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Analyzing Investment Opportunities: The Time Value of Money in Farm Decisionmaking

FACT SHEET

Fact Sheet 543

James C. Hanson
farm management specialist
Billy V. Lessley
professor
Dale M. Johnson
Extension economist
Department of Agricultural and Resource Economics
University of Maryland at College Park

If you were offered $10,000 today or $10,000 a year from now, which would you pick? Most people who are asked this question would pick now, thereby asserting that money has positive "time value". Money's positive time value means that $1 today is worth more than $1 a year from now. Understanding money's time value is important in making investment decisions, including farm investment decisions.

Defining Time Value

A person would take the cash now instead of later for various reasons. The prudent person might place the $10,000 in a savings account earning 5 percent interest. This would generate $500 extra income that the person receiving the $10,000 1 year later would miss. Alternative uses could earn the investor even more money. Another person may want the money for immediate gratification. For example, why wait a year for a new car when it can be purchased and enjoyed now? Or, a person may be worried about the precariousness of life. Either the giver of the $10,000 or the receiver might not be here in a year to fulfill her or his part of the transaction. These various reasons are all valid and demonstrate the positive time value of money.

The Role of Interest Rates

Establishing that money has a positive time value is not difficult; quantifying this time value can be. Interest rates generally are used to equate the present and future *claims* for financial assets. Different interest rates imply different time values.

Lenders of capital receive interest, and borrowers pay interest because of money's positive time value. For example, a lender who provides $100 today at 8 percent interest per year is paid back $108 in 1 year. The $8 compensates the lender for alternative investments not made, personal consumption foregone, or the risk that the money might not be repaid.

The borrower and lender agree that $100 today is worth $108 a year from now. The one agrees to receive $100 now and pay back $108 in 1 year; the other gives $100 now to receive $108 in 1 year. It might be that 9 percent interest is necessary to convince the lender to part with the $100. In this case, the time value of money over the 1-year period is $9.

Future Values of Present Sums

Interest rates also can be used to find the future value of a present sum of money. With simple interest, the interest received is not reinvested and therefore does not generate additional income. For example, $100 yields $8 in 1 year at 8 percent. The $8 is not reinvested the second and subsequent years; only the original principal of $100 earns interest. Eight dollars is earned in the second year, and so forth.

Table 1 is a compound interest table that shows factors used for finding future values. With compound interest, the $8 earned in the first year is reinvested. In the second year, $8.64 is earned on the new principal of $108. Over 2 years, $100 yields $16.64 of interest. Using Table 1 gives the same result. In 2 years at 8 percent, $100 will be worth $116.64 ($100 × 1.1664).

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Table 1. Value of $1 compounded annually at specified interest rates for periods up to 20 years

Number of years	Rate of interest (percent) 7	8	9	10	12	14
1	$1.0700	$1.0800	$1.0900	$1.1000	$1.1200	$1.1400
2	1.1449	1.1664	1.1881	1.2100	1.2544	1.2996
3	1.2250	1.2597	1.2950	1.3310	1.4049	1.4815
4	1.3108	1.3605	1.4116	1.4641	1.5735	1.6890
5	1.4026	1.4693	1.5386	1.6105	1.7623	1.9254
6	1.5007	1.5869	1.6771	1.7716	1.9738	2.1950
7	1.6058	1.7138	1.8280	1.9488	2.2107	2.5023
8	1.7182	1.8509	1.9925	2.1437	2.4760	2.8526
9	1.8385	1.9990	2.1718	2.3581	2.7731	3.2520
10	1.9672	2.1589	2.3673	2.5939	3.1059	3.7072
15	2.7590	3.1722	3.6424	4.1783	5.4736	7.1380
20	3.8697	4.6610	5.6043	6.7300	9.6463	13.7435

Table 1 is based on the following formula. The formula can be used to compute future values not given in the table.

$$\text{Future value} = \text{Present value} \times (1 + r)^n$$

where r equals the interest rate and n equals the number of years.

Present Values of Future Sums

The interest rates in Table 2, which are used to find the present values of future sums, are called discount rates. The process of finding the present value of a future sum is called discounting.

The factors in Table 2 can be used to calculate the present value of money to be received at a future date using different rates of interest. For example, the present value of $1 received 1 year from now at 7 percent interest is $0.9346. In other words, receiving 93 cents today or $1 a year from now is equivalent at 7 percent interest. One dollar received in 2 years is worth $0.8734 in today's terms. Equivalently, $87.34 today is equal to $100 in 2 years.

Table 2. Present value of $1 to be received in the number of years specified

Number of years	Rate of interest (percent) 7	8	9	10	12	14
1	$.9346	$.9259	$.9174	$.9091	$.8929	$.8772
2	.8734	.8578	.8417	.8264	.7972	.7695
3	.8163	.7938	.7722	.7513	.7118	.6750
4	.7629	.7350	.7084	.6830	.6355	.5921
5	.7130	.6806	.6499	.6209	.5674	.5194
6	.6663	.6302	.5963	.5645	.5066	.4556
7	.6227	.5835	.5470	.5131	.4524	.3996
8	.5820	.5403	.5019	.4665	.4039	.3506
9	.5439	.5002	.4604	.4241	.3606	.3075
10	.5083	.4632	.4224	.3855	.3220	.2697
15	.3624	.3152	.2745	.2393	.1827	.1401
20	.2584	.2145	.1784	.1486	.1037	.0728

Table 2 is based on the following formula. The formula can be used to compute present values not given in the table.

$$\text{Present value} = \text{Future value}/(1 + r)^n$$

where r equals the interest rate and n equals the number of years.

Analyzing Investments

One of the principal uses of the time value of money on the farm is analyzing investments. Typically, money is invested now for an expected return sometime in the future. However, the problem for such investments returns to the statement that "a dollar today is worth more than a dollar later". If this is true, how can income or cost flows from different years be compared?

For example, it is incorrect to say "I am $250 richer if I receive $100 today and am promised $150 a year from now". Dollar amounts from different years cannot be added together. One solution to this problem is to express the future value of $150 in its present value, in other words, to discount it. If the discount rate is assumed to be 8 percent, the discount factor is .9259 (Table 2). In today's terms, $150 to be received 1 year from now with 8 percent interest is equal to $138.89 (.9259 × $150) now. The two amounts ($100 + $138.81) can now be added because they are both expressed in today's terms. If promised $150 a year from now (and assuming an 8 percent discount rate and no risk), it is correct to say "I am now $138.89 richer".

Another equally valid approach is to express the present value of $100 in its future value 1 year from now. The critical factor is that to analyze an investment accurately, all returns or costs should be expressed in the same time period.

Costs and returns for three hypothetical investments are shown in Table 3. Each investment has a life of 5 years and brings a total net cash-flow of $15,000. Investment A returns $3,000 per year. Investment B receives most of its money in the later years; investment C returns most of its money in the early years.

Table 3. Net cash-flow and discounted net cash-flow for three investments

	Investment A			Investment B			Investment C		
Year	Net cash-flow	Present value factor	Present value	Net cash-flow	Present value factor	Present value	Net cash-flow	Present value factor	Present value
1	$3,000	.9259	$2,778	$1,000	.9259	$926	$5,000	.9259	$4,630
2	3,000	.8578	2,573	2,000	.8578	1,716	4,000	.8578	3,431
3	3,000	.7938	2,381	3,000	.7938	2,381	3,000	.7938	2,381
4	3,000	.7350	2,205	4,000	.7350	2,940	2,000	.7350	1,470
5	3,000	.6806	2,042	5,000	.6806	3,403	1,000	.6806	681
Total			$11,979			$11,366			$12,593

If you ignore the time value of money, all three investments are equal, with each returning $15,000. However, given the time value of money, the sums from different years cannot be added together. The net cash-flows must be expressed in the same time period. Finding the present values of those amounts in years 1 through 5 and expressing them in today's dollars is one possible method.

The second column for each investment lists the present value factors for years 1 through 5 assuming a discount factor of 8 percent. For investment A, discounting the year 1 net cash-flow of $3,000 into today's terms equals $2,778. The $3,000 net cash-flow in year 5 is worth $2,042 in today's terms.

Investment A's discounted net cash-flows from different years are now comparable. Adding them together yields a return of $11,979. Over the next 5 years, that person will see $15,000 flow through the farm's bank account. However, since a dollar today is worth more than a dollar 4 years from now, the value of the investment, when expressed in today's dollars, is $11,979.

The discounted sum of net cash-flows for investments B and C are $11,366 and $12,593, respectively. If a farmer were choosing among the three investments, investment C returns the most money in today's terms.

These three investments illustrate the importance of the flow of funds for an investment. All three investments show a total undiscounted return of $15,000. Though the total sum is the same, investment C receives most of its flow in the early years, investment A receives the same amount each year, and investment B receives most of its money in the later years. It is not surprising that investment C has a larger discounted net cash-flow, then investment A, and finally investment B.

The analysis based on Table 3's data is called finding the net present value of an investment. Two other similar forms of analyses are benefit-cost ratios and internal rates of returns. These investment tools use the same discounting principle illustrated by the net present value method shown in this fact sheet.

Choosing the Appropriate Discount Rate

Selecting different discount rates significantly changes the results of an analysis. If a discount rate of 5 percent had been used for investment A, the sum of the discounted net cash-flows (net present value) would have equaled $12,988. This is a more positive result than the $11,979 return shown with 8 percent.

No discount rate fits all people at all times. Investment alternatives vary for different people and change over time. Consequently, discount rates vary, too. It is important that a farmer selects a discount factor appropriate for his or her situation.

In general, the discount rate is the minimum rate of return a farmer requires an investment to pay. Theoretically, this rate should offer a return to time, inflation premium and risk premium. Determining how much a farmer allocates to each of these factors can be a difficult process.

One solution for specifying these different rates is to use a rate called the nominal rate. The nominal rate can be approximated by using the local bank's insured savings account rate or yield on U.S. Government securities. The maturity of the particular security chosen should equal the approximate life of the investment. This nominal rate represents a reasonably risk-free rate of return because it is an insured account.

Tax Consequences

In analyzing farm investments, it generally is best to calculate after-tax returns since the tax consequences of various investments can be substantial. If investment returns are adjusted to reflect taxes, then the nominal rate should be adjusted for taxes, too. Since interest earnings are taxable, reduce the rate by the income tax rate. For example, if your income tax rate is 28 percent and a government security pays 8.33 percent, then the after-tax rate would be 6 percent ([28 percent of 8.33] subtracted from 8.33 percent). This 6 percent represents a reasonably risk-free, after-tax return. The 6 percent rate contains a return to time and an inflation premium, but does not contain a risk premium.

Another equally valid method for determining the farmer's reasonably risk-free, after-tax return is to use his or her loan rate. Paying off loans saves the cost of interest and is a valid use of funds. Interest paid is an income tax deduction. If the farmer's income tax rate is 28 percent and the loan rate is 12.5 percent, then the risk-free, after-tax return is 9 percent ([28 percent of 12.5] subtracted from 12.5 percent).

The best choice of risk-free, after-tax rates (6 percent or 9 percent in this example) depends on whether the farmer is primarily a debtor or creditor. If the farmer has a lot of debt, the appropriate rate is 9 percent. If the farm is largely debt-free, then 6 percent makes more sense.

The farmer must now determine how much return for risk he or she wants. A new investment should pay more than placing money in an insured savings account or government security or paying off debt because it is risky and not a guaranteed source of income. If the farmer chooses a 3-percent rate as an additional return to risk, then the discount factor becomes 9 percent for the creditor farmer (6 percent + 3 percent), or 12 percent for the debtor farmer (9 percent + 3 percent). This discount factor is then used to select the appropriate column in Table 2 for use in the analysis.

Clearly, there are many considerations in selecting a discount rate. The goal is to select the one most appropriate for the farm operation. As mentioned earlier, showing that money has a positive time value is not difficult; however, quantifying that time value involves some work.

Summary

Money's positive time value means that $1 today is worth more than $1 received later. The implications of this positive time value for farm investments are that income and cost flows from different years cannot be added together. The net present value method of analysis enables you to make comparisons by discounting these flows into a common year, often the first year. By using Table 2, you can determine the present value factors for different discount rates for various years. The crucial factor in this form of analysis is selecting the appropriate discount rate for your situation. The present value method of analysis helps you select the most profitable investments for your farm.

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