Occupational Income Betas for Financial Advisers

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Executive Summary

- Previous research has shown that a person's occupational income variability affects the level of risk aversion within a portfolio. Typically, it is assumed that those with high income variability ought to favor fixed-income assets over equities. This paper hypothesizes that a person's income variability is occupation-specific and that an occupational income beta, using a best fit index can be developed for any occupation.
- Occupational income betas, the outcome from this study, can be used by financial advisers as an asset allocation tool when developing and rebalancing client portfolios.
- This paper establishes beta coefficients for a variety of occupations relative to stocks, bonds, and T-bills. It finds that betas for most occupations relative to T-bills are both positive and large, betas for most occupations relative to stocks are generally low and variable, and betas for most occupations relative to bonds are predominantly significant and positive.
- It is shown that the best fit for most occupations is not equities but fixed-income indexes. Of particular interest is the finding showing occupational income, in the majority of cases examined, being most closely associated with the Treasury bill market.
- The paper establishes goodness of fit to determine the amount of explained variance using r^2, finding, in most cases, that variations in occupational incomes could only be somewhat explained, and that, in most cases, the explained variance was low.
- The paper concludes with a summary of how financial advisers can calculate occupational income betas and how each beta can be assessed and used when working with clients.

The notion that a person's source of lifetime income affects the level of risk someone should be willing to take when developing a portfolio is an idea researchers have contemplated for years. Yet, according to Chen (2007), the concept has "not been widely used in the management of the individual investor's financial portfolio" (p. 13) because some assume that the relationship between returns on human capital and marketable securities is weak (Fama & Schwert, 1977) or that forms of human capital play no role in one-period mean-variance portfolio models (Boyle & Guthrie, 2005). This does not mean, however, that these assumptions are necessarily correct. Chen, Ibbotson, Milevsky, and Zhu (2006) argued that not only is there a strong association between returns on human capital and investment assets but that human capital and its derivatives "must be taken into account when building optimal portfolios for individual investors" (p. 97). This paper extends Chen's and his associate's recommendation by deriving occupational income betas and using these data as inputs into the asset allocation process. The purpose of this paper is twofold. First, it addresses the issue of whether or not people with volatile incomes should, in the majority of cases, reduce or avoid stock holdings in their portfolios. Second, it provides financial advisers with a tool—occupational income betas—for measuring occupation income risk as a way to balance a client's portfolio such that maximum diversification is obtained.

A person's ability to generate income is known as human capital. Defining and valuing human capital is quite complex. Human capital is affected by a person's household consumption, age, health, job security, and mortality rate (Washer & Nippani, 2004). The definition of human capital used in this paper is assumed to include these factors. In terms of pure measurement, human capital is the present value of future labor income (Canner, Mankiw, & Weil, 1997; Kyrychenko, 2008). Chen (2007) noted that "human capital is one of two parts of an investor's total wealth; financial assets is the other" (p. 13). According to Canner et al., human capital is the most important non-traded asset available to any investor.

Although rarely considered to be an asset within an individual's investment portfolio because of the difficulty of measuring it, human capital is usually the largest asset someone has available when attempting to maximize his or her wealth over time. Kyrychenko (2008) estimated that human capital, housing, and private business constitute 82 percent of the average U.S. household's total assets. As with other investment assets, human capital's inherent value can be found in its ability to generate a payoff for the investor. Using Fama and Schwert's (1977) payoff analogy, occupational income can be viewed as a human capital dividend. Almost all studies that address human capital and income are derived from human capital as a factor that affects how portfolios are created. Such studies tend to look at occupational income in relation to time (Boyle & Guthrie, 2005). For example, it is often assumed that young people have more human capital than older people because those who are older have less occupational time to accumulate wealth. Conversely, older people tend to have more investment wealth as a result of asset accumulation over their lifetime. This accumulation of wealth acts as a counter-balance to reduced levels of human capital.

Chen (2007) showed how advisers might use these observations when allocating a client's assets. He asserted that a client's income stream can be compared to either a stock or bond investment. If a person has a very stable income stream, Chen hypothesized that this would be equivalent to a bond investment. So, if it is assumed that a 55-year-old investor's portfolio would consist of 60 percent bonds and 40 percent stocks without accounting for human capital, the allocation might change to 35 percent bonds and 65 percent stocks when human capital is included in the allocation mix. Younger individuals would have much more allocated to stocks than even the most aggressive asset allocation mix might suggest.

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The example above is hypothetical and somewhat simplistic. Chen (2007) observed that "the uncertainty in the labor income makes human capital a risky asset" (p. 14). Every occupational endeavor offers a different level of risk. For instance, a tenured university faculty member will have much less occupational income risk than an electrician. Conceptually, it is widely held as true that someone who is exposed to high occupational income risk ought to invest more conservatively because his or her income already resembles an equity investment, which, of course, assumes a high positive correlation between income and equities (Chen et al., 2006). Whether or not this covariance assumption is universally true is not known.

The underlying argument for using human capital as an asset within an asset allocation model is based on the correlation between a person's occupational income stream and financial assets, such as equities, fixed-income securities, and cash equivalents. Chen (2007) concluded the following: "Advisers should invest clients' financial assets in a way that diversifies and balances out their human capital.... The higher the risk of human capital, the smaller the allocation to stocks for the financial assets. High correlation of human capital and the stock market will also reduce the allocation to stocks for the financial assets" (p. 14). Although not discussed directly, what Chen was hinting at is a high correlation between consumption and financial wealth. As human capital decreases, consumption generally stays stable, requiring individuals to rely on wealth rather than income to buffer consumption shocks. Minimizing wealth volatility in these situations is of critical importance. This helps explain why portfolios tend to be rebalanced toward risk-free assets as clients age (Faig & Shum, 2002).

Kyrychenko (2008) provided one of the most useful descriptions of how income variability can impact an investor's portfolio. Kyrychenko examined associations between variability in human capital resulting from employment in various industries and returns on stocks, bonds, housing, and cash. He advocated "safer portfolios for investors employed in finance, insurance, and real estate than for those working in public administration, manufacturing, or trade, whereas for those working in trade, it [his model] recommends the most aggressive portfolios. Government employees are advised to hold a lower share of bonds than those working in manufacturing or trade" (p. 83). His conclusions stemmed directly from variability in industry income and correlations between and among human capital and investment assets. In general, those working in the finance, insurance, and real estate fields were shown to have variable income highly associated with equities, which resulted in a recommendation to reduce portfolio risk. This follows from Chen et al.'s (2006) observation that "a person whose income relies heavily on commission should consider his human capital 'stock-like' because the income is highly correlated with the market. This characteristic results in great uncertainty in his human capital...." (p. 105).

Viceira (2001) used a different approach to illustrate that, in general, investors shift their investment wealth based on the riskiness of their human capital. He also noted a positive relationship between a person's income variability and willingness to increase savings (that is, avoid equity holdings). Viceira concluded the following:

> The increase in labor income volatility has two effects: First, it makes labor income look more like the risky asset than the riskless asset, so that the investor is less willing to assume portfolio risk; second, it causes an increase in the level of savings that reduces the importance of labor income relative to financial wealth as a source of consumption for the employed investor, who becomes more like a retired investor when making her portfolio decisions (p. 460).

The idea that a person's level and volatility of occupational income should have an impact on portfolio choice, as discussed by Viceira (2001), Chen (2007), Chen et al. (2006), and Kyrychenko (2008) was illustrated by Bodie, Merton, and Samuelson (1992). They concluded that a person's "labor flexibility creates a kind of insurance against adverse investment outcomes" (p. 428). Individuals who can vary not only how much they work but also how long they work should be willing to invest more money in risky assets than a person who has limited income flexibility. Several propositions emerged from their research. Two are of particular importance to this study. First, "Accounting for human capital is crucial to explaining investment, labor, and consumption behavior of rational economic agents" (p. 446); second, "At any given age in the life cycle, the riskier is an individual's human capital, the lower will be his financial investment in risky assets" (p. 447). Whether or not the second proposition always holds true is a focus of this study.

> "Counter to what one might expect ... only four occupational categories with variable income returns exhibited a positive correlation with the stock index."

Research findings from previous human capital studies that have addressed the issue of asset allocation models lead to several observations. First, because occupational income sources tend not to be extremely volatile, human capital, when measured using income variability, should resemble fixed-income investments more so than equity investments (Canner et al., 1997). Second, those with high occupational income variability ought to offset this unpredictability with lower risk investments (Heaton & Lucas, 2000; Kyrychenko, 2008). Third, financial advisers should consider incorporating measures of occupational income variability into the asset allocation development process (Chen et al., 2006). While potentially useful, these observations actually provide only the vaguest guidelines for use when allocating a client's assets in a portfolio setting.

As currently stated, it would be difficult for an adviser to actually implement allocation changes based solely on these types of descriptions. Further, it is unknown whether the assumption that stable occupational income is at all times equivalent to a fixed-income security (that is, bond) or whether volatile income is always a proxy for equities is accurate. It may be possible, for instance, that some occupational income streams act more like equities or cash equivalent assets than fixed income securities, regardless of volatility. If this is correct, then the way in which a portfolio is reallocated to account for human capital becomes more complex. An anticipated outcome of this paper is to provide direct evidence of the role occupational income variability plays when an asset allocation approach is developed. The primary result from this paper is the presentation of occupational income betas that can be used by financial advisers as a tool to help conceptualize client portfolios.

Occupational Income Betas: A Conceptual Introduction

According to Picerno (2007), "Asset allocation's value proposition flows from the historical record that shows that owning a mix of assets with low and negative correlations provides superior risk-adjusted returns in the long run compared with a relatively undiversified portfolio" (p. 69). This is one of the cornerstones of modern portfolio theory (MPT). Another keystone of MPT is the way an investment asset's volatility (risk) is evaluated. The performance of an individual asset or security is usually measured in relationship to a market index (Hirt & Block, 2006). This is most often done by assessing the asset's *beta coefficient*. Beta allows an investor to evaluate an asset's performance relative to changes in a market index. The index itself can be any market—stock, fixed income, cash, or another market sector. In its most basic form, beta indicates how volatile or risky an asset is in relation to its index (that is, the market). Hirt and Block explained the relationship this way: "Because beta measures the correlation of a stock's total return to a market index, the beta of the market when regressed on itself will always be 1.0" (p. 602). Knowing this, an investor can predict that an asset with a beta of 1.1 will increase in value by 11 percent if the market moves up by 10 percent (the asset is considered to be 10 percent more volatile than the market). Conversely, an asset with a beta less than 1.0 will move up or down with less severity than the market. A negative beta indicates that an asset will move inversely with the market index. The level of change is directly proportional to the size of the beta coefficient.

The beta coefficient for an asset can be calculated with the following formula. Note that a linear relationship between the asset and the market is assumed.

Formula 1: $\beta = (N \Sigma K_i K_M - \Sigma K_i \Sigma K_M) / (N \Sigma K_M^2 - (\Sigma K_M)^2)$

Where

β = beta

N = number of observations

K_i = nominal asset return

K_M = nominal market return

The beta formula can be simplified if the correlation between the asset and the market index is known. The following formula can be used when the correlation coefficient has been identified:

Formula 2: $\beta = (\sigma_i / \sigma_M) * r_{iM}$

Where,

β = beta

σ_i = standard deviation of asset

σ_M = standard deviation of market

r_{iM} = correlation between asset and market

> "At least initially, it was evident that the majority of occupational categories resembled fixed income assets—particularly T-bills—more so than equity assets."

As a component of MPT, beta is used to capture an asset's level of systematic risk, which is assumed to be non-diversifiable. Theoretically, investors are compensated solely for taking systematic risk. Beta is commonly used in the derivation of the security market line as well as in the development of asset allocation strategies. Investors who wish to limit their exposure to market risk search for asset combinations that provide portfolio betas less than 1.0. Less risk-averse investors often seek assets that, when combined into a portfolio, generate portfolio betas greater than 1.0, with the assumption that greater investment risk will lead to increased returns.

Conceptually, a beta coefficient can be calculated for any asset, given the following two requirements. First, the asset must have identifiable returns that are comparable to a market index. Second, the asset must be theoretically associated with the market index. It is well established in the literature that occupational income is often assumed to be a proxy for certain types of investment assets. Some (for example, Chen, 2007; Chen et al., 2008) have even argued that occupational income, as a measure of human capital, is an asset that should be incorporated into asset allocation strategies. Although it is a simple assertion, it is reasonable to hypothesize that occupational income risk can be measured by beta. More specifically, this study proposes the concept that distinct occupations expose workers to unique risk that is associated with investment assets such as equities, fixed-income securities, and Treasury bills. This risk can be measured by beta, using investment market indexes as a basis for comparison. Further, we propose that after accounting for occupational income risk, investors and their advisers ought to consider rebalancing portfolios to account for correlations between and among occupational income volatility and market indexes.

Method

Occupational income beta coefficient estimates were calculated using workers' income and wage estimates from the Department of Labor (2008) and data from Ibbotson Associates (2008). Twenty-two occupational income betas were evaluated in this study. These included farmers and ranchers, accountants, financial advisers, architects, engineers, zoologists, sociologists, political scientists, therapists, lawyers, professors, teachers, editors, dentists, pharmacists, nurses, firefighters, electricians, bakers, bartenders, insurance agents, and real estate agents. These occupational categories were chosen to represent a wide variety of employment endeavors held by Americans. Average national income data were collected over the 10-year period 1998 through 2007.

Ibbotson Associates (2008) stock, bond, and Treasury bill rate of return and standard deviation data were collected for the same period. Two indexes were created using Ibbotson data. A stock index was developed by assuming equal-weighted holdings of large company and small company stocks. A bond index was derived by assuming holdings of equal weight in long-term corporate and long-term government bonds. Over the period 1998 to 2007 these indexes were calculated to generate 9.8 percent and 7.2 percent rates of return, respectively, with corresponding standard deviations equal to 17.2 percent and 7.5 percent, respectively. United States Treasury bills were shown to return 3.6 percent with a standard deviation of 1.7 percent over the same period.

Rate of return and standard deviation data for occupations were also calculated. Income rates of return were computed by determining year-over-year increases (decreases) in aggregate national income for various occupational endeavors. An average was then calculated using this information. All rates of return, including the stock and bond indexes and Treasury bills, were generated using nominal data as reported by Ibbotson Associates (2008) and the Department of Labor (2008). Combined, this information was used to estimate correlations between and among assets. Rate of return, standard deviation, and correlation information were used in Formula 2 (presented above) to estimate occupational income beta coefficients. We hypothesized that each occupation tested would have a different beta coefficient depending on the index used to calculate the coefficient. We further hypothesized that occupations with volatile earnings would only occasionally, rather than often, have a positive beta in relation to the stock index. In other words, we thought that the majority of occupations would resemble bond or cash equivalent indexes more than a stock asset, regardless of the level of income variability inherent in the occupation. We did not predict which of the occupations might show this pattern of beta coefficient at the outset of the study.[1] Results are discussed below.

Table 1: Stock, Bond, Bill, and Occupation Rates of Return and Standard Deviations

	Rate of Return	Standard Deviation
Stocks	9.8%	17.2%
Long-Term Bonds	7.2%	7.4%
T-Bills	3.6%	1.7%
Farm/Ranch	3.4%	2.5%
Accountant	5.4%	3.0%
Financial Adviser	4.6%	3.8%
Architect	3.9%	1.5%
Engineer	3.8%	2.5%
Zoologist	3.5%	1.1%
Sociologist	5.0%	5.3%
Political Scientist	2.6%	2.8%
Therapist	3.8%	4.4%
Lawyer	5.1%	6.5%
Professor	4.0%	2.1%
Teacher	3.0%	1.4%
Editor	4.1%	2.0%
Dentist	5.1%	7.3%
Pharmacist	5.5%	2.0%
Nurse	4.2%	0.9%
Firefighter	3.4%	1.2%
Bartender	3.6%	2.8%
Insurance Sales Agent	3.7%	4.1%
Real Estate Agent	4.8%	3.6%
Electrician	2.9%	3.5%
Baker	3.1%	2.3%

Results

Table 1 shows the average rate of return and standard deviation estimates for stocks, bonds, Treasury bills, and occupation income for those employment categories tested in this study. In general, growth rates in occupational incomes were what one would expect. In the majority of cases, incomes kept pace with Treasury bill returns (that is, a proxy for inflation). Only four occupations showed income growth significantly less than 3.6 percent over the 10-year period: political scientist, electrician, teacher, and baker. The greatest variation in income over the period was associated with professional occupational activities—law and dentistry.

Rate of return data were used to estimate bivariate correlation coefficients between and among occupations and stocks, bonds, and Treasury bills. Table 2 (on page 56) shows the results. Counter to what one might expect, but consistent with the research hypothesis, only four occupational categories with variable income returns exhibited a positive correlation with the stock index (that is, farmers-ranchers, sociologists, electricians, and bakers). This result was in line with Canner et al.'s (1997) observation that "it is not obvious that human capital is similar to stock" (p. 188). Fourteen occupations had a positive correlation with the bond index, while 17 were positively correlated with Treasury bills. At least initially, it was evident that the majority of occupational categories resembled fixed income assets—particularly T-bills—more so than equity assets.

Table 2: Bivariate Correlations Between Stocks, Bonds, Bills, and Occupations

	Stocks	Long-Term Bonds	T-Bills
Stocks	1.00	–	–
Long-Term Bonds	(0.71)	1.00	–
T-Bills	(0.25)	(0.06)	1.00
Farm/Ranch	0.15	(0.52)	0.47
Accountant	(0.14)	0.30	0.57
Financial Adviser	(0.42)	0.12	(0.05)
Architect	(0.46)	0.32	0.14
Engineer	(0.11)	0.02	0.28
Zoologist	(0.42)	0.61	(0.20)
Sociologist	0.31	(0.35)	0.22
Political Scientist	(0.20)	0.28	0.27
Therapist	(0.02)	(0.00)	(0.36)
Lawyer	(0.10)	(0.32)	0.01
Professor	(0.28)	0.01	0.42
Teacher	(0.46)	0.37	0.74
Editor	(0.31)	0.05	0.43
Dentist	(0.43)	0.03	0.05
Pharmacist	(0.14)	0.22	0.34
Nurse	(0.25)	0.16	0.10
Firefighter	(0.24)	(0.18)	0.27
Bartender	(0.45)	0.23	0.75
Insurance Sales Agent	(0.18)	(0.16)	(0.08)
Real Estate Agent	(0.24)	0.55	(0.60)
Electrician	0.25	(0.74)	0.28
Baker	0.17	(0.51)	0.59

Beta and Stocks

Data from Tables 1 and 2 were incorporated into Formula 2 to estimate occupational income beta coefficients. Results are shown in Table 3 (on page 58). As hypothesized, each occupation had a unique beta coefficient. Further, only four of the occupations examined in this study exhibited a positive beta in relation to the stock index, and in general, these beta coefficients were low (that is, 0.02, 0.09, 0.05, and 0.02, respectively, for farmers-ranchers, sociologists, electricians, and bakers). In all other cases, the beta estimates associated with stocks were small and negative, suggesting that in most cases, occupational income over the period moved inversely with changes in the equity index, although such changes were quite modest.

Beta and Bonds

Significantly more occupations exhibited a positive beta in relation to the bond index. These included accountants, financial advisers, architects, engineers, zoologists, political scientists, professors, teachers, editors, dentists, pharmacists, nurses, bartenders, and real estate agents. For interpretation purposes, a positive beta coefficient, when the market index was bonds, indicated that occupational income moved, to some degree, in the same direction as the bond market. It is noteworthy that the largest positive estimated beta was 0.27 for real estate agents, whereas in almost all other cases the positive betas were very small. A negative beta, using the bond index as the benchmark, was estimated for seven occupations. The negative beta estimates ranged from a low of –0.03 to –0.35. The beta estimate for one occupation—therapist—was 0.00, indicating no income-bond index association.

Beta and Treasury Bills

The most unexpected findings were in relation to occupational income and Treasury bills. Beta coefficients were, in the main, both positive and large. Positive beta estimates ranged from a low of 0.03 (lawyer) to 1.23 (bartender). A non-negative beta indicated that changes in occupational income moved positively with changes in Treasury bill returns. Only five occupations exhibited negative betas in comparison to Treasury bills (that is, financial advisers, zoologists, therapists, insurance sales agents, and real estate agents). The negative beta coefficient for real estate agents was very large (that is, –1.24), suggesting that an increase in Treasury bill returns could result in a drop in real estate agent incomes.

Assessing Goodness of Fit

It is important to qualify the strength of beta coefficients in order to determine the amount of explained variance the underlying index has on each occupation. One way to assess the strength of the association is to measure the goodness of fit between the beta coefficient and the underlying index. The coefficient of determination statistic, usually referred to as r squared (r^2), can be used to describe the percentage of variation in occupation income that is explained by the market index. The r^2 statistic can range from 0.00 to 1.00. The higher the coefficient, the stronger the relationship between the market index and the particular occupation. Take, for example, the beta and r^2 for real estate agents. Beta estimates using the stock, bond, and Treasury bill indexes were –0.05, 0.27, and –1.24, respectively. The r^2 statistic for real estate agents using the same indexes was 0.06, 0.30, and 0.36 (see Table 4 on page 59). These were estimated by squaring the correlation coefficients for real estate agents

Table 3: Estimated Beta Coefficients for Occupations Compared to Stocks, Bonds, and Bills

	Stocks	Long-Term Bonds	T-Bills
Stocks	1.00	–	–
Long-Term Bonds	–	1.00	–
T-Bills	–	–	1.00
Farm/Ranch	0.02	(0.17)	0.67
Accountant	(0.02)	0.12	0.98
Financial Adviser	(0.09)	0.06	(0.11)
Architect	(0.04)	0.06	0.12
Engineer	(0.02)	0.01	0.40
Zoologist	(0.03)	0.09	(0.13)
Sociologist	0.09	(0.24)	0.65
Political Scientist	(0.03)	0.11	0.44
Therapist	(0.01)	(0.00)	(0.91)
Lawyer	(0.04)	(0.28)	0.03
Professor	(0.03)	0.00	0.51
Teacher	(0.04)	0.07	0.60
Editor	(0.04)	0.01	0.50
Dentist	(0.18)	0.03	0.22
Pharmacist	(0.02)	0.06	0.39
Nurse	(0.01)	0.02	0.06
Firefighter	(0.02)	(0.03)	0.19
Bartender	(0.07)	0.09	1.23
Insurance Sales Agent	(0.04)	(0.09)	(0.19)
Real Estate Agent	(0.05)	0.27	(1.24)
Electrician	0.05	(0.35)	0.56
Baker	0.02	(0.16)	0.78

in Table 2. The stock r^2 was very low, suggesting that the equity index was not the best fit index for real estate agents. The 0.30 r^2 using the bond index was larger but not as large as the r^2 of 0.36 for Treasury bills. In descriptive terms, an adviser would generally choose the Treasury bill index as the best fit index for real estate agents, although the amount of explained variance was relatively low. The r^2 statistic, in this case, indicates that approximately 36 percent of real estate income variability can be explained by changes in Treasury bill returns. In other words, an adviser could have a modest degree of confidence that a 10 percent increase in Treasury bill returns will decrease real estate agent incomes by 12.4 percent.

It is important to note, however, another important finding from this study. There were only a few cases in which the r^2 values were consequential. Notice the relatively high r^2 values for teachers (that is, 0.55), bartenders (that is, 0.57), and electricians (that is, 0.55). These r^2 estimates corresponded to betas of 0.74, 0.75, and 0.74 in relation to Treasury bills for teachers and bartenders and bonds for electricians. Only for these occupations could one have more than a modest degree of confidence in the income-index association. In some cases, occupational income had no meaningful association with return changes in stocks, bonds, or Treasury bills. The r^2 estimates for engineers, political scientists, pharmacists, nurses, firefighters, and insurance agents were quite low. These estimates were indicative of the low level of variance in occupational income that could be explained by changes in the stock, bond, or Treasury bill indexes. All other r^2 estimates were of modest size, which leads to the conclusion that variations in occupational incomes could only be explained somewhat by changes in stock, bond, and Treasury bill values, and again, in the majority of cases, the amount of explained variance was not that large.

Practice Management Implications

Although the r^2 estimates were, in the majority of cases, modest, the results from the analyses suggest that Canner et al. (1997) and others (for example, Cocco et al., 2005) were generally correct in arguing that occupational income is most similar to a fixed income asset, regardless of the amount of variance in annual occupational income; however, this conclusion explains only part of the situation. This is one of the first studies to examine occupational income variability in relation to Treasury bills, as well as stock and bond indexes. In this respect, results help refine the link between income and investment assets more precisely. Whereas nearly all researchers in the field have proposed that occupational income variability serves as a proxy for strict bond investments, except in cases of high income volatility, this research suggests that occupational income can, in fact, represent equities, long-term bonds, or Treasury bills, but, in the majority of cases, occupational income is most closely linked with Treasury bills—the lowest standard deviation index—in terms of returns and variability. Stated another way, occupational income acts more like cash than bonds or stock. Counter to the hypothesis that those with occupational income variability ought to offset income unpredictability with lower risk investments, results suggest that in the majority of cases, it can sometimes make sense to add equity holdings to portfolios to increase diversification when human capital is included in the portfolio mix. This logically follows from the relationship between occupational incomes and Treasury bills. In certain cases it may pay to add equities to increase diversification. This finding supports Chen's (2007) assertion that average investors today are underweighted in equities. Finally, support was shown for the third proposition, namely, financial advisers should consider incorporating measures of income variability into the asset allocation process, especially when a client's income comes from an occupational endeavor with a strong association with a particular market index.

Discussion

The information in Table 3 is potentially very useful from a financial planning and asset allocation point of view. Using r^2 values from Table 4, it is possible to estimate a best fit index for each occupation. In most cases, the best fit index can be determined by identifying the highest coefficient of determination. There are some situations in which the coefficient of determination is weak for all occupation index associations. For example, the highest r^2 value for political scientists is 0.08. This relates to a beta of 0.11 when the bond index is used. This can be interpreted to mean that although incomes for political scientists move most closely with the bond market, any variation in income resulting from changes in bond prices will be minimal. That is, returns in the bond market explain only a small amount of income variance for political scientists. In this particular case, it is reasonable to conclude that income for political scientists is to a large extent independent of changes in the securities markets. It is also possible to use the correlation coefficient estimates in Table 2 to approximate effect sizes. According to Cohen (1988), effect sizes range from small (coefficients less than 0.25) to large (coefficients greater than 0.40). The higher the correlation coefficient, the greater the effect of the particular index on occupational income. In the case of political scientists, the effect size for the bond-occupation association is modest. On the other hand, the effect size of the bond-occupation relationship for electricians is very large, −0.74; the coefficient of determination is also relatively high, making bonds the best fit index for electricians. As such, whenever occupation income is going to be included as a portfolio input it would be wise to first identify a best fit index. Second, an evaluation of the best fit index should indicate a coefficient large enough for prediction confidence. Finally, a moderate to large effect size should be confirmed using Cohen's correlation rule.

Table 4: Estimated Coefficients of Determination (r^2) for Occupations, Stocks, Bonds, and Bills

	Stocks	Long-Term Bonds	T-Bills
Stocks	1.00	-	-
Long-Term Bonds	0.50	1.00	-
T-Bills	0.06	0.00	1.00
Farm/Ranch	0.02	0.27	0.22
Accountant	0.02	0.09	0.33
Financial Adviser	0.18	0.01	0.00
Architect	0.21	0.10	0.02
Engineer	0.01	0.00	0.08
Zoologist	0.18	0.37	0.04
Sociologist	0.09	0.12	0.05
Political Scientist	0.04	0.08	0.07
Therapist	0.00	0.00	0.13
Lawyer	0.01	0.10	0.00
Professor	0.08	0.00	0.17
Teacher	0.21	0.14	0.55
Editor	0.10	0.00	0.19
Dentist	0.18	0.00	0.00
Pharmacist	0.02	0.05	0.11
Nurse	0.06	0.02	0.01
Firefighter	0.06	0.03	0.07
Bartender	0.21	0.05	0.57
Insurance Sales Agent	0.03	0.03	0.01
Real Estate Agent	0.06	0.30	0.36
Electrician	0.06	0.55	0.08
Baker	0.03	0.26	0.35

Application Examples

While not all financial advisers will be comfortable incorporating a client's occupational income variability into asset allocation models, there may be merits to doing so. The following examples are provided for descriptive purposes only. The employment categories illustrated provide an insight to how any client's occupational income beta can be assessed and used in the asset allocation process. Advisers who adopt the procedure should either calculate a client's personal income beta or use a more broadly calculated occupational income beta. If the former approach is used, advisers should consider the following issues. First, it is possible that a client's occupational variability may have too much unsystematic risk associated with it. That is, if an adviser calculates beta for an individual, the outcome may be associated too directly to a client's skill set rather than the occupation itself. Second, it is possible that when calculated, a client's occupational income beta will be small, and as such, of limited use in portfolio optimization situations. In these situations there may, in fact, be little value added by including the occupational beta in an asset allocation model.

Assuming that a particular occupational income is significant, it is possible to infer investment strategies from the information in Tables 2, 3, and 4 or from similar data computed by an adviser. Notice the positive beta (that is, 0.60) and the corresponding high r^2 (that is, 0.55) and correlation (that is, 0.74) estimates for teachers when the best fit index is Treasury bills. Teacher incomes tend to move in positive proportion to changes in Treasury bill returns. Nearly all school districts, for example, link income increases to annual changes in inflation, so it is not surprising that teachers' incomes are somewhat less volatile than Treasury bill returns. Even though teachers' incomes lag return changes in Treasury bills, the return characteristic of teachers' income is much like a cash asset. When viewed from a portfolio perspective, typical teachers are holding too much cash in their investment portfolio because they are not accounting for the cash equivalency of their occupational income.

One way to balance out the influence of occupational income variability in a teacher's portfolio is to decrease actual cash holdings and increase exposure to equity assets, such as stocks. Adding stock will act to diversify a teacher's portfolio and increase potential long-term returns. This follows from Coaker's (2007) advice that to "optimize the risk/return relationship, the asset allocation decision should emphasize low-correlated assets that still meet return objectives" (p. 68). In other words, occupational income beta coefficients provide a useful insight into which assets can be combined, based on low correlations, to consistently reduce portfolio risk. In the example above, cash assets can be reduced to implement such a recommendation.[2]

Real estate agents provide another example of how occupational income betas can inform the portfolio development process. The best fit index for real estate agents is Treasury bills. Even though the r^2 estimate is modest (that is, 0.36), the large negative beta (that is, –1.24) serves as a striking example of how occupational income can alter an investment portfolio. Real estate agent incomes are 24 percent more volatile than returns on Treasury bills. However, as shown in Table 3, the beta is negative, suggesting that a rate of return increase in Treasury bills will result in an income loss for real estate agents. A financial adviser who works with a real estate agent can use this information to hedge income volatility by increasing cash equivalent holdings within the client's investment portfolio (that is, essentially building an emergency fund).[3] To a lesser extent, adding fixed-income holdings could also serve a diversification objective. This recommendation corresponds with what Kyrychenko (2008) noted in his study.

Data in Table 3 provide additional insight into the relationship occupational income has with stock, bond, and Treasury bill indexes. In almost all cases, even in those situations in which the r^2 estimate is low, the overall recommendation remains the same—reducing cash and adding stock holdings to an investment portfolio is a way to increase diversification when human capital is accounted for within an asset allocation framework. This point contradicts generally applied asset allocation strategies. Heaton and Lucas (2000), for example, noted that business owners who have variable income should rightly hold less wealth in equities than typical wage earners. While this may be the descriptive case, results from this study suggest that this may not always be the most appropriate (that is, normative) strategy. Volatility itself is not the primary issue. Instead, it is the level of volatility associated with a particular market index that is most important. In cases in which income variability is highly correlated with equities, the Heaton and Lucas recommendation holds true; however, this is rarely the case. Instead, it appears that Cocco et al. (2005) were correct in proposing that occupational income, for the majority of employment classifications, acts as a proxy for less volatile investment assets. In other words, of the occupations studied in this research, the largest portion had occupational betas most closely linked with long-term bonds and Treasury bills.

Several rules emerge for those who would like to incorporate findings from this study in the development of asset allocation models. To begin with, a best fit model index should be identified. The easiest way to do this is to find the market index with the highest r^2 value of the occupation in question. Once the best fit index has been identified, the occupational income beta coefficient should be evaluated. Four concurrent observations are needed. First, is the beta coefficient positive, negative, or near zero? Second, how large is the beta coefficient? Third, how large is the r^2 value, and fourth, is the correlation between the occupational income stream and the index of at least modest size? A positive beta coefficient indicates that variability in income will move positively with the underlying index. The larger the beta coefficient the more impact a change in the index will have on changes in occupational income. The larger the r^2 value, the more confidence one can have in the anticipated change in income. A confirmation of the correlation effect size will add to a financial adviser's confidence when using occupational income in a portfolio optimization system.

Financial advisers who use portfolio optimization programs can use rate of return and correlation statistics, such as those shown in Tables 1 and 2, to identify model asset allocations. Alternatively, financial advisers can use a simplified heuristic to help reallocate assets. Specifically, for cases in which the best fit beta is positive, the adviser should reduce holdings of the benchmark asset. For situations in which the best fit beta is negative, additional holdings of the benchmark asset should be used. So, for example, assume an adviser is working with a client whose occupational income beta is –1.00. Also assume that the best fit benchmark is the bond index. In this case, holding other factors constant, the adviser should reallocate assets to increase exposure to the bond index.[4]

In summary, the evidence from this study suggests that occupational income variability can, indeed, have an impact on a person's level of risk aversion within investment portfolios. We demonstrated that some occupational income streams act like stock or bond indexes, but in the majority of cases, occupational income resembles most closely returns of Treasury bills. While initial support was shown for the hypothesis that occupational income variability should be offset with changes in stock holdings, such a recommendation was deemed far from universal. It appears that each occupation has its own best fit index, and in some cases, the best fit beta coefficient is linked with a stock, bond, or cash equivalent index. How a portfolio is designed or reallocated will depend on the size and strength of the coefficient in relation to its benchmark.

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Endnotes

1. Portfolio optimization techniques using stocks, bonds, Treasury bills, and occupational data were used to estimate the impact occupational income variability can have on a model portfolio. These results are reported for selected portfolios in endnotes.
2. If it were possible to sell short occupational income this would be the preferred strategy when developing an optimized portfolio for teachers. The optimal portfolio, including teacher income as an asset is as follows: 16 percent equities, 36 percent bonds, 116 percent Treasury bills, and –68 percent occupational income. Obviously, this is not possible; as such, adding equities while reducing cash and bonds is a practical way to achieve better diversification.
3. The optimal allocation for a four asset portfolio consisting of stocks, bonds, Treasury bills, and real estate agent occupational income is 6 percent, 11 percent, 50 percent, and 33 percent, respectively. This compares to an optimal portfolio of 11 percent stocks, 26 percent bonds, and 63 percent Treasury bills when occupational income is excluded. The intuition behind the use of occupational betas is thus supported in a mean-efficient analysis.
4. It may be possible to know from which other asset category the assets should be taken. If the beta for either stocks or Treasury bills is positive, it is reasonable to conclude that one or both of these asset classes can be reduced.

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