A Method for Estimating the Change in Terminal Value Required to Increase IRR

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INTRODUCTION

Although by definition there is a close relationship between times money earned (TME, defined as distributions plus terminal valuations divided by invested capital) and internal rate of return (IRR) for a private market investment, the relationship is ordinarily quite hazy in the portfolios of most institutional investors. This lack of precision is due to the nature of the IRR computation itself, since it is affected to an unpredictable extent by the idiosyncratic blending of the unique weights and timing of each of the individual cash flows that make up the typical private equity portfolio.

However, with some simplifying assumptions it is possible to represent the confused tangle of capital invested, capital distributed and terminal valuation of a private investment portfolio in terms of zero-coupon bond equivalency. The two simplifying assumptions are: that all invested capital is invested on the date of the first capital call and that all distributions and the terminal valuation all have the same ending date. Viewed as a zero-coupon bond in this way, a private investment or a portfolio of private investments has a precise relationship between TME and IRR. Alignment Capital Group, (ACG) refers to this relationship as the zero-coupon equivalent duration (ZCED), which is an estimate of the dollar-weighted, time-weighted average holding period of an investment or portfolio.

ZCED, even though it requires simplifying assumptions, can be adapted to estimate certain attributes of the typical private equity portfolio, including its change in IRR as a function of its change in TME and/or terminal valuation, as described in detail below.

METHODOLOGY

The internal rate of return (IRR) of a stream of cash flows (where capital invested in period t is denoted Inv_t and capital distributed in period t – or, in the case of the terminal valuation, capital deemed to be distributed in period T - is denoted $Dist_t$) is to choose r such that:

1. $$\sum_{t=0}^{T} \frac{Inv_t}{(1+r)^t} = \sum_{t=0}^{T} \frac{Dist_t}{(1+r)^t}$$

It is obvious, in equation 1 above, that the magnitudes of Inv_t and $Dist_t$ and their relative timing all affect the outcome of the computation. It is not, however, obvious – indeed, it is well beyond the scope of this research brief – to what *degree* each of these elements affects the outcome. This is so because there is a theoretically infinite number of

permutations of the weights and timing of the various cash flows that will result in the same IRR, as illustrated in the example below:

Date of Cash Flow	Scenario 1	Scenario 2	Scenario 3
1/31/1990	($1,000,000)	($5,000,000)	($5,000,000)
1/31/1991	$1,200,000	$1,000,000	$0
1/31/1992	($1,000,000)	$1,000,000	$0
1/31/1993	$1,200,000	$1,000,000	$0
1/31/1994	($1,000,000)	$1,000,000	$0
1/31/1995	$1,200,000	$1,000,000	$0
1/31/1996	($1,000,000)	$1,000,000	$0
1/31/1997	$1,200,000	$1,000,000	$0
1/31/1998	($1,000,000)	$1,000,000	$0
1/31/1999	$1,200,000	$6,000,000	$25,824,763
Invested Dollars(I)	($5,000,000)	($5,000,000)	($5,000,000)
Returned Dollars (R)	$6,000,000	$14,000,000	$25,824,763
Dollars Earned (DE)	$1,000,000	$9,000,000	$20,824,763
IRR	**20.0%**	**20.0%**	**20.0%**
Times Earned (TE) = R/I	**1.2 X**	**2.8 X**	**5.2 X**

However, it is possible to eliminate all of the uncertainties associated with the calculation of IRR by repositioning the dates of all the capital invested to the date of the first capital call and all of the capital distributed to the terminal valuation (ending) date. These moves have the effect of transforming the investment or the portfolio into a zero-coupon bond with only two cash flows: one at the outset of the investment and another at its termination. As a zero-coupon bond, the cash flows bear the relationship to one another described in the rudimentary future value equation below:

2. $$TME = (1 + IRR)^n$$

Solving equation 2 for IRR, we obtain:

3. $$IRR = TME^{\frac{1}{n}} - 1$$

The first derivative of equation 3 is the instantaneous rate of change of IRR given a slight change in TME:

4. $$\frac{dIRR}{dTME} = \frac{TME^{\frac{1}{n}-1}}{n}$$

Or, another way to express the same relationship is:

5. $\Delta IRR \approx \frac{dIRR}{dTME}\Delta TME$, when ΔTME is very small.

In this research brief, we have assumed that the desired change in IRR is 0.1% (10 basis points):

6. $\Delta IRR = 10bp$ or 0.10%

The change in TME required to result in a 10 basis point change in IRR is therefore:

7. $$\frac{.001}{\frac{dIRR}{dTME}} = \Delta TME$$

Remember that TME is the relationship of total distributions plus the terminal valuation (in the equations below, *Val* = total distributions + terminal valuation) and capital invested (*Inv* in the equations below):

8. $$TME = \frac{Val}{Inv}$$

Therefore we can describe the change in TME as a function of the change in terminal valuation, assuming in this equation the distributions are a constant:

9. $$\Delta TME = \frac{\Delta Val}{Inv}$$

Thus, the change in valuation required to result in a 10 (is this 100?) basis point change in the IRR of a zero-coupon bond is:

10. $\Delta Val = \Delta TME * Inv$

11. $$\Delta Val \approx Inv\left(\frac{.001n}{TME^{\frac{1}{n}-1}}\right)$$

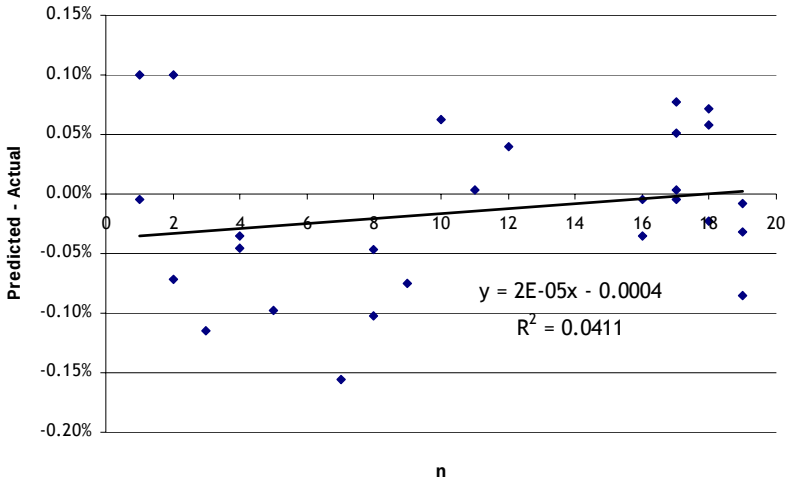
Equation 11 can be used to estimate the change in IRR resulting from a fractional change in the terminal valuation of a typical private investment. We believe that, except for unusual circumstances, the results of this simple equation should be within a few basis points of the results of a complete calculation using all of the cash flows in the portfolio. In general, the shorter the time horizon of the investment, and the fewer the cash flows involved, the better the estimate.

RESULTS

We sampled twenty investments from a portfolio using Equation 11 above, calculated the required change in TME and compared the result to the actual change in TME as follows:

Inv #	Vintage	n	TME	Actual Diff	Predicted Diff	Predicted - Actual
1	2004	1	0.89	0.10%	0.10%	0.00%
2	2004	1	5.79	0.00%	0.10%	0.10%
3	2003	2	0.85	0.00%	0.10%	0.10%
4	2003	2	0.98	0.17%	0.10%	-0.07%
5	2002	3	1.02	0.21%	0.10%	-0.11%
6	2001	4	0.95	0.14%	0.10%	-0.04%
7	2001	4	1.65	0.15%	0.10%	-0.05%
8	2000	5	1.52	0.20%	0.10%	-0.10%
9	1998	7	1.34	0.26%	0.10%	-0.16%
10	1997	8	1.30	0.20%	0.10%	-0.10%
11	1997	8	1.40	0.15%	0.10%	-0.05%
12	1996	9	1.86	0.18%	0.10%	-0.08%
13	1995	10	3.09	0.04%	0.10%	0.06%
14	1994	11	2.37	0.10%	0.10%	0.00%
15	1993	12	3.41	0.06%	0.10%	0.04%
16	1989	16	1.58	0.14%	0.10%	-0.04%
17	1989	16	2.18	0.10%	0.10%	0.00%
18	1988	17	1.74	0.10%	0.10%	0.00%
19	1988	17	2.12	0.10%	0.10%	0.00%
20	1988	17	3.11	0.05%	0.10%	0.05%
21	1988	17	3.52	0.02%	0.10%	0.08%
22	1987	18	1.82	0.12%	0.10%	-0.02%
23	1987	18	4.26	0.03%	0.10%	0.07%
24	1987	18	4.46	0.04%	0.10%	0.06%
25	1986	19	1.21	0.19%	0.10%	-0.09%
26	1986	19	1.58	0.13%	0.10%	-0.03%
27	1986	19	1.86	0.11%	0.10%	-0.01%
				0.11%	**Mean**	-0.01%
				0.07%	**Std Dev**	0.07%

The mean error of the estimate (i.e., the predicted change in IRR minus the actual change in IRR) is only about 1 basis point. The large standard deviation of the error of the estimate relative to the mean contributes to the lack of correlation between *n* and the error of the estimate, as indicated in the following regression:



CONCLUSION

The use of simplifying assumptions (all capital is invested on the first capital call date; all capital returned and the valuation are at the ending date, transforming the investment into a zero-coupon bond) is sufficient to enable the analyst to estimate fairly accurately the change in IRR to be expected from small changes in TME, even for older investments with a history of complex cash flows.

Alignment Capital Group is a full-service private equity consulting firm based in Austin, Texas. The firm's mission is to understand private equity as an asset class in a portfolio context, and thus to assist our clients in making optimal investment decisions.

Austin Long is a co-founder of Alignment Capital Group. His responsibilities include performing due diligence on investment managers, providing strategic portfolio management advice and conducting original research.

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