desired

Table 1 Determining critical wealth based on human capital, HC, and financial wealth, TW, for three individuals with equal earnings power and retirement goals, but varying risk tolerances

t	HC	TW_1	TW_2	TW_3
8.2	$358,740	$444,056	$404,966	$369,617
8.3	$362,600	$439,529	$400,361	$364,982
8.35	$364,526	$437,281	$398,077	$362,684
8.4	$366,449	$435,043	$395,804	$360,399
8.45	$368,369	$432,815	$393,543	$358,128
8.5	$370,287	$430,598	$391,293	$355,869
8.55	$372,201	$428,391	$389,055	$353,622
8.6	$374,113	$426,194	$386,828	$351,389
8.65	$376,022	$424,006	$384,613	$349,168
8.7	$377,928	$421,829	$382,409	$346,959
8.75	$379,831	$419,662	$380,216	$344,764
8.8	$381,732	$417,505	$378,035	$342,580
8.85	$383,629	$415,358	$375,864	$340,409
8.9	$385,524	$413,220	$373,705	$338,250
8.95	$387,416	$411,092	$371,557	$336,103
9	$389,305	$408,974	$369,420	$333,969
9.05	$391,192	$406,866	$367,294	$331,846
9.1	$393,076	$404,767	$365,178	$329,736
9.15	$394,956	$402,678	$363,074	$327,637
9.2	$396,835	$400,598	$360,980	$325,550
9.25	$398,710	$398,528	$358,897	$323,476
9.3	$400,583	$396,468	$356,824	$321,412

Approximate critical levels are calculated using Eq. (3), where $RG = 1,000,000$, $S = 5,000$, $r_f = 0.03$, and $r_I = 0.12, 0.108$, and 0.096.

consumption during retirement, the individual with the greatest human capital has a relatively greater value on wealth over time compared with the other individuals. Fig. 5 illustrates that there is an inverse relationship between earnings power and critical time horizons. Thus, all other things equal the individuals with greater human capital have greater critical wealth and shorter critical time horizons.

Table 3 assumes the individuals differ with respect to all parameters, except the sustainable withdrawal rate. The three individuals are assumed to have equal risk tolerances, expected returns, asset allocations, and desired consumption in retirement. However, the retirement goal is based on their desired consumption in retirement and their sustainable withdrawal rate. All three individuals are assumed to desire $40,000 annual consumption during retirement. If the individuals have sustainable withdrawal rates of 4%, 5%, and 6%,

Table 2 Exact critical wealth and time horizons with varying individual risk tolerances are calculated using Eq. (3), where $RG = 1,000,000$, $S = 5,000$, $r_f = 0.03$, and using Excel goal seek macro

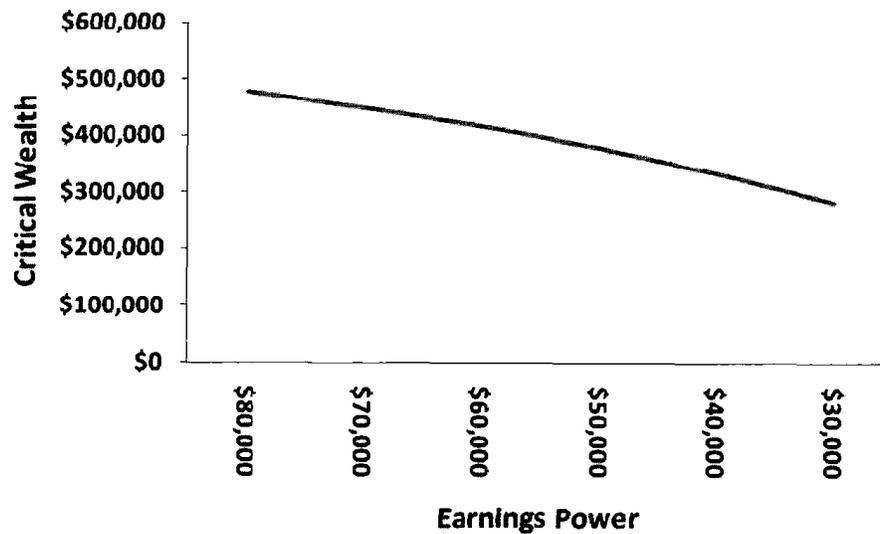|	Maximum equity	Minimum equity	Expected return	Earnings power	Critical years	Critical wealth
Individual 1	60%	50%	9.6%	$50,000	9.2477	$398,624
Individual 2	80%	50%	10.8%	$50,000	8.7547	$380,010
Individual 3	100%	50%	12.0%	$50,000	8.3282	$363,686

Fig. 4. Illustrates critical wealth increases with increases in earnings power, holding all other variables constant. Critical wealth is calculated using Eq. (3), where $RG = 1,000,000$, $S = 5,000$, $r_f = 0.03$, and $r_I = 0.108$.

then their retirement goals will be $1,000,000, $800,000, and $666,667, respectively. The results of Table 3 suggest that there is an inverse relationship between sustainable withdrawal rates and the level of critical wealth. This is strictly because of the requirement of greater retirement goals to meet the smaller withdrawal rates and still provide the same standard of living or consumption during retirement.
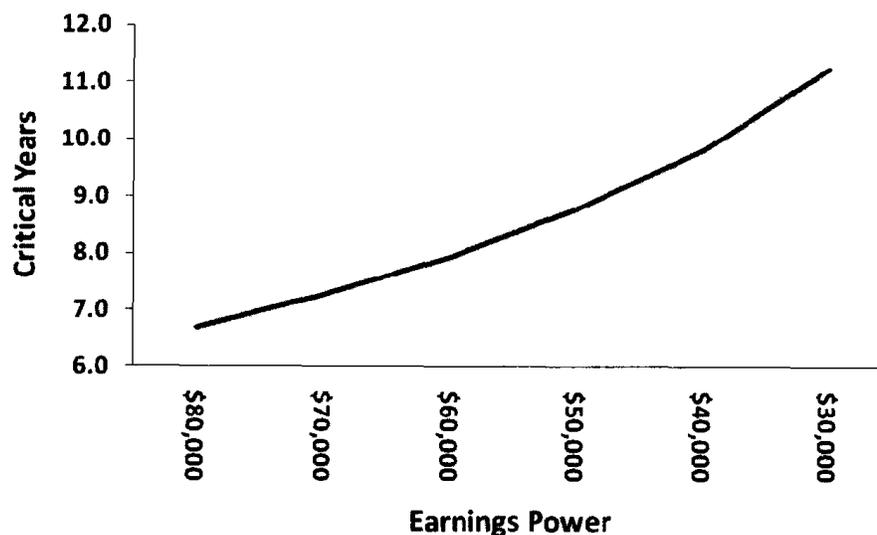

Fig. 5. Illustrates an inverse relationship for critical years and earnings power, using Eq. (3) and holding all other variables constant: $RG = 1,000,000$, $S = 5,000$, $r_f = 0.03$, and $r_I = 0.108$.

Table 3 Critical wealth and time horizons with varying sustainable withdrawal rates holding all other variables constant; $RG = 1,000,000$, $S = 5,000$, $r_f = 0.03$, and $r_j = 0.108$

	Expected return	Earnings power	Sustainable withdrawal	Retirement goal	Critical years	Critical wealth
Individual 1	10.8%	$50,000	4.0%	$1,000,000	8.7547	$380,010
Individual 2	10.8%	$50,000	5.0%	$800,000	7.6828	$338,590
Individual 3	10.8%	$50,000	6.0%	$666,667	6.8679	$306,213

4.2. Applying the model as a foundational theory for TDFs

Traditional asset allocation models often assume individuals desire the maximization of wealth and ignore the fact that individuals have declining human capital and desire to optimize consumption and leisure time. The model developed in this paper provides a theoretical basis for the dynamic asset allocation decision process for individuals. Critical wealth levels are defined based on individuals' intersection of declining human capital and increasing financial wealth. Critical wealth along with target retirement wealth are used as reference points to define glide paths for the reduction of allocation to risky assets in TDFs. Sustainable consumption, savings, risk aversion, and the expected rate of return are important factors in determining the length of the glide path.

Commonly used asset allocation models for institutions are not automatically applicable for determining asset allocation for individual portfolios. Portfolios managed for a defined contribution plan are subject to the unique characteristics of individuals with finite lives. Whereas, defined benefit plans are managed with less restrictive infinite time horizons reflecting the continuous time line of large groups of participants. The assumption of maximizing wealth is an appropriate assumption for institutions and entities with infinite lives. Conversely, maximizing wealth implicitly assumes that individuals should never retire from work voluntarily and continue to make choices that always maximize financial wealth. Because individuals have finite lives it is reasonable to assume they do not solely desire to maximize wealth. The maximization of wealth is not the observed behavior of individuals who voluntarily retire before expiring all of their human capital. Most individuals value leisure time as well as consumption.

The use of TDFs based strictly on the age and retirement date ignores the fact that individuals have unique preferences with respect to time and consumption. Designing TDFs based on a theoretical foundation provides a basis to further analyze other important issues in retirement planning such as social security, taxes, inflation, long-term care, medical expenses, travel, and life expectancy. The significant reduction in human capital at retirement requires that asset allocation is not simply a continuation of the process used in the accumulation phase. Defining the glide bath based on critical and target wealth levels provides a theoretical basis that individuals, fund managers, and regulators can implement and significantly reduce the misconceptions and major deficiencies of TDFs. The study does not consider the impact of inflation, taxes, social security, health issues, legacy goals, differences in risk tolerances during retirement and other important issues that are necessary for retirement planning. Including these parameters into the model would further illustrate the complexity and uniqueness of each individual's glide path of shifting asset allocations as

individuals approach retirement. This emphasizes the importance of seeking financial advice or planning tools in the retirement decision and not relying on ad hoc rules of thumb to reduce equities that inherently strictly assume individuals desire the maximization of wealth. However, this is not to say that TDFs are without value. TDFs are valuable for individuals who do not desire to seek professional guidance and never rebalance their portfolio on their own. The industry clearly recognizes the shortcomings of TDFs and offers them as a simple solution that is not necessarily the optimal solution but a better one than never rebalancing. Defining glide paths for TDFs based on theory and not ad hoc rules of thumb should significantly reduce the variance of returns across the industry for TDFs with the same date.

5. Summary

Bodie et al. (1992) were the first to suggest human capital as a rationale explanation for the reduction of risky assets as individuals approach retirement. Individuals' wealth is comprised of human capital and financial capital. A critical wealth level is defined where the individual values human capital and financial capital equally. The glide path for individuals is shown to vary based on their unique preferences and circumstances.

TDFs automatically adjust asset allocation based on groups of individuals' ages. However, there is no theoretical rationale for these reductions and they are simply based on variations of traditional financial planning approaches that reduce equities based on age alone. A major concern addressed in the June 18, 2009, joint hearing of the SEC and DOL was the lack of a well defined glide path that resulted in variations of time horizons as great as 30 years. Whereas, the critical time horizon is based on an individual's critical wealth and target wealth goals that reflect unique preferences with respect to consumption and leisure time. Furthermore, the critical wealth level and target retirement wealth level identify important reference points that provide a theoretical basis for asset allocation changes and the length of the glide path rather than simple ad hoc rules of thumb.

The model developed in this paper addresses the major concern emphasized during the June 18, 2009, joint hearing of the SEC and DOL regarding glide paths for TDFs. The lack of theory for defining a glide path for TDFs is at least partially responsible for the wide range of performance of 2010 TDFs in 2008. The greater than expected losses in 2008 upset many individuals planning to retire in 2010. Individuals with limited human capital and finite lives become more loss averse as they approach retirement. However, the practice of some TDFs extended the glide path well beyond the target date, resulting in a much riskier portfolio than individuals and regulators expected. The "set it and forget it" philosophy of TDFs implies retirement planning is a static process. However, the retirement planning process is a dynamic process as many events in life impact the moving target date for retirement.

Notes

1. Dallas Salisbury, Employee Benefit Research Institute, Written Statement for the United States Senate Special Committee on Aging, *"Boomer Bust?: Securing Retirement in a Volatile Economy,* February 25, 2009.

2. The Securities and Exchange Website provides more information regarding the hearing at http://www.sec.gov/news/press/2010/2010-103.htm.
3. For examples of more recent developments in dynamic wealth-consumption models for the portfolio decision see Semmler, Grune, and Ohrlein (2009) and Campbell and Viceiria (1999).
4. Sustainable payout rates during retirement are examined using historical data and simulations by Bengen (1994), Ho, Milevsky, and Robinson (1994), Cooley, Hubbard, and Walz (1998, 2003), Pye (2000), Ameriks, Veres, and Warshwsky (2001), and Guyton (2004). The results of these studies suggest a reasonable initial payout of four to six percent is sustainable during the retirement period.
5. This paper assumes all individuals desire a 50% allocation to equities during retirement. For the curious reader Milewsky (2006) provides excellent examples of determining appropriate asset or product allocations during retirement.

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