## Contents

<table>
<thead>
<tr>
<th>Page</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Editorial</td>
</tr>
<tr>
<td>02</td>
<td>Valuing your human capital</td>
</tr>
<tr>
<td>10</td>
<td><strong>Interview</strong>: David McWilliams speaks with Chip Castille</td>
</tr>
<tr>
<td>13</td>
<td>Case studies</td>
</tr>
<tr>
<td>14</td>
<td><strong>Case study 1</strong>: Shifting gears</td>
</tr>
<tr>
<td>15</td>
<td><strong>Case study 2</strong>: A winning playbook</td>
</tr>
<tr>
<td>16</td>
<td><strong>Case study 3</strong>: Two brothers, two approaches</td>
</tr>
<tr>
<td>17</td>
<td>Appendix</td>
</tr>
<tr>
<td>20</td>
<td>Disclaimer</td>
</tr>
<tr>
<td>21</td>
<td>Publication details</td>
</tr>
</tbody>
</table>

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Dear readers,

One of Nobel Prize winner Gary Becker’s greatest contributions to economics was his study of how an individual’s investment in education and training is similar to business investment in equipment and employee development. The simple and underappreciated conclusion: Your most important asset is yourself. Yet, perhaps no asset is more overlooked by individuals and households in terms of its importance when managing wealth than human capital.

We continue our total wealth approach this quarter with an in-depth look at how this intangible asset – human capital – impacts financial decisions over the life cycle. Some people have safe human capital, others have volatile human capital, and yet others might have human capital that is correlated with financial assets. All of these possibilities affect personal balance sheets, and therefore the choices we make, in different ways.

As always, we hope the material presented here helps you to make better-informed investment decisions. For those using our goals-based wealth management approach, the content presented pertains specifically to allocating the Longevity portfolio.

Mike Ryan, CFA
Chief Investment Strategist, WMA
Regional CIO, Wealth Management US

Michael Crook, CAIA
Head of Portfolio & Planning Research
CIO, Wealth Management US
When the 2012 NFL draft commenced at Radio City Music Hall directly across the street from our midtown Manhattan offices, several of us – like many other fans and talking heads – were focused on the strength of the quarterback class. Two of those draft picks, Robert Griffin III and Russell Wilson, are particularly interesting in retrospect. Griffin was selected as the second overall pick in the draft, whereas Wilson was selected as the 75th overall pick. Griffin signed a four-year $21mn rookie contract with the Redskins while Wilson signed a three-year $3mn contract with the Seahawks. At the time, Griffin’s earnings potential – or human capital – was much greater than Wilson’s, based on his perceived talent on the field.

Fast forward three seasons and the outlook for the quarterbacks has changed dramatically. Since earning the NFL’s Offensive Rookie of the Year award in 2012, Griffin has been sidelined by injuries and inconsistent performance for much of the last two seasons. He will likely not be Washington’s starting quarterback in 2015. Wilson, on the other hand, has led his team to the playoffs in all three seasons, including one Super Bowl win. Despite being drafted 73 picks after Griffin, Wilson now has a much greater and more certain human capital than Griffin (see Fig. 1).

What is human capital? Most of us are not professional athletes. Nevertheless, human capital plays an equally important role in our financial lives. When a 21- or 22-year-old graduates from college, she (and it’s more likely to be she now than he) typically doesn’t have much financial wealth. In fact, it’s not unusual for a graduate to have a negative net worth on paper due to student loans and other costs of education.
However, a more holistic view of the graduate’s balance sheet would find that she is actually quite well-off. Why? The knowledge gained while in school will pay dividends throughout her life in the form of higher wages and increased lifetime earnings. This human capital, which is broadly defined as the attributes that enable someone to produce economic value through his or her labor, includes knowledge, skills, training, creativity, and judgment, among other traits.

Graduating from high school, college, and graduate school all typically lead to increases in human capital – even after accounting for tuition and opportunity costs (see Fig. 2). According to a study by the Federal Reserve Bank of San Francisco, college graduates can expect to earn $800,000 more than non-college graduates over their lifetimes.1

The choice of major also matters. The Federal Reserve Bank of New York looked at returns on college degrees by major and found that an engineering degree typically offers a return of 21% above the cost of attendance, whereas a social sciences degree had an average return of 15% (see Fig. 3). In addition to their education, individuals can impact the value of their human capital in a multitude of ways, including through networking, selecting to enter specific industries or professions, maintaining and improving their skill base, and by working more or less.

There are two important wealth management aspects of human capital:

- First, we must protect and grow our human capital.
- Second, the impact of human capital on our balance sheets is large enough to impact our ideal asset allocation.

We explore both of these topics in the remainder of this publication.

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**Fig. 1: The tables have turned since rookie year**

R. Wilson’s and R. Griffon III’s estimated earnings, in millions of dollars

Source: Spotrac.com, UBS

**Fig. 2: College is still worth the cost**

Rate of return (ROR), in %

The investment impact

Why is the conventional wisdom that younger investors should hold significantly more in stocks than older investors? Two reasons are frequently given: first, time horizon; and second, less commonly, the presence of labor income.

Time horizon plays a role, but the reality is that a 60-year time horizon for a 40-year-old isn’t all that different from a 35-year time horizon for a 65-year-old. Both time horizons are long enough to provide a fairly high confidence in equities outperforming bonds for the entirety of the period. In fact, holding everything else constant, shifting from a 10-year horizon to a 30-year horizon would only add one to two percentage points of equity to most investors’ allocations.2 So clearly time horizon alone doesn’t explain the large shift into equities.

Labor income is the main reason we advise younger investors to hold more in stocks. A commonly used metaphor is that human capital is similar to a bond in that you receive a recurring stream of income in exchange for your labor output. More specifically, human capital would either be a series of coupon payments or perhaps a term annuity, but the exact analogy isn’t important. What is important is that a worker has a large asset on his or her balance sheet that has some of the characteristics of a bond and should be accounted for in asset allocation decisions.

Over the course of our lifetimes, human capital typically shifts from the dominant asset on our balance sheet to a de minimis position (see Fig. 4). It is this shift that results in the “glide path” of declining equity exposure (discussed in greater detail below).

Note: Percentage return based on the cost of the degree. The total cost includes the out-of-pocket costs as well as the opportunity cost of going to school.

detail in the Interview section) over the life cycle exhibited in most target date retirement funds.

Protecting human capital
Because human capital is such a substantial asset, it’s important to consider ways to protect against its potential loss. This point cannot be emphasized enough as such loss would be catastrophic to the lifetime financial health of most individuals or families.

Life insurance and disability insurance are two specific ways to accomplish this hedge in the event of human capital loss due to death or disability. One important implication of the human capital framework is that individuals should actually have more insurance when they are young (and human capital is the highest), and less insurance as they age. Due to the difficulty in precisely measuring human capital, many financial planning tools contain calculators that estimate
insurance needs based on financial objectives and goals. This “needs-based” framework generally leads to a similar answer as a human capital framework.

Additionally, we all must take steps to ensure that we are not the proverbial “buggy whip maker” of the 21st century. Aptitude with technology, development of skill sets that complement machines and computers, leadership skills, and an understanding of how jobs will change over the next 30 years are all important aspects of maintaining and growing our human capital.

To provide one example from our business, 30 years ago it would have been technologically impossible for an advisor to combine all of the aspects of a family’s wealth and estimate thousands of potential outcomes to determine the best course of action for the family. Today, that type of analysis is commonplace in financial planning. The software has improved the productivity of the human, and the human has improved the productivity of the software. These types of human-computer “teams” are likely going to be increasingly common across all industries.3

Three types of human capital
Quantitatively, the value of an individual’s human capital is roughly equal to the net present value of his or her future earnings. Accordingly, actions that increase those earnings (e.g., further education) are additive to human capital, whereas actions that decrease future earnings (e.g., reduced schedule) are detractive. The “riskiness” of human capital also matters because a stable income of $150,000 per year might be equally valuable to a worker as an average income of $200,000 that fluctuates wildly on a yearly basis. From an investment standpoint, we’re specifically interested in the income portion that the investor intends to save over time. A worksheet for estimating human capital is provided in Appendix A on pg. 17.

In general, there are three distinct human capital possibilities that investors need to consider (statistical properties are provided in Fig. 5):

1) They have safe human capital;
2) They have volatile human capital; or
3) They have correlated human capital.

### Fig. 5: Three human capital scenarios
Volatility (standard deviation) and correlation to US equities

<table>
<thead>
<tr>
<th></th>
<th>Volatility</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe</td>
<td>0%</td>
<td>0</td>
</tr>
<tr>
<td>Volatile</td>
<td>25%</td>
<td>0</td>
</tr>
<tr>
<td>Correlated</td>
<td>25%</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Source: UBS. See Appendix B for more details.
Safe human capital is typically associated with tenured professors, unionized employees, and other workers with very stable jobs. We believe that these jobs are few and far between as many historically stable jobs are becoming less so in the current economy. For instance, some large law firms (typically considered safe employers) experienced significant layoffs during the financial crisis. More acutely, technology is quickly disrupting the workforce in many industries; transportation, financial services, education, hotels and motels, and retail are just a few examples.

Volatile human capital is just that – earnings that fluctuate, sometimes dramatically, on a frequent basis. Russell Wilson, Robert Griffin III, and other professional athletes clearly have volatile human capital, but so do many serial entrepreneurs, those in the arts and entertainment industry, C-suite professionals, and workers who are paid on a commission or bonus structure basis. In general, research indicates that high lifetime earnings are correlated with more volatile earnings, so if you are a high-wage earner, you are likely to fit into this category.

Finally, some individuals have correlated human capital. A recent paper by David Blanchett and Philip Straehl of Morningstar attempted to quantify the relationship between estimated human capital and various asset classes, and found that some industries – particularly cyclical ones – exhibit low but positive correlations to risk assets. Intuitively this makes sense. Someone in the real estate industry, for instance, almost certainly has human capital that is correlated with real estate investment trusts (REITs), and a mining executive’s income will likely be tied to commodity prices. These relationships become even more significant for investors who are compensated through profit sharing and restricted employer stock or stock options.

We focus on these three broad groupings for a few reasons. One, we believe it would be a mistake to be overly precise when measuring or accounting for human capital. Second, it is also likely a stretch to expect human capital to be highly correlated to any one asset class. Personal actions and choices can far outweigh broader industry factors, for example. For that reason, we believe
taking human capital characteristics into account based on general groupings (i.e., safe, volatile, or correlated) is a better approach.

By way of example, financial services employees do not automatically fall into the correlated human capital category, even if they receive stock compensation. Oftentimes their income is better categorized as volatile because year-over-year fluctuations may have been driven by unique factors (e.g., employer’s financial health) which were not correlated to the broader equity market.

**Adjusting portfolios for human capital**

The three types of human capital described have three distinct impacts on asset allocation strategy. In order to solve for the portfolio impact, we 1) quantify human capital based on the descriptions above; 2) hold it as a constrained position in the portfolio; and 3) re-optimize to determine the “completion” portfolio that most closely aligns the investable assets with the target-risk portfolio the investor would hold in the absence of human capital (e.g., retirement). An illustration of this process is provided in Fig. 6 and a technical description can be found in Appendix B.

The results of this analysis are in Fig. 7, and they assume that the investor’s target retirement portfolio has a 50/50 equity and fixed income allocation. The chart might look familiar to investors who have examined the equity glide paths associated with target date retirement funds, but there is one important difference. Instead of listing age or calendar year on the horizontal axis, we have labeled it “human capital as a percentage of total wealth.” Unlike typical target date funds, which make specific assumptions about your financial situation at different points in your life, presenting the results in this way enables you to customize a glide path for your longevity portfolio based on your specific financial situation.

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**Fig. 6: Determining the financial asset portfolio in the context of total wealth**

- **Human capital**: Roughly equal to net present value of future earnings. Can be safe, volatile, or correlated.
- **Financial capital**: Financial portfolio should be allocated to bring total wealth in line with the target risk portfolio.
- **Unconstrained optimal portfolio**: Target risk portfolio that would be held in the absence of human capital.

Source: UBS
Conclusions
The following are three rules of thumb that most, if not all, investors should use as they relate to managing their portfolios based on their human capital:

1) Decrease equity exposure as financial assets increase as a percentage of total wealth;
2) Underweight or completely avoid assets that you know to be highly correlated to your human capital, such as company stock; and
3) Be diligent about protecting human capital through both personal actions and appropriate insurance structures.

Beyond these rules of thumb, there are also some guidelines you can use to account for the unique characteristics associated with your human capital (safe, volatile, or correlated):

If you have **safe human capital:**
- Equity exposure remains high for most of your working career
- Equity exposure begins to decline only after financial assets exceed a majority of total wealth
- From that point, equity exposure declines until retirement

If you have **volatile human capital:**
- Equity exposure begins to decline after financial assets exceed roughly 25% of total wealth
- Once financial assets comprise 75% of total wealth, you should hold roughly the same portfolio you would hold if already retired

If you have **correlated human capital:**
- Equity exposure starts to decline almost immediately after commencing work
- The pace of decline in equity exposure is more gradual overall than for safe or volatile human capital
- Once financial assets comprise a majority of total wealth, you should hold roughly the same portfolio you would hold if already retired

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**Fig. 7: Equity glide paths based on characteristics of human capital**

Target equity allocation, in %

![Equity glide paths](image_url)

Source: UBS
David McWilliams: Chip, you were part of the team that built the industry’s first target date fund. What was the impetus for developing that product?

Chip Castille: It was the early 1990s, and the very influential work that Brinson, Hood, and Beebower had just published suggested, or rather forcibly argued, that asset allocation explained 95%-plus of your investment outcome. The thought within defined contribution (DC) plans at that time was that individuals should move among funds and change their asset allocation as they got older. And we thought that instead of asking investors to do it themselves, why not do it for them? In that way, we could manage the asset allocation risk, which we knew was the most important risk, yet the one that average investors are least qualified to manage.

So that was the basic idea behind the first target date fund. At the time, we were very excited about its prospects, and now we’re happy that our first product designed for DC turned into something pretty special in the marketplace.

David: Why would an investor want a portfolio where the allocation changes over time based on his or her age?

Chip: It really comes down to taking a more holistic view of your assets. We have two types of assets: human capital, which is our know-how and our ability to earn wages from that know-how, and financial capital, which is what we’ve saved and invested.

When you’re young, you don’t have a lot of financial capital, but you have a lot of human capital since you have all of your working years ahead of you. Now, if you think about it from an asset allocation perspective, human capital kind of behaves like a bond. You get paid on a regular basis, and there’s typically some inflation...
“If your older self could meet your younger self, that person would probably have a lot to say. One statement would be, ‘Hey, pay me. I want to retire.’”

adjustment. It certainly behaves more like a bond than equity.

At the same time, most people have a preferred level of risk that they’re comfortable with. For some people, it’s high. For others, it’s low. Regardless, most people have a level of risk that they’re comfortable taking with their assets, and that risk remains constant, on a relative basis, throughout their lives.

When you’re young and have a lot of human capital that acts like a bond, you will typically need to take your financial capital and put it in something that has more risk, because that’s the only way to get closer to your preferred risk level.

What happens as you get older is that you have less and less bond exposure in your portfolio because you have less and less human capital. So to maintain that same target level of risk that you’re comfortable with, you need to start buying bonds.

This means that when you’re looking at your investment portfolio over time, you’ll likely start with a lot of equities, but you will reduce that exposure as your human capital falls to bring your portfolio more in line with your long-term risk tolerance. That’s the motivation behind a target date fund and the concept of an equity glide path.

David: So what exactly is an equity glide path?

Chip: It’s based on this premise that you’re going to change your asset allocation over time. You’re going to start with a lot of equities in your portfolio when you have a lot of human capital, and over time, you will end with a more balanced portfolio when you no longer have much human capital. That sequence of portfolios is what we refer to as an equity glide path.

David: Does that mean that an equity glide path should stop gliding once an individual retires?

Chip: We think so. You’re changing your equity allocation as you convert human capital into financial capital. When you reach retirement, you’re essentially saying that you don’t want to sell any more human capital, even if you have some. You’re retiring and not going to earn any more wages. By saying that, you’ve lost the motivation for changing your asset allocation.

We like to describe the day you retire as the riskiest day of your financial life. That’s because for most people, it’s going to be the largest amount of retirement savings that you’re going to have since you’ve been building it up and now you’re going to start spending it. In addition, you don’t have the ability – or it will be much harder – to earn wages in the future to replenish any investment losses.

If your older self could meet your younger self, that person would probably have a lot to say. One statement would be, ‘Hey, pay me. I want to retire.’”
“That’s roughly the retirement system we’ve built. Everyone knows the value of their investment portfolio, but nobody knows what the cost of their retirement will be.”

And finally, that retirement nest egg has to last for the longest period because it’s your first day of retirement.

Because of this, we think it’s more important to get the right level of risk on your retirement date and to own that portfolio throughout your retirement than it is to try to get a couple of more years of maybe good returns out of the equity market.

David: What aspects of human capital are important when it comes to asset allocation?

Chip: As I mentioned earlier, human capital tends to have characteristics like a bond due to the regularity of payments. But there are other characteristics that are important. One of them is the risk of that future earnings stream and the fact that wages tend to take a certain shape or profile over time. This shape can vary by country, industry, and level of education. So when designing the glide path, it’s often useful to look at the shape of human capital through time. For example, US real wages tend to peak when one is around 45 years old and then they taper off. In Japan, this typically occurs several years later in the early 50s.

David: I’ve heard retirement described as a debt you owe yourself. Could you touch on why it could be seen this way?

Chip: I think that’s a really useful way to develop some intuition about what’s happening when you’re saving for retirement.

If your older self could meet your younger self, that person would probably have a lot to say. One statement would be, “Hey, pay me. I want to retire.” Essentially, that young person should be thinking about what he or she owes that older self in terms of retirement needs.

Thinking about retirement as debt actually fits nicely with how people tend to think about things they own and things they owe to others on their “personal balance sheet.” What’s exciting about where we are as an industry, as asset managers and advisors who have been historically focused on growing assets, is that we’re now developing the ability to help people understand more clearly what their retirement needs are.

The analogy I like to use is: You know what house prices are. Imagine a housing market where everyone knew the price of their house but nobody knew what the mortgage was. You talk to your advisor and she or he recommends mailing in a $1,000 check each month, since that seems to be the right amount. And then 30 years later, a banker will show up and tell you whether or not you have actually paid off your house.

That’s roughly the retirement system we’ve built. Everyone knows the value of their investment portfolio, but nobody knows what the cost of their retirement will be.

That is the opportunity we have to help our clients understand how to relate their investment portfolio to what their needs will be in the future. ■
Case studies

Hockey jock, retiree?
• Lucas is 33 years old and a three-time Stanley Cup champion.
• He is considering retiring from the league when his contract expires in two years.

Portfolio manager pauses
• Elizabeth is a 50-year-old portfolio manager for an equity mutual fund.
• Her current compensation is tied to management fees received by the fund.
• She is currently phasing out of her role as a portfolio manager in favor of other pursuits.

Twins diverge
• Andrew and William are 40-year-old twin brothers.
• Andrew is an orthopedic surgeon and William is a sociology professor.
• Earlier this year, their father passed away and they each inherited $2mn.
Elizabeth is a 50-year-old portfolio manager for a US equity mutual fund at Lion’s Share Asset Management. In her current role, Elizabeth receives a base salary and a bonus that is tied directly to the management fees received by the fund. Because of this structure, her pay generally fluctuates along with the broad equity market.

The last couple of years have been tough for Elizabeth. She has come to realize that her work-life balance is no longer sustainable, and she has lost much of her motivation to continue working in such a stressful job. Elizabeth decides to start phasing out her role as a portfolio manager and to open a part-time consulting business oriented toward institutions with which she has built relationships during her 25-year career.

At an annual review with her financial advisor, Elizabeth discussed her plans. Three important asset allocation considerations were apparent:

1) Elizabeth’s average annual compensation will likely be significantly lower, which means that the value of her human capital has declined.
2) Her compensation will no longer be tied to equity markets.
3) Her compensation will remain fairly volatile due to the nature of the consulting business.

Based on these considerations, Elizabeth is essentially moving from the correlated human capital glide path to the volatile human capital glide path. Her choice to move to a likely less lucrative career means that her human capital as a percentage of overall financial assets is decreasing. The overall asset allocation impact is to decrease equity exposure slightly (see Fig. 8).

**Fig. 8: Equity glide paths based on characteristics of human capital**

Target equity allocation, in %

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<td>45</td>
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Source: UBS
Lucas Bernard is a three-time Stanley Cup champion. He is currently 33 years old, co-captain of his team, and a leading defenseman in the National Hockey League. Lucas’s pro career started 14 years ago, at the ripe age of 19 when he was selected in the second round of the NHL Entry Draft after playing one season for the North Dakota University hockey team. At that time, he signed a three-year rookie contract for around $1mn/year.

Over the years, his talent on the ice has brought him greater fame and fortune than he could have ever imagined. As he honed his game, he diligently worked with his financial advisor, Monica LeFleur, to establish and build a sizable financial asset base with his earnings. Lucas is considering retiring from the league when his current contract expires in two years.

With this change on the near horizon, Monica informs him that no major shifts are needed within his investment portfolio at this time. Lucas doesn’t fully comprehend how what he perceives to be an abrupt change in his income would not trigger a bigger change in his portfolio strategy. Monica explains that she evaluated his investment approach after each contract signing, and walks him through the key stages of his career to illustrate.

At the first stage, Lucas was a rookie earning a high salary. At that time, his human capital – or future earnings potential – far surpassed any financial assets he could save on a rookie’s salary. While his career in the NHL was promising, his earnings potential was extremely risky. Subpar performance or a career-ending injury could have resulted in his being cut from the league after three short years of playing.

The second stage was when Lucas’s rookie contract expired. He was a proven entity in the NHL at that point and demanded a much more lucrative contract. His human capital, while still risky, sharply spiked when he signed a six-year contract for $3mn/year. Now, Lucas is in the third and final stage of his career. In the peak of his earnings, he has two years left in an eight-year contract that was originally valued at $50mn.

Monica explains to Lucas that at the beginning of each new contract, the value of his human capital was at its highest point (on a relative basis), but it was also potentially short-lived (see Fig. 9). Accordingly, at each stage, she evaluated how much he had saved relative to how much he would earn in that contract to determine the appropriate allocation to risk assets. As each year passed, Monica always advised to incrementally reduce risk since a subsequent contract was never guaranteed.

For instance, when Lucas signed his $50mn contract six years ago, his human capital was at an all-time peak. While Monica advises most 28-year-olds to hold nearly their entire portfolio in equities, she warned Lucas against taking this “all or none” approach. He was unlike other young adults in many ways: He was less than 10 years from retirement, already had significant savings. Since she never assumed that another contract would follow the current one, Monica had already de-risked Lucas’s portfolio over the years to bring it more in line with a moderate risk tolerance.
Andrew and William Brown are 40-year-old twin brothers. Growing up, they were inseparable. They played the same sports, had the same friends, and both decided to attend the University of Michigan. From that day forward, however, they began down what would turn into two very different career paths. Today, Andrew is a highly sought-after orthopedic surgeon and William is a sociology professor.

Earlier this year, Andrew and William lost their father rather unexpectedly to cancer. Upon his death, the two sons inherited approximately $2mn each in investable assets and are now working with their respective financial advisors to determine how to allocate the new funds. While they are both moderate risk investors, plan to work for 25 more years, and save the same percentage (but not dollar amount) of their incomes, their advisors have provided each of them with different allocation advice. To understand why, we must review their economic circumstances.

Andrew is married to Maureen – also a successful doctor – and they have an eight-year-old daughter, Bella. They are both high-income earners and have amassed more than $750k in savings. While the $2mn inheritance is a noticeable addition to their existing financial asset base, they have yet to reach their peak earnings years and their human capital is substantial.

William is married to Marsha, who stays at home to take care of their eight-year-old son, Thomas. While William earns a comfortable living as a tenured professor at a local university, the estimated value of his future earnings is modest in comparison to that of Andrew and his wife, Maureen. Accordingly, the $2mn inheritance was a financial windfall for the couple as they only had $50k in their savings account prior to receiving it.

After the deposit of the $2mn into the brothers’ respective accounts, both advisors are suggesting that they should decrease their target equity allocation percentages. This is because their human capital is a smaller proportion of their total wealth than it was prior to their receiving the inheritance, which has essentially pushed them both further out on the equity glide paths illustrated in Fig. 7. However, the move was not uniform.

Andrew’s advisor recommends that he continue to hold upward of 80% in equities, while William’s advisor now recommends a more balanced allocation (50% in equities).

What is driving the discrepancy in advice? It is the difference in their human capital. Andrew and Maureen still have substantial human capital that is estimated to be 40% of their total wealth – down from 70% prior to the inheritance. Accordingly, a large bond-like asset remains on their balance sheet, which allows them to take more risk with their financial assets.

On the other hand, William’s human capital now only represents 5% of his estimated total wealth (down from 65%, see Fig. 10). With very limited earnings potential relative to the value of his financial assets, William is effectively at the end of his glide path, so human capital is no longer playing an influential role in allocating the portfolio (see Fig. 11). Accordingly, he should hold a more balanced portfolio that is in line with his moderate tolerance for risk as his income is no longer effective to mitigate portfolio losses.
Appendix A

Objective

Estimating human capital

An individual’s human capital can be estimated as a net present value calculation of future savings at any given time. To do so, we recommend using the “NPV” (net present value) function within Excel. Below are helpful guidelines for attempting this calculation, in Excel, organized by column:

Step 1
In Column B, identify the individual’s number of years until retirement. For this example, a 40-year old planning to retire at age 65 has 25 years until retirement.

Step 2
In Columns C and D, estimate the individual’s salary and annual savings (as a percentage of salary) for each year until retirement.

Step 3
In Column F, determine the appropriate rate to discount future savings. While there are unique attributes associated with each individual’s future earnings and savings potential, you can apply a rule of thumb based on our framework. If the individual’s human capital is safe, consider a discount rate of 3.0%. If the individual’s human capital is risky or correlated, consider a discount rate of 7.0%.

Step 4
Finally, in Column G, use the NPV Excel formula circled below. Note, the formula is: = NPV(discount rate, range of projected savings).

Fig. 12. Net present value calculation

Human capital can be estimated in Excel

<table>
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<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Years</td>
<td>until</td>
<td>Salary</td>
<td>Annual</td>
<td>Annual</td>
<td>Step 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>retirement</td>
<td></td>
<td>savings</td>
<td>savings</td>
<td>Discount</td>
<td>Human capital</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>$500,000</td>
<td>10.0%</td>
<td>=C2*D2</td>
<td>$55,000</td>
<td>3.00%</td>
<td>=NPV/F2:E2:$E46</td>
</tr>
<tr>
<td>3</td>
<td>19</td>
<td>$550,000</td>
<td>10.0%</td>
<td>$60,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>18</td>
<td>$600,000</td>
<td>10.0%</td>
<td>$65,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>17</td>
<td>$650,000</td>
<td>10.0%</td>
<td>$70,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>16</td>
<td>$700,000</td>
<td>10.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: UBS
Appendix B

Objective

Three human capital scenarios

The technical details behind our human capital asset allocation model.

\[ H_t = \text{human capital at time } t \]
\[ W_t = \text{financial capital at time } t \]
\[ \alpha = \text{optimal share of financial wealth in equities} \]
\[ \Omega = \text{covariance matrix} \]
\[ \omega_b = \text{unconstrained optimal benchmark portfolio weights} \]
\[ \omega_a = \text{financial asset portfolio} \]
\[ \omega_{a-b} = \text{difference in weights of financial asset portfolio compared to unconstrained benchmark (sums to zero)} \]

**Fig. 13: Correlation matrix**

<table>
<thead>
<tr>
<th>Asset Class</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Aggregate</td>
<td>1.00</td>
<td>0.53</td>
<td>0.81</td>
<td>0.81</td>
<td>0.54</td>
<td>0.09</td>
<td>0.79</td>
<td>0.34</td>
<td>0.07</td>
</tr>
<tr>
<td>S&amp;P US Muni</td>
<td></td>
<td>0.53</td>
<td>1.00</td>
<td>0.33</td>
<td>0.45</td>
<td>0.22</td>
<td>0.16</td>
<td>0.36</td>
<td>0.10</td>
</tr>
<tr>
<td>Barclays US Agg Long Treasury</td>
<td>0.81</td>
<td>0.33</td>
<td>1.00</td>
<td>0.62</td>
<td>0.24</td>
<td>–0.30</td>
<td>0.77</td>
<td>0.36</td>
<td>–0.03</td>
</tr>
<tr>
<td>Barclays TIPS</td>
<td>0.81</td>
<td>0.45</td>
<td>0.62</td>
<td>1.00</td>
<td>0.55</td>
<td>0.13</td>
<td>0.58</td>
<td>0.17</td>
<td>0.03</td>
</tr>
<tr>
<td>Global Aggregate ex US</td>
<td>0.54</td>
<td>0.22</td>
<td>0.24</td>
<td>0.55</td>
<td>1.00</td>
<td>0.48</td>
<td>0.32</td>
<td>0.19</td>
<td>0.09</td>
</tr>
<tr>
<td>Global Equity</td>
<td>0.09</td>
<td>0.16</td>
<td>–0.30</td>
<td>0.13</td>
<td>0.48</td>
<td>1.00</td>
<td>–0.05</td>
<td>0.03</td>
<td>0.24</td>
</tr>
<tr>
<td>Safe Human Capital</td>
<td>0.79</td>
<td>0.36</td>
<td>0.77</td>
<td>0.58</td>
<td>0.32</td>
<td>–0.05</td>
<td>1.00</td>
<td>0.45</td>
<td>0.07</td>
</tr>
<tr>
<td>Volatile Human Capital</td>
<td>0.34</td>
<td>0.10</td>
<td>0.36</td>
<td>0.17</td>
<td>0.19</td>
<td>0.03</td>
<td>0.45</td>
<td>1.00</td>
<td>0.05</td>
</tr>
<tr>
<td>Correlated Human Capital</td>
<td>0.07</td>
<td>–0.04</td>
<td>–0.03</td>
<td>0.03</td>
<td>0.09</td>
<td>0.24</td>
<td>0.07</td>
<td>0.05</td>
<td>1.00</td>
</tr>
</tbody>
</table>


**Safe human capital glide path**

The investor has constrained holdings of \( H_t \) in human capital. In order to adjust his financial assets to hold the optimal unconstrained equity allocation of \( \bar{\alpha} \), the optimal share of financial wealth held in stocks is:

\[ \alpha = \frac{\bar{\alpha} (W_t + H_t)}{W_t} \]

**Volatile human capital glide path and correlated human capital glide path**

The investor has constrained holdings of \( H_t \) in either volatile or correlated human capital. Our objective is to minimize ex-ante tracking error (TE) between the optimal unconstrained portfolio and the financial wealth plus human capital portfolio, where

\[ TE = \sqrt{\omega_{a-b} \Omega \omega_{a-b}}. \]
About the contributors

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**Thomas Thibeault II** We would like to acknowledge the assistance of Thomas Thibeault II, previously a Graduate Training Program analyst, in the preparation of this report.
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Endnotes

1 Bengali, Leila, and Mary Daly, “Is it still worth going to college?” *FRBSF Economic Letter*, Federal Reserve Bank of San Francisco, May 2014.


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