

Private Equity Performance Analysis in R

Karl Polen

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What is private equity?

- Private Equity (“PE”) involves investing in companies that are not listed on a public stock exchange
- PE investments generally take the form of a limited partnership interest in a partnership, usually called a “fund”
- A typical fund will invest in around ten companies
- PE invests in situations where there is a value add opportunity from growth, restructuring, acquisitions and other such strategies

Performance Measurement Issue

- Because of the illiquidity and risks associated with the value creation strategies, PE investors generally expect to earn a return premium compared to public markets
- However, PE investments vary in amount over time because the PE investor draws the capital over the first 3 to 5 years of the partnership and then sells the investments over the remaining 5 to 7 years
- This creates a challenge in assessing performance in comparison to public market returns because because IRRs calculated on PE cash flows are not comparable to time weighted returns (“TWR”) on public markets investments

Traditional Performance Measurements

- We can analyze the performance of a fund from the following data
 - the time series of capital calls C_t
 - the time series of distributions D_t
 - the remaining unrealized value at time n of the investment V_n
- The distributions as percent of invested (“DPI”) is $\frac{\sum D_t}{\sum C_T}$
- The total value as percent of invested (“TVPI”) is $\frac{\sum D_t + V_n}{\sum C_T}$
- The IRR is calculated from the calls (as negative numbers), the distributions and the final value $IRR(-C_t, D_t, V_n)$

How to calculate an IRR

- An IRR is found by calculating the root of a polynomial $\sum_{i=0}^n c_i x^i$
- where c are the cash flow coefficients and x is $\frac{1}{1+irr}$
- You can use `uniroot` or `polyroot` to calculate the answer in R
- But you need a way to select among multiple roots
- And it turns out there are problems in a production environment with long cash flow time series (hundreds of entries) with many sign changes
- I demonstrate code to deal with these issues at <http://rpubs.com/kpolen/15756>

Public Market Equivalent Measures

- The traditional performance measures of IRR, DPI and TVPI provide useful tools to understand the performance of a particular investment and to compare private equity investments with each other
- But they don't provide a reliable way to compare private equity investments with public market indices
- So there were a number of efforts that attempted to calculate a benchmark public market return as though you made investments and withdrawals from the public market portfolio in the same pattern as the private equity investment
- Such methods are referred to as “PME”
- We will discuss two such methods here

- Steve Kaplan and Antoinette Schoar proposed a method for calculating PME that we will refer to as “KSPME” [2]
- In this approach, you calculate a ratio where
 - the numerator is the wealth you have from the distributions you receive from a PE as if invested in the public market index and held until time n and
 - the denominator is the wealth you would have had you invested the capital that was called for the PE investment in the stock market, instead, and held it until time n
- Values of this ratio greater than one indicate the private equity investment outperformed the public market index

- So, KSPME requires additional data of values of a dividend adjusted index M_t
- You then calculate a factor to convert cash flows to their value at time n as $FV_t = \frac{M_n}{M_t}$
- Next you calculate the future values of C_t and D_t as $C_{FV} = C_t * FV_t$; $D_{FV} = D_t * FV_t$
- You can now calculate

$$KSPME = \frac{\sum D_{FV} + V_n}{\sum C_{FV}}$$

Direct Alpha

- KSPME provides a wealth measure of how much extra money you made, but doesn't tell you how fast you made it
- Gredil, Griffiths and Stucke have proposed a method called "Direct Alpha" to express the outperformance as an annual rate of return[1]
- This calculation works from exactly the same data as KSPME
- Direct Alpha is calculated as the IRR of a time series constructed by combining the future value adjusted calls (as negative numbers), distributions and the final value

$$DirectAlpha = \log(1 + IRR(-C_{FV}, D_{FV}, V_n))$$

Determining a Market Return from Direct Alpha

- For consistency with the capital asset pricing model Direct Alpha is stated as continuously compounded return
- For a PE investment with an internal rate of return of IRR_{PE} you can calculate an equivalent IRR for an investment in public markets IRR_M as

$$\log(1 + IRR_M) = \log(1 + IRR_{PE}) - DirectAlpha$$

Example Calculation

- Code and a realistic data file for a hypothetical private equity portfolio are provided at <https://github.com/karlpolen/pme-calcs>
- I describe the calculations and how to use the code at <http://rpubs.com/kpolen/16062>
- Sample output from this code shown as a table

	Fund.1	Fund.2	Fund.3	Fund.4	Total
tvpi	1.11	2.40	1.80	1.27	1.57
dpi	0.19	0.78	0.96	0.35	0.55
irr	0.04	0.63	0.27	0.07	0.18
kspme	0.68	1.88	1.33	0.85	1.08
direct.alpha	-0.13	0.35	0.12	-0.05	0.03
ind.irr	0.18	0.14	0.12	0.13	0.14

Example Graph



- Here is a summary of the links previously mentioned
 - Technicalities of Calculating IRRs in a production environment <http://rpubs.com/kpolen/15756>
 - More background on PE performance measurements with example calculations <http://rpubs.com/kpolen/16062>
 - Source and data files <https://github.com/karlpolen/pme-calcs>



Oleg Gredil, Barry E Griffiths, and Rudiger Stucke.
Benchmarking private equity: The direct alpha method.
Available at SSRN, 2014.



Steven N. Kaplan and Antoinette Schoar.
Private equity performance: Returns, persistence and capital
flows.
The Journal of Finance, 60(4), August 2005.