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The value of retirement income streams: the value of military retirement☆

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Abstract

We examine issues surrounding the value of military retirement income. We then provide estimates of the expected present value of this income stream after taxes for singles, married couples, widows and widowers of military retirees. Finally, we contend that individuals should treat the after-tax present value of military retirement income as a bond in their family portfolio. When so considered, it can dramatically affect the family's asset allocation. Published by Elsevier Science Inc.

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1. Introduction

Retirement planning is a core component of financial planning. The typical approach to retirement planning begins with a target level of retirement spending. Expected pension payments and Social Security benefits are deducted from this spending level to compute an income gap that the investment portfolio must fund. Typically, pensions are considered when planning for retirement income but they are not considered when calculating the asset

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allocation. We argue that this is inconsistent. Since both pensions and the investment portfolio generate retirement funds, both should be considered part of the family's portfolio.

In this paper, we examine issues surrounding, and present estimates of, the present value of one of these retirement streams—military retirement income. This analysis is more than a case study; many issues examined also pertain to estimates of the values of corporate pensions and Social Security benefits. With approximately 1,910,000 annuitants, the value of military retirement income is worthy of analysis in its own right. The military retirement system presents an interesting illustration in several dimensions. Service members, for example, are eligible to receive benefits after 20 years of service. Like many firefighters and police officers, military members retire and then start a second career and earn a second pension, that is, they "double-dip." Because their initial retirement typically occurs while they are in their forties, many pursue a second career. Military retirees do not incur the penalty associated with job switching in defined-benefit pension plans (Woerheide & Fortner, 1994) because a military retirement income begins immediately after the first retirement, and the income is indexed for inflation.

Valuing military retirement benefits allows us to demonstrate two important implications for asset allocation. First, like traditional IRAs and 401(k)s, funds derived from military retirement are taxable. We address this difference using Reichenstein's (1998, 2000) insight that asset allocation should be based on after-tax values. Second, we use the similarities between inflation-indexed Treasury bonds and military retirement benefits to value those benefits. Cash flows from both Treasury Inflation Protection Securities (TIPS) and military retirement are linked to the Consumer Price Index (CPI), and both sets of cash flows are backed by the federal government. These similarities suggest treating the present value of military retirement benefits as bonds in the family's portfolio.

The "true" family portfolio includes financial assets and the present value of retirement income streams such as military retirement income (Scott, 1995). As Reichenstein (1998, 2000) and Fraser, Jennings, and King (2001) demonstrate, including these pseudo-bonds in the portfolio can dramatically affect the family's asset allocation. For example, suppose a family's risk tolerance calls for a 50/50 stocks/bonds asset allocation and it allocates its financial assets—the traditional definition of the family portfolio—to meet this target asset mix. Its true portfolio, which includes military retirement income, may be 25/75 in stocks/bonds. If the family fails to recognize that military retirement income is a bond in its portfolio then it will miss its target asset allocation.

Section 2 reviews the literature that supports our recommended changes to the traditional approach of calculating a family's asset mix. Section 3 presents details of the U.S. military retirement system. We then discuss issues surrounding estimation of the present value of retirement income streams, present our estimation method, and critique it. Finally, we present an example that demonstrates the importance of including the present value of retirement income streams—in this case military retirement—in a family's portfolio. The final section concludes.

2. Review of the literature

In this section, we present two modifications of the traditional approach of calculating a family's asset mix. First, we review the literature that addresses the issue of before-tax

versus after-tax valuation of portfolio components. Second, we discuss the question of which assets, beyond the financial assets included in a traditional portfolio, should be included in an expanded view of a family's true portfolio.

2.1. Before-tax versus after-tax funds

Reichenstein (1998, 2000) argues that a family's asset allocation should be based on after-tax funds because goods and services are purchased with after-tax funds. The traditional approach to calculating the asset allocation does not distinguish between before-tax and after-tax funds. For example, suppose a family has a $10,000 bond fund held in a 401(k) and a $10,000 bond fund held in a taxable account. In the taxable account, both market value and book value are $10,000. The traditional approach would consider each of these accounts worth $10,000. Yet, the 401(k) contains before-tax funds, while the taxable account contains after-tax funds. A retiree cannot buy as many goods and services from the $10,000 in the 401(k) as he can from the $10,000 in the taxable account. After-tax funds should be compared to after-tax funds. Asset values should first be converted to after-tax values, and the family's asset allocation should reflect these after-tax values. Reichenstein (1998, 2000) discusses issues surrounding the conversion of market values to after-tax values for assets held in deductible pensions (e.g., 401(k), 403(b), Keogh, etc.), non-deductible IRAs, non-qualified tax-deferred annuities, and taxable accounts.

2.2. What "counts" in the family portfolio?

Scott (1995), Reichenstein (1998, 2000), and Fraser et al. (2001) among others argue that the family portfolio should reflect the present value of retirement income streams such as Social Security, company pensions, and military retirement. Retirement income streams are traditionally included in studies of retirement preparedness (see Poterba, Venti, & Wise, 1994; Kennickell, Starr-McCluer, & Sunden, 1997; Yuh, Hanna, & Montalto, 1998, among others), but excluded when calculating a family's asset allocation (see Peavy & Sherrerd, 1990; Stevens, 2000, among many others). Scott's criterion for deciding whether to include an asset in the family portfolio is to include "financial assets that you would be willing to sell for spending money or that generate some form of spending money, either now or sometime in the future . . .." (1995, p. 15) She thus includes the present value of the *before-tax* Social Security payments and other retirement-income cash flows. In this paper, we include the present value of these *after-tax* amounts. Whether someone includes before-tax or after-tax values of retirement income streams, their inclusion can dramatically affect the measurement of the family's asset allocation. Thus, the decision to include or exclude the retirement income stream is an important one whether we use before-tax or after-tax values.

3. U.S. military retirement systems

There are three main military retirement systems—Final Pay, High Three, and REDUX ("REDUX" is suggestive of the reduction in benefits in the third military retirement system

created under the 1986 Military Retirement Reform Act (see U.S. Code, Title 10, §1409)). Final Pay applies to service members who entered the service before September 8, 1980. High Three applies to service members who entered from September 8, 1980 to July 31, 1986. Service members who enter the service after July 31, 1986 must, after 15 years of service, elect the High Three system or elect the REDUX system and receive a $30,000 career retention bonus. Except in unusual circumstances, service members must serve 20 years to be eligible for retirement pay. Note that time at Service Academies or on ROTC *scholarships* counts for determining the entry date, but do not count for computing years of service. Table 1 summarizes key aspects of each system.

Few military personnel can choose between the three systems since, in general, date of entry into military service determines eligibility. The only choice is for those who entered after July 31, 1986. While their choice will depend on individual circumstances, a quick analysis, based on the valuation Multiples we present below, suggests that only those who expect long military careers (e.g., 28 years or longer), senior ranks (e.g., to Colonel or General), and/or high real returns (e.g., greater than 8%) should remain under REDUX and take the $30,000 career retention bonus. The website pay2000.dtic.mil (2001) provides a more detailed discussion of the choice for those who entered after July 31, 1986.

Three key elements of each system are Base Pay Amount, Percentage, and cost-of-living adjustment. To avoid confusion, Base Pay Amount and Percentage are typed with capital letters when they refer to a key element. Current Annual Payment (CAP) is the product of Base Pay Amount and Percentage.

Under Final Pay, Base Pay Amount at retirement is the final base pay, excluding bonuses such as for hazardous duty. Under High Three and REDUX, Base Pay Amount at retirement is the average base pay for the highest 36 months, excluding bonuses.

Table 1
Comparison of three U.S. military retirement systems

	Final Pay	High Three	REDUX
Base Pay Amount	Final base pay, excluding bonuses	Average base pay in highest 36 months, excluding bonuses	Average base pay in highest 36 months, excluding bonuses
Percentage of Base Pay Amount received in retirement	50% + 2.5% (years of service − 20)	50% + 2.5% (years of service − 20)	Before age 62, 40% + 3.5% (years of service − 20); beginning age 62, 50% + 2.5% (years of service − 20)
Cost-of-living adjustment	Base Pay Amount increases with CPI inflation rate	Base Pay Amount increases with CPI inflation rate	Before age 62, Base Pay Amount increases with CPI inflation rate less 1%; at age 62, Base Pay Amount is adjusted to amount under High Three; after age 62, this adjusted Base Pay Amount increases with CPI inflation rate less 1%

Percentage for Final Pay and High Three is $50\% + 2.5\%$ (years of service $-$ 20). Essentially this means a retiree received 50% of the Base Pay Amount after 20 years of service, and the Percentage increases by 2.5% a year. For example, if someone retirees after 21.3 years of service, the Percentage is 53.25%. The Percentage for REDUX is $40\% + 3.5\%$ (years of service $-$ 20). This means that after 20 years a retiree receives 40% of Base Pay Amount, and the Percentage increases by 3.5% a year. After 30 years of service, a retiree receives 75% of the Base Pay Amount under all three systems. Once the Percentage reaches 75%, it does not increase.

Unlike most private sector pensions, military retirement payments receive cost of living adjustments. Under Final Pay and High Three, Base Pay Amount increases annually with the CPI-W inflation rate, where CPI-W denotes the Consumer Price Index for Urban Wage Earners and Clerical Workers. Under REDUX, Base Pay Amount increases annually by 1% less than the CPI-W inflation rate. No COLA is granted if CPI-W is less than 1%.

Under REDUX, at age 62 there is a one-time ''catch-up'' that adjusts retirement pay to the level it would be under High Three. This catch-up requires two adjustments: Base Pay Amount is changed to the level it would have been without the 1% inflation lag and Percentage is changed to the higher Percentage under High Three. Under REDUX, after age 62 Base Pay Amount again increases annually by 1% less than the CPI-W inflation rate. The DFAS website (2001) provides more detailed information about the retirement plans.

4. Issues, illustration, and critique of our estimates

4.1. Issues

Three issues must be resolved before calculating the present value of military retirement income. These include the use of before-tax or after-tax income, the appropriate discount rate, and the projected income stream.

The first two issues can be covered quickly. For reasons discussed earlier, we estimate the value of military retirement income as the present value of projected after-tax income. For present value calculations, the discount rate is the yield on the TIPS with maturity closest to the length of the expected income stream. TIPS pay a fixed real rate of interest each year on principal, and the principal is increased each year based on CPI-U, the CPI inflation rate for Urban Consumers. Thus, principal and interest payments increase with the level of the CPI. They are inflation-protected securities. As such, the TIPS real yield can be used to discount the inflation-adjusted or real military retirement income stream. Real rates are used to discount real income, and nominal rates are used to discount nominal income.

For 1974–1999, the correlation coefficient between CPI-W and CPI-U is 0.9998, and there is a negligible difference between their long-horizon cumulative inflation rates. Consequently, use of TIPS yields, which rely on CPI-U, does not bias our estimates of military retirement income, which relies on CPI-W. Henceforth, we ignore the distinction and refer to them as CPI. Fraser et al. (2001) acknowledge the CPI difference and other caveats in using TIPS to value real income streams, but conclude the usefulness of TIPS outweighs the shortcomings.

The final issue is the projected income stream. We estimate the pre-tax value of military retirement income as the present value of expected pre-tax income, which is the profession's traditional method of estimating an asset's value. As we shall see, this is different from the present value of income through someone's expected life.

4.2. Illustration

We estimate the after-tax present value of military retirement income for single males and single females as follows:

$$\text{CAP} = \text{Base Pay Amount} \times \text{Percentage} \tag{1}$$

$$\text{Present value before taxes} = \text{CAP} \times \text{Multiple} \tag{2}$$

$$\text{Present value after taxes} = \text{CAP} \times \text{Multiple} \times (1 - t) \tag{3}$$

where t is the expected marginal tax rate, Multiples are explained in the next paragraph and the other variables are described in Section 3.

Before going into details of calculating a Multiple, consider a simple demonstration of the preceding equations. For example, assume Luke is single and retires on his 44th birthday in the Final Pay or the High Three system. He served 20 years, so the Percentage is 50%. If his Base Pay Amount is $40,000, his CAP is $20,000. In his first year of retirement, he will receive $1,667 a month, $20,000/12. Assuming a 4% TIPS yield, we estimate the pre-tax value of Luke's military retirement income at $20,000 (19.29) or $385,800, where 19.29, the Multiple from Table 3, is the present value of military income if the CAP is $1. Since military retirees can easily calculate their CAP at 12 times the current monthly check amount, Multiples are always expressed as a multiple of CAP.

Table 2 details the calculation of a Multiple under Final Pay or High Three systems. Since Luke just retired, there is a 100% probability that he will receive the first $1 CAP. We estimate the Multiple as if annual pay is received at the beginning of each year, when it is actually received monthly. Based on updated mortality tables (Society of Actuaries, 2000), he has a 0.998603 probability of being alive at age 45 and thus, receiving the second $1 real payment. Since nominal payments increase with inflation, the real payments remain constant. The expected real payment in Year 2 is thus, $0.998603. There is a 0.997097 probability that he will live to age 46, and receive the third $1 real payment. This process is repeated through his 120th birthday—the end of the mortality tables—where there is a 0.0000004 probability that he will be alive and receive one last $1 real payment. The pre-tax Multiple is the sum of the present value of each year's expected real income. Assuming a 4% TIPS yield, it is the sum of $\$1 + \$0.998603/(1.04)^1 + \$0.997097/(1.04)^2 + \cdots + \$0.0000004/(1.04)^{76}$. *The Wall Street Journal* presents TIPS yields at the end of its Treasury Bonds, Notes & Bills table under Inflation-Indexed Treasury Securities.

The pre-tax value of Luke's military retirement income is $20,000 (19.29) or $385,800. If he expects to be in the 28% tax bracket, the after-tax value is about $277,800. We argue that Luke should include military retirement income in his portfolio and consider it a bond worth about $277,800 after taxes.

Table 2
Calculations of Multiples

Age	Probability of being alive	Real Base Pay Amount ($)	Fraction	Real payment ($)	Expected real payment ($)	Present value of expected real payment ($)
Assumption: 44-year-old single male under Final Pay or High Three retirement system[a]						
44	1.000000			1	1	1
45	0.998603			1	0.998603	$0.99806/(1.04)^{1}$
46	0.997097			1	0.997097	$0.997097/(1.04)^{2}$
79	0.608287			1	0.608287	$0.608287/(1.04)^{35}$
80	0.573050			1	0.573050	$0.573050/(1.04)^{36}$
120	0.0000004			1	0.0000004	$0.0000004/(1.04)^{76}$
						Multiple = 19.29
Assumption: 50-year-old single male under REDUX retirement system[b]						
50	1.000000	1	1		1	1
51	0.997862	$1/(1.01)^{1}$	1		0.987982	0.987982/(1.04)
52	0.995418	$1/(1.01)^{2}$	1		0.975804	$0.975804/(1.04)^{2}$
61	0.957004	$1/(1.01)^{11}$	1		0.857785	$0.857785/(1.04)^{11}$
62	0.949658	$1(1.01)^{6}$	1.14		1.149212	$1.149212/(1.04)^{12}$
63	0.941342	$1(1.01)^{5}$	1.14		1.127870	$1.127870/(1.04)^{13}$
120	0.0000004	$1/(1.01)^{52}$	1.14		0.0000003	$0.0000003/(1.04)^{70}$
						Multiple = 18.13

[a] This Multiple is the present value of expected real payments, where $1 is the annual real or inflation-adjusted payment. The Multiple can be applied to the Current Annual Payment to determine the value of retirement benefits. The $1 is an annuity due. The discount interest rate is 4%.

[b] This Multiple is the sum of present value of expected real payments, where $1 is the Current Annual Payment. The Multiple can be applied to the Current Annual Payment to determine the value of retirement benefits. The discount interest rate is 4%. At age 62 and beyond, the Fraction is 0.575/0.505, where 0.575 and 0.505 are the Percentages of Base Pay Amount before and after age 62, respectively. At age 62, real Base Pay Amount is adjusted to the level it would have been if Base Pay Amount had been adjusted since military retirement with CPI inflation rate instead of CPI-1%. For REDUX, the military personnel is assumed to retire at age 44. The Multiple for this 50-year-old male single retiree is $1(9.15) + 1.14(7.88) = 18.13$.

4.3. Critique of our estimates

There are at least three potential criticisms of our method of estimating the value of military retirement income. First, we estimate its value as an annuity due with all payments occurring at the beginning of the year. The key is that military retirement is a real annuity, not a nominal annuity. Nominal interest rates can be expressed $1 + i = (1 + \text{Inf})(1 + \text{RR})$, where i denotes a nominal interest rate, Inf denotes inflation, and RR denotes a real rate. Suppose real income from military retirement is \$20,000 a year. With an annuity due, the present value of before-tax payments received 1 and 2 years hence are $\$20{,}000(1 + \text{Inf})/(1 + i)$ and $\$20{,}000(1 + \text{Inf})^2/(1 + i)^2$, respectively. Substituting $(1 + \text{Inf})(1 + \text{RR})$ for $(1 + i)$ produces $\$20{,}000/(1 + \text{RR})$ and $\$20{,}000/(1 + \text{RR})^2$, respectively. That is, only the real rate is needed to estimate the present value of the \$20,000 real income stream.

If the \$20,000 is an ordinary annuity, the present value of after-tax payment received 2 years hence would be $\$20{,}000(1 + \text{Inf})/(1 + i)^2$ since only one inflation adjustment would have occurred. Substituting $(1 + \text{Inf})(1 + \text{RR})$ for $(1 + i)$, we get $\$20{,}000/(1 + \text{Inf})(1 + \text{RR})^2$. Unlike the annuity due, the calculation of the present value of a regular annuity requires two estimates—an estimate of the expected real rate and an estimate of expected inflation. Using an annuity due imparts a slight upward estimation bias.

Second, we calculate the value of military retirement income as the present value of *expected cash flows*. Some professionals would prefer to estimate it based on either *cash flows through life expectancy* or cash flows for a period longer than life expectancy.

Let us return to Luke, the 44-year-old single male retiree. His life expectancy is 36.5 years. The present value of a \$20,000 a year annuity due for 36.5 years when discounted at 4% is about \$395,800. This present value exceeds the present value of expected cash flows, which is \$385,800. Experimentation indicates that the present value of cash flows through life expectancy is consistently slightly larger than the present value of expected cash flows. For single retirees, estimates based on cash flows through life expectancy are approximately equal to estimates based on expected cash flows, which implies that the former estimates have merit. However, we cannot estimate the value of military retirement based on the couple's life expectancy. For a 65-year-old couple, the last to die may be the joint life expectancy of 26 years. But the payments to the couple depend upon whether the military retiree is the first or last to die.

The fact that one estimate is higher or lower than others does not determine its desirability. An estimate's desirability depends upon whether its assumptions fit the situation. For example, one goal of financial planning is to ensure that someone will not outlive his or her resources. Thus, some planners may want to value military retirement income assuming Luke will live longer. These planners would place a higher value on military retirement income than our method. We believe those interested in the average case should use the present value of expected cash flow—the profession's traditional method of calculation.

The third potential criticism concerns the difference between a *contingent* value and a *guaranteed* value. The expected value of Luke's military retirement income is \$385,800 before taxes or \$277,800 after taxes. Let us compare two packages of payments: first, expected payments from Luke's military retirement and, second, payments from a 401(k)

that contains a laddered portfolio with $20,000 of (zero-coupon) TIPS bonds maturing each year for 37.65 years (i.e., TIPS bonds worth $20,000 mature each year for 37 years and $13,000 matures in the 38th year). The payment packages are both backed by the U.S. government. Assuming a TIPS yield of 4%, they both have a present value of about $385,800 before taxes and $277,800 after taxes.

The laddered portfolio has one important advantage compared to military retirement. If Luke should die prematurely, the laddered portfolio will continue to pay $20,000 inflation adjusted for the remainder of the 37.65 years. In contrast, Luke's military retirement income ceases.

Suppose Luke has a daughter from a previous marriage who needs special care. To insure his daughter's financial needs, he may wish to guarantee the *after-tax* value of military retirement income by buying life insurance. Since life insurance benefits are tax exempt, he could buy a $277,800 term life policy. This effectively converts the *contingent* value of military retirement—contingent upon him living at least 37.65 years—into a *guaranteed* value. Through the years, he can reduce the size of the death benefit. With the exception of this important caveat, we contend that Luke should view military retirement as a $277,800 *after-tax* bond.

5. Multiples

Income multiples are always expressed as a Multiple of CAP. Retirees can easily calculate the latter as 12 times the most recent monthly payment. We believe this format best serves the reader.

5.1. Multiples under Final Pay and High Three systems

Tables 3 and 4 present Multiples for retirees under the Final Pay and High Three systems. Table 3 presents Multiples for single males, single females, widowers and widows. The earlier illustration presented the estimation method for single males. The same method applies to single females. Due to their longer life expectancy, single females have larger Multiples than single males as can be seen in the two left panels of Table 3.

The two right panels of Table 3 present the income Multiples for a surviving male spouse and a surviving female spouse, where their deceased partner was the military retiree. Suppose Sal and Suzanne, both age 44, are married. Sal retires under Final Pay or High Three with Base Pay Amount of $60,000 and 20 years of service. If single, he would have received $30,000 a year, which we call CAP1. If they elect the Survivors Benefit Plan, their CAP is 6.5% less or $28,050 or [(0.50) ($60,000) (1 − 0.065)], which we call CAP2. If Sal dies before Suzanne reaches age 62, she will receive 55% of CAP1. She will continue to receive 55% of CAP1 until she reaches 62, and 35% of CAP1 thereafter. Multiples in the two right panels of Table 3 are expressed relative to CAP1, which is 12 times the survivor's current monthly payment.

Table 4 presents income Multiples under Final Pay and High Three for married male retirees and married female retirees who choose the Survivor Benefit Plan (SBP). Most

Table 3
Multiples for single males and females, widowers, and widows under Final Pay or High Three retirement system

Age	Single male			Single female			Widower			Widow		
	2.5%	3%	4%	2.5%	3%	4%	2.5%	3%	4%	2.5%	3%	4%
44	23.93	22.20	19.29	25.04	23.12	19.95	20.49	19.19	16.99	21.21	19.80	17.42
50	21.45	20.07	17.72	22.68	21.13	18.50	17.41	16.44	14.77	18.21	17.13	15.28
56	18.68	17.64	15.83	20.04	18.83	16.76	13.92	13.23	12.03	14.79	14.00	12.63
59	17.22	16.34	14.78	18.63	17.59	15.78	12.02	11.45	10.45	12.92	12.25	11.09
62	15.73	14.99	13.68	17.19	16.30	14.74	15.73	14.99	13.68	17.19	16.30	14.74
65	14.24	13.63	12.54	15.74	14.99	13.67	14.24	13.63	12.54	15.74	14.99	13.67
68	12.77	12.28	11.39	14.29	13.67	12.57	12.77	12.28	11.39	14.29	13.67	12.57
74	9.91	9.61	9.06	11.44	11.04	10.31	9.91	9.61	9.06	11.44	11.04	10.31
80	7.30	7.14	6.83	8.77	8.53	8.09	7.30	7.14	6.83	8.77	8.53	8.09

The 2.5%, 3%, and 4% are TIPS yields. The Multiples assume the military personnel retired at age 44. Multiples are applied to retired annuitant's Current Annual Payment to determine the present value of expected cash flows.

married retirees choose the SBP. In fact, the retiree is automatically enrolled with full spousal coverage unless the spouse waives his or her right to demand it. There are two sets of Multiples in Table 4. One set assumes the husband and wife are the same age. The other assumes the wife is 3 years younger.

Suppose Luke, age 44, retires with Base Pay Amount of $40,000 and Percentage of 50%. He and his wife, who is 3 years younger, opt for the SBP. If single (or married and not in the SBP), his CAP1 would be $20,000. Since he and his wife chose the SBP, the CAP2 is $18,700 or [Base Pay Amount $\times$ Percentage $\times$ $(1 - 0.065)$], where 6.5% is the cost of the

Table 4
Multiples for married males and females military retirees under Final Pay or High Three retirement system

Age	Married male						Married female					
	Wife same age			Wife 3 years younger			Husband same age			Husband 3 years older		
	2.5%	3%	4%	2.5%	3%	4%	2.5%	3%	4%	2.5%	3%	4%
44	25.17	23.25	20.07	25.42	23.46	20.21	25.84	23.82	20.47	25.68	23.68	20.37
50	22.78	21.23	18.61	23.07	21.47	18.78	23.99	22.28	19.39	23.35	21.72	18.97
56	20.10	18.91	16.84	20.42	19.18	17.04	20.95	19.65	17.42	20.74	19.47	17.28
59	18.67	17.64	15.85	19.00	17.93	16.06	19.56	18.43	16.47	19.35	18.24	16.32
62	17.21	16.33	14.79	17.54	16.62	15.01	18.12	17.15	15.46	16.06	15.30	13.93
65	15.72	14.99	13.69	16.06	15.29	13.93	16.66	15.84	14.40	14.59	13.95	12.82
68	14.24	13.64	12.56	14.58	13.95	12.81	15.19	14.51	13.30	13.12	12.60	11.67
71	12.75	12.27	11.40	13.11	12.59	11.66	13.71	13.16	12.16	11.66	11.25	10.51
74	11.29	10.91	10.22	11.65	11.24	10.49	12.25	11.81	11.00	10.25	9.93	9.35
80	8.53	8.31	7.90	8.88	8.64	8.19	9.44	9.18	8.69	7.65	7.47	7.13

The 2.5%, 3%, and 4% are TIPS yields. The Multiples assume the military personnel retired at age 44. Multiples are applied to retired annuitant's Current Annual Payment to determine the present value of expected cash flows.

SBP. If Luke dies first, his surviving wife receives 55% of *CAP1* until *she reaches* age 62, and 35% of *CAP1* thereafter. The Multiples in Table 4 are multiples of CAP2, which is 12 times their current monthly payment.

The Multiple for a married male retiree in Table 4 is larger than the Multiple for a single male retiree in Table 3. The married-male Multiple reflects expected cash flows if the male is alive *plus* expected cash flows to his wife if he dies first. The single male Multiple reflects only expected cash flow to the male if alive. The same relationship exists between Multiples for single females and married female retirees.

Full analysis of choosing SBP, or not, is beyond the scope of this paper, but our Multiples offer some insight into whether choosing the SBP makes economic sense. Recall that while most retirees take SBP, it is possible to decline SBP with spousal consent. Such a decision is made at retirement. It is also possible, with spousal consent, to select less than the full SBP coverage we analyze, and it is also possible to purchase Supplemental SBP. If Luke waives SBP, his pension wealth is $19.29 \times \$20{,}000$, or \$385,800, since he is 44-year-old and the TIPS rate is 4%. If Luke elects SBP, Luke and his wife have pension wealth of $20.07 \times [\$20{,}000 \times (1 - 6.5\%)]$, or about \$375,300. The present value of expected cash flows is slightly higher without SBP. The same conclusion holds for female military members, instances when the female is 3 years younger, and lower TIPS yields. Again, full analysis of the SBP decision (including issues of insurability, risk tolerance, individual circumstances, etc.) is beyond the scope of this paper, but the present value of expected pension cash flows is slightly higher without SBP.

5.2. Multiples under REDUX retirement system

Military personnel will begin to retire under REDUX retirement system in year 2000. Nevertheless, the tables present Multiples for a wide range of ages to accommodate future retirees.

Calculations of Multiples under REDUX are inherently more complex. Consider two identical twin brothers who are currently 61-year-old. They entered the service together and had identical careers except Alex retired after 20 years at age 41 and Barry retired after 23 years at age 44. Alex's annual payment increases have lagged behind inflation by 1% a year for 20 years, while Barry has lagged behind inflation for 17 years. At age 62, Alex will catch up for more years of 1% inflation shortfalls. In addition, Alex's Percentage will rise from 40% to 50%, while Barry's Percentage will rise from 50.5% to 57.5%.

Table 5 presents numbers that allow someone to estimate the income Multiple under REDUX retirement system for single males and females. The following example illustrates how to use Table 5.

Suppose Barry is 50-year-old and retired at age 44 with 23 years of service. His CAP is 50.5% of Base Pay Amount at age 50. Since he retired 6 years earlier, the real Base Pay Amount has lagged the CPI inflation rate by 1% a year for the last 6 years. At age 62, there are two adjustments. First, his Base Pay Amount increases to the level it would have been without the CPI CAP; mathematically, the real Base Pay Amount at age 62 equals real Base Pay Amount at age 50 times $(1.01)^6$. Second, the Percentage is increased from 50.5% to 57.5%, the Percentage for someone retired after 23 years of service under High Three.

Table 5
Multiples for single males and females under REDUX retirement system

Age	Males			Females		
	2.5%	3%	4%	2.5%	3%	4%
44						
Before 62	13.40	12.92	12.05	13.45	12.97	12.09
After 62	8.61	7.53	5.81	9.46	8.24	6.30
50						
Before 62	9.83	9.59	9.15	9.87	9.63	9.18
After 62	10.70	9.65	7.88	11.73	10.53	8.53
56						
Before 62	5.45	5.38	5.26	5.46	5.40	5.28
After 62	13.40	12.44	10.76	14.63	13.52	11.61
59						
Before 62	2.88	2.87	2.84	2.89	2.87	2.85
After 62	15.08	14.20	12.65	16.40	15.38	13.60
62	14.28	13.64	12.51	15.45	14.70	13.38
65	13.04	12.51	11.56	14.27	13.63	12.50
68	11.80	11.36	10.58	13.07	12.54	11.58
74	9.31	9.04	8.55	10.65	10.29	9.65
80	6.97	6.82	6.54	8.29	8.27	7.67

The 2.5%, 3%, and 4% are TIPS yields. The Multiples assume the military personnel retired at age 44. Multiples are applied to retired annuitant's Current Annual Payment to determine the present value of expected cash flows. For ages below 62, the Multiple is computed as (before 62 Multiple) + Fraction × (after 62 Multiple) where Fraction is the Percentage of Base Pay Amount that the retiree receives after 62 divided by the Percentage of Base Pay Amount that the retiree receives before 62; this accommodates the variable step-up feature of REDUX.

Compared to his real CAP at age 50, the real CAP at age 62 will be almost 21% larger, $[\{(1.01)^6(57.5/50.5)\} - 1]$.

Table 5 requires detailed explanation. For a 4% TIPS yield, present value of Barry's payments through age 61 is the product 9.15 × CAP, his CAP at age 50. The present value of payments after age 62 is the product 7.88 × Fraction × CAP. The Fraction is 57.5/50.5 or 1.14, where 50.5 and 57.5 are the Percentages of Base Pay Amount that the retiree receives before and after age 62. The pre-tax value of Barry's retirement income is thus: 18.13 × CAP where 18.13 is 9.15 + 7.88 × 1.14. The lower panel of Table 2 presents details of the calculation.

Return to the twin brothers, Alex and Barry. At age 50, the pre-tax present value of Alex's retirement income is $19 \times \mathrm{CAP}_{\mathrm{Alex}}$. The pre-tax present value for Barry is $18.13 \times \mathrm{CAP}_{\mathrm{Barry}}$. Although Alex has the larger Multiple, it is a multiple of his smaller benefit. Since he retired later, the present value of Barry's military retirement will always be greater than the present value of Alex's.

Table 6 presents Multiples for married male and married female retirees who opt for the SBP, respectively. Suppose Luke, age 44, retires after 24 years of service with Base Pay Amount of $40,000 under REDUX and his Percentage is 50%. He and his wife, who is

Table 6
Multiples for married males and females retirees under REDUX retirement system

Age	Married male						Married female					
	Wife same age			Wife 3 years younger			Husband same age			Husband 3 years older		
	2.5%	3%	4%	2.5%	3%	4%	2.5%	3%	4%	2.5%	3%	4%
44												
Before 62	13.53	13.04	12.16	13.53	13.05	12.16	13.55	13.07	12.18	13.54	13.05	12.17
After 62	9.52	8.30	6.36	9.71	8.46	6.47	10.05	8.74	6.67	9.93	8.64	6.60
50												
Before 62	9.92	9.68	9.23	9.92	9.68	9.23	9.94	9.70	9.24	9.92	9.68	9.23
After 62	11.80	10.60	8.60	11.34	10.17	8.24	12.44	11.15	9.01	11.58	10.38	8.40
56												
Before 62	5.48	5.42	5.30	5.48	5.42	5.30	5.49	5.43	5.31	5.48	5.42	5.30
After 62	14.70	13.59	11.69	13.29	12.27	10.53	15.46	14.27	12.21	13.57	12.53	10.74
59												
Before 62	2.89	2.88	2.85	2.89	2.88	2.85	2.89	2.88	2.85	2.90	2.89	2.86
After 62	16.47	15.45	13.68	14.44	13.53	11.95	17.29	16.19	14.27	14.30	13.39	11.82
62	15.49	14.75	13.44	15.74	14.97	13.61	16.22	15.41	13.98	14.55	13.90	12.73
65	14.29	13.66	12.54	14.55	13.89	12.72	15.06	14.36	13.12	13.34	12.79	11.80
68	13.05	12.53	11.59	13.33	12.78	11.79	13.85	13.27	12.21	12.10	11.65	10.83
74	10.54	10.20	9.58	10.84	10.47	9.81	11.37	10.98	10.27	9.62	9.33	8.80
80	8.09	7.89	7.52	8.40	8.18	7.77	8.91	8.67	8.23	7.29	7.12	6.81

The 2.5%, 3%, and 4% are TIPS Yields. The Multiples assume the military personnel retired at age 44. Multiples are applied to retired annuitant's Current Annual Payment to determine the present value of expected cash flows. For ages below 62, the Multiple is computed as (before 62 Multiple) + Fraction × (after 62 Multiple) where Fraction is the Percentage of Base Pay Amount that the retiree receives after 62 divided by the Percentage of Base Pay Amount that the retiree receives before 62; this accommodates the variable step-up feature of REDUX.

3 years younger, opt for the SBP. If single, his CAP1 would be $20,000. Since he and his wife chose the SBP, the CAP2 is $18,700 or 6.5% less due to the cost of the SBP. If Luke dies before he reaches age 62, his surviving wife receives 55% of *CAP1*. When he, *the military retiree*, would have reached age 62, the one-time catch up occurs, i.e., the Base Pay Amount catches up for the years of 1% inflation lag and the Percentage increases to 60%, the level under Final Pay and High Three. When she, *the surviving spouse*, reaches age 62, the fraction is reduced to 35%. In Table 6, the Multiple calculation is parallel for a retired female and her husband under the SBP.

5.3. Properties of Multiples

Income Multiples exhibit bond-pricing properties, because valuing a retirement income stream is essentially like valuing a bond. Although we use Multiples in Table 3 to demonstrate the bond-pricing properties, they are present in all Multiples. The Multiples are sensitive to the level of TIPS yield. Moreover, this sensitivity is larger for younger retirees than for older retires. At age 44, a single male's Multiple is 15.1% larger when the TIPS

yield is 3% instead of 4%. At age 74, the Multiple is 6.1% larger. In addition, for a given change in yield this sensitivity is larger at low yields than at high yields. For example, the 44-year-old single male's Multiple increases 2.91 years when the TIPS yield falls from 4% to 3% and a relatively larger 1.73 years when the yield falls half as much from 3% to 2.5%. Finally, the size of the Multiple decreases relatively slowly, especially for younger retirees. At age 44 and a TIPS yield of 4%, a single male has a Multiple of 19.29 and a life expectancy of about 36 years. At age 62, half his life expectancy later, the Multiple has only decreased about 30% to 13.68.

In addition to the bond-pricing properties noted above, life situation affects the Multiples. As noted, due to their longer life expectancy, single women have higher Multiples than single men. Similarly, widows have higher Multiples than widowers. Married retirees have higher Multiples than singles, widows, and widowers. This results from joint life expectancies exceeding single life expectancies. This effect is amplified when the retiree's spouse is younger.

6. Illustration of new approach to calculating the asset mix

George, age 64, is a military retiree. Pam, age 62, is his wife. George retired from his post-military job 3 years ago and Pam recently retired. They have $300,000 in stocks in 401(k) plans and $300,000 in bonds in taxable accounts; the cost basis and market value of the bonds are $300,000. They expect to be in the 28% tax bracket during retirement. Their CAP from military retirement is $30,000. (For simplicity, we assume that George did not earn a second defined-benefit pension that would require valuation and integration into the portfolio.) Their target asset mix is 50% stocks and 50% bonds. What is their current asset mix?

Consider two views of Pam and George's asset mix. If they calculate the asset mix based on the traditional approach, they believe they have achieved the desired asset mix. Their traditional portfolio contains $300,000 in stocks and $300,000 in bonds.

Now let us calculate their "true" portfolio, which includes their military retirement and consistently reflects after-tax values. We must first convert all assets to after-tax values. The $300,000 in the 401(k) plans is pre-tax dollars. It represents $216,000 after taxes, $300,000 $(1 - 0.28)$. The $300,000 of bonds in the taxable account is after-tax funds. We must estimate their Multiple. Today's TIPS yield is 4%. From Table 4, the Multiple for a 65-year-old male retiree with a wife 3 years younger is 13.93. George is 1-year younger than 65 and Pam is 2 (not 3) years younger than George. So we need to interpolate from the tables. Their Multiple is 14.21 or $13.93 + 0.36 - 0.08$. The 0.36 is one-third the difference between the Multiples for males age 65 and age 62 with a wife 3 years younger or 1/3 $(15.01 - 13.93)$, and 0.08 is one-third the difference between the Multiples for male age 65 with a wife the same age and male age 65 with a wife 3 years younger or 1/3 $(13.93 - 13.69)$. The present value of their after-tax military retirement income is about $306,900, or $30,000 (14.21) $(1 - 0.28)$.

Based on after-tax funds and including the value of military retirement, their portfolio contains $822,900 in assets. Their true asset mix consists of 26% stocks ($216,000/

$822,900) and 74% bonds, which is about half the stock portion they desire (and think they have). To achieve the desired 50% stock exposure, they could invest all $216,000 after taxes of 401(k) funds and $195,450 of the taxable account in stocks. Alternatively, they could invest all $300,000 of the taxable account in stocks and $111,450 of after-tax 401(k) funds (or $154,800 of pre-tax 401(k) funds) in stocks.

The choice between these two alternative portfolios depends upon the investor's asset location choice. That is, to the degree possible, should stocks or bonds be located in pensions? Shoven (1999) and Shoven and Sialm (1998) among others argue that active stock investors should locate stocks in pensions, but Reichenstein (2001) among others reach the opposite conclusion. This topic is beyond the scope of this paper.

To convert Pam and George's traditional asset mix to their true asset mix, we need an estimate of their marginal tax rate during retirement. In addition, the Multiple reflects numerous assumptions, including the assumption that the actuarial tables reflect their unique life expectancy. Although Pam and George's true asset mix can only be estimated, we hold that it is better to rely on an estimate of their true portfolio than to rely on their traditional portfolio. By ignoring taxes, the traditional portfolio implicitly assumes their marginal tax rate will be zero. Ignoring military retirement implies its value is zero; in contrast, the example demonstrates it is important to properly measure a family's asset mix.

7. Conclusion

We argue that it is inconsistent to consider pension income streams in retirement planning, but ignore pension wealth in retirement asset allocation. Stoller (1992) notes, ''The present value of a spouse's pension can easily be the most valuable asset that a couple possesses.'' Therefore, pension wealth will affect portfolio analysis. We argue the regular payment pattern of pensions makes them bond-like. In particular, we argue that the inflation-adjusted, regular payments from military pensions makes them like Treasury Inflation Protection Securities, and value military pensions accordingly.

As the illustration in Section 6 demonstrates, a portfolio managed with a target asset allocation can be grossly out of alignment if pension wealth is ignored. Given the relative importance of asset allocation over security selection and market timing (Brinson, Hood, & Beebower, 1986), there is a critical need for accuracy in determining the portfolio. We build on the work of Scott (1995) and others by highlighting the importance of including pension wealth. Given the substantial bond-like value associated with pension wealth, we recommend considering military pension wealth as a bond in a family's ''true'' portfolio.

There are several implications to doing so. Because pension wealth can invert a seemingly stock-heavy portfolio into a bond-heavy one, excluding pension wealth can have a significant impact on investment decisions. Thinking of pension wealth as a bond creates arguments for including more stock in the financial part of the ''true'' portfolio. We find it intuitively appealing to think of pension wealth as a bond; this intuition might prove persuasive for some investors afraid of increased equity commitments. Finally, excluding bond-like pension wealth from asset mix decisions results in sub-optimal portfolios. Ignoring pension wealth means that the desired (and presumably optimal) risk/return

tradeoff as implemented under the traditional view of the portfolio is unlikely to be achieved in the ''true'' family portfolio. This means investors who ignore pension wealth are giving up return-enhancement or risk-reduction opportunities.

This paper makes a contribution on several levels. First, it represents the convergence and assimilation of three strands of literature—the Scott (1995) insight about expanded views of family's ''true'' portfolios to include pension wealth, the Reichenstein (1998, 2000) insight about after-tax valuation of portfolio assets, and the Fraser et al. (2001) insight that TIPS yields are useful in valuing federally-backed inflation-indexed cash flows. Second, it demonstrates and critiques the use of present value of expected cash flows for pension valuation in lieu of the more typical, but theoretically inferior, present value of cash flows through life expectancy. Third, it applies rigorous analysis to a sizable and important pension system—that of the U.S. military.

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