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Equivalence: A Crucial Financial Concept for Extension, Consumer, and Investor Education

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Abstract: Equivalence is a fundamental concept that is the basis of personal financial planning. Any Extension consumer financial education program would need the concept to explain financial products that involve a series of payments over some length of time (pensions, fixed annuities, and mortgages). A table of annuity factors is presented that can be used in financial planning situations to explain the impact of interest rate and time length on the cash received from these financial products. A set of examples is included to illustrate use of the table.

Introduction

Today, more than ever, the need for consumer financial education is clearly visible (Erikson, Delgadillo, & Piercy 2008). While Internet-based software is available as an aid in consumer financial education (O'Neill, 1999), not all teaching applications occur where computer access is good. Many consumers prefer to learn from tables and print-based applications. Simple practical applications that stress common consumer financial problems can lead to positive changes in consumer financial behavior (Osteem, Muske, & Jones, 2007) and lead to more effective extension financial education programs (O'Neill, 1998).

The basic consumer products (fixed annuities, mortgages, and pensions) all have the same financial framework. They involve a series of payments over some length of time. Once the consumer understands the simple theory behind these products, much more deliberate financial decisions are possible. This article presents a simple table to convert a sum of money today into a monthly income stream. It can be a powerful tool in education consumers about financial products that involve an income stream.

Car Payments, Mortgages, Pensions, and Other Annuities

You win a million dollars in the lottery. One payment option is $50,000 per year over 20 years. This certainly adds up to a million dollars, but what if you want the money today in a lump sum? Most of us know the lump sum option would be quite a bit less than a million dollars. At 8% interest, for example, the lump sum would be $530,179.96. The reason it only adds up to about a half of the million dollar payout is that, except for the first $50,000 payment, each payment occurs years in the future. Future payments are worth less because you have to wait to receive them.

You may never have the problem of how to collect a million dollar lottery payout, but the principle involved is common to millions of everyday transactions. A vehicle might be purchased for $30,000 today or $580 per month over 5 years (at 6% interest). The principle is equivalence; at 6% interest $580 per month for 60 months is equivalent to $30,000 today. The cash flow series is called an "annuity" (from Latin *annu(us)* meaning yearly). An annuity is any periodic cash flow series that runs for a specified length of time. A mortgage is a monthly annuity. So is a pension; the length of time is an individual's remaining life time. Social security would also qualify as an annuity.

Equivalence means an individual ought to be indifferent between a lump sum today and a series of payments over time that equate (considering interest) to the lump sum. For example, $100,000 today earning 8% interest would be worth $466,095.72 in 20 years. Likewise, $10,185.22 a year deposited into a savings account over 20 years that earns 8% interest will accumulate to $466,095.72. The two are equivalent. Of course, equivalence means risk is equal or accounted for in the interest rate. Riskier investments pay higher interest rates or a risk premium. If I perceive a greater risk in receiving my payments over time, I will ask for more interest. In the example above I might ask for 12% rather than 8%, increasing my payments from $10,185.22 to $13,387.88.

There is such a thing as a perpetual annuity. An endowment is an example. Often someone wants to fund something into perpetuity. The math is simple for this type of annuity. If an endowment fund is expected to earn 5% over time, how much principal must I donate today to endow a $10,000 annual scholarship? The formula is to divide the annuity amount by the interest rate (in decimal form); or $10,000 divided by 0.05 equals $200,000. How much income will a lump sum generate for a perpetual annuity? Just multiple the principal by the interest rate; in our example, $200,000 times 0.05 equals $10,000.

Annuity Factors and Examples

Financial calculators will perform most annuity calculations. Basic interest rate rules control the relationships. For standard periodic non-perpetual annuities, the higher the interest rate, the higher the payment, and the longer the term, the lower the payment (think of a mortgage). Below is a table of common annuity factors (Bullard & Straka, 1998). They provide the basis for some very practical "sensitivity analyses" of how annuities function.

Table 1.
Factors to Convert a Single Sum Today to a Monthly Annuity

Interest Rate	10 Years	20 Years	30 Years	Perpetual
5%	0.0106066	0.0065996	0.0053682	0.0041667
6%	0.0111021	0.0071643	0.0059955	0.0050000
7%	0.0116108	0.0077530	0.0066530	0.0058333
8%	0.0121328	0.0083644	0.0073376	0.0066667
9%	0.0126676	0.0089973	0.0080462	0.0075000
10%	0.0132151	0.0096502	0.0087757	0.0083333

Example. Think of your own mortgage. What if I go with a 20 year rather than a 30 year mortgage on my $250,000 house with a 6% mortgage? The payment increases from $1,498.88 to 1,791.08. (Use the 0.0059955 and 0.0071643 factors and multiply by $250,000.)

Example. What if the interest rate increases from 6% to 8% on my 30 year $250,000 mortgage? The payment increases from $1,498.88 to $1,834.40. (Use the 0.0059955 and 0.0073376 factors, and multiply by $250,000.)

Example. How much monthly income will $10,000 produce forever at 10% interest? Monthly income will be $83.33. (Use the 0.0083333 factor, and multiple by $10,000.)

Example. How much money can I remove monthly from an account containing $100,000 today and earning 6% over 30 years? You can withdraw $599.55 monthly for 30 years before the account value reaches zero. (Use the 0.0059955 factor, and multiply by $100,000.)

Example. What is the payment if I took my $1,000,000 winnings from the lottery on a monthly basis, at 8% interest? You'd receive $8,364.40 per month for 20 years. (Use the 0.0083644 factor, and multiply by $1,000,000.)

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