CIPM Principles Review Course

Study Session: Performance Measurement
Reading: Rate of Return Measurement

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Investment Returns Overview

- What is the formula for calculating a portfolio return??

$$ROR = \frac{EMV - BMV - C}{BMV + WC}$$

$$r_t = \frac{MV_1 - (MV_0 + CF)}{MV_0 + CF}$$

$$r_t = \frac{MV_1 - MV_0}{MV_0}$$

$$0 = -BV + \sum_{i=0}^{n} \frac{cf[i]}{(1+r)^{t[i]}} + \frac{EV}{(1+r)^{n}}$$

$$r_t = \frac{(MV_1 - CF) - MV_0}{MV_0}$$

- One simple formula to remember…

$$\frac{\text{Profit}}{\text{Capital (at work)}}$$

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Expressing the Return

- Goal is to explain a change in portfolio value, *relative* to the original value:

$$\text{Relative change in value} = \frac{V_1}{V_0}$$

- In practice, we express change in value as a percentage of the original value:

$$\text{"Holding period" return} = \frac{V_1 - V_0}{V_0} = \frac{V_1}{V_0} - \frac{V_0}{V_0} = \frac{V_1}{V_0} - 1$$

Profit

Capital

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Investment Return Expanded

- Profit =
  - Change in Market Value (EMV – BMV)
    - Unrealized Gains & Losses
    - Realized Gains & Losses

    } = Capital Appreciation Return aka "Price Return"
    - Income: *should* be implicit in the market value = Income Return
  - Excludes external contributions/withdrawals (i.e. "cash flows")
  - Possibly fees and expenses (depending upon gross or net)
- Capital =
  - Beginning of Period Market Value
  - "Average" Capital may include time-weighted "cash flows"

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Valuation Issues

- Cost vs. Market vs. Fair
  - Cost = Book value: represents original cost. Can be used to represent a cumulative return, but not practical for periodic returns.
  - Market = Market value: Convention is to use the change in the value that could be obtained in an arm's length transaction.
  - Fair = Fair value: Can be the same as the market value, but may diverge if there is no liquid market to obtain a reasonable value from.
- Gain/Loss Recognition:
  - Unrealized gains/losses: "Paper" profits are accrued in each respective time period generated.
  - Realized gains/losses: Often more relevant for tax reporting.

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Valuation Issues continued

- Trade accounting
  - Trade-Date: Portfolio valuation and subsequent price changes are reflected as of the trade-date for each transaction.
  - Settlement-Date: Portfolio valuation does not change until asset is received.

  Example: AAPL bought on 3/30 for $200, increases to $220 on 3/31, and received on 4/2.
- Cash vs. Accrual: Same principle as trade vs. settlement, but for fees and other cash activity.
  - Accrual accounting (think trade-date)
  - Cash accounting (think settlement-date)

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Types of Returns

- Inflation
  - Nominal Returns: Unadjusted returns based on current prices.
  - Real Returns: Adjusted returns to reflect changes in purchasing power. Cannot be derived by itself.
- Management Fees
  - Gross Returns: Better for comparing managers
  - Net Returns: Reflective of investor's experience
- Taxes
  - Pre-Tax: Best for comparison, because tax regimes vary.
  - Post-Tax: Complicated, but deducts taxes after actual or assumed capital gains are realized.
- Margin…

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Margin & Performance

- "Margin" is the generic term for borrowing cash or securities.
  - "Leverage": Generally refers to borrowing cash to buy additional securities.
  - "Short-selling": Borrowing securities to sell, and use the cash for other purposes.
- General rule: Borrowed assets must be returned (sometimes with interest), while gains/losses on borrowed assets are kept.

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Margin & Performance

- Leverage example: Start with $100, borrow $20 more. Value is $150 at end of month. Margin interest is 9% per year.

Margin Return = $\frac{150 - 120 - 0.15}{120 - 20} = 29.9\%$ (Total Profit / Equity)

Cash-Basis Return = $\frac{150 - 120}{120} = 25\%$ (Total Profit / Total Assets)

- Short-position example: Start with $100 of A, sell $20 of B short. A ends at $120, B ends at $25.

Long Return = $\frac{120 - 100}{100} = 20\%$ Short Return = $\frac{25 - 20}{20} = 25\%$

Margin Return = $\frac{(120-25)-(100-20)}{100 - 20} = 18.75\%$

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Multi-currency Returns

- Exchange Rates ("forex" or "FX")
  - Indirect quote: Foreign currency per unit of domestic currency.
  - Direct quote: Domestic currency per unit of foreign currency.
- Calculations:
  - Convert all values to a common currency, using the relevant exchange rate.
  - Calculate as normal.
- Short-cut: $R_{DC} = R_{FC} + R_{FXdirect} + (R_{FC} \times R_{FXdirect})$

Base ccy Return | Local ccy Return | FX Return | Interaction

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Multi-currency Example

- U.S. Domiciled investor has a $1,000 portfolio of half Nikkei 225 index, and half FTSE 100 index.
- FX rates are:
  - 0.5£/$ and 1,000¥/$ at 1 January
  - 0.6£/$ and 1,100¥/$ at 31 January
- Index returns are: 10% for the FTSE 100, -5% for the Nikkei 225

[($500 × 0.5£/$) × (1 + 10%)] ÷ 0.6£/$ = $458.33
[($500 × 1,000¥/$) × (1 + -5%)] ÷ 1,100¥/$ = $431.83
($458.33 + $431.83)/$1000 – 1 = -10.985%

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Compounding

Compounding = $(1 + r_1) \times (1 + r_2) \times (1 + r_3) \ldots - 1$

- Can be used for any length of time period.

Discrete: For defined time periods. Interest rate must be adjusted.

- Effective Annual Rate (EAR) = $\left(1 + \frac{i}{n}\right)^n - 1$

Continuous: Assumes infinite compounding, or daily is a close approximate.

- $i_c = \ln(1 + i_d)$ ⟺ $i_d = e^{i_c} - 1$

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Annualized Returns

- Tells you the "average" compounded return over a period of time.
  - Uses the same TWR formula, but averages it geometrically…

$$\text{Return} = [(1 + r_1) \times (1 + r_2) \times \ldots (1 + r_n)]^{(1/n)} - 1$$

Tells you the single annual return that will equal the cumulative return, when compounded each year.

Note: This is only used for periods greater than one year

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Average Returns

- Arithmetic Averages: $\frac{\sum r}{n}$
  - Better for determining average periodic return; risk statistics.
  - Better for future estimation and historical analysis.
- Geometric Averages: (see previous slide)
  - Better for determining average change in value and wealth.
- Arithmetic average ≥ Geometric average

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Excess Returns

- Arithmetic Difference: Portfolio – Benchmark
  or: Gross – Net
  - For excess return based on amount invested.
  - Intuitive.
- Geometric Difference: $\frac{1+A}{1+B} - 1$
  - For excess profit based on ending value.
  - Can compound differences over time.

Spreadsheet example…

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"Cash Flows"!!

- External contributions/withdrawals of "capital."
  - Can be cash or securities.
  - Does not include dividends and interest receipts.
  - Fees…?
- Implications:
  - Flows may not be result of manager decisions.
  - Simple use of beginning and ending values cannot determine the return due to the period.
  - Magnitude and timing of cash flows have an effect.

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Cash Flow Treatments

- Cash flows not controlled by manager:
  - Use TWRR
    - Negates impact of external cash flows
    - Measures performance between cash flow events

$$TWR = (1 + r_1) \times (1 + r_2) \times \ldots (1 + r_n) - 1$$

- Cash flows <u>are</u> controlled by manager:
  - Use MWRR
    - Size and Timing of cash flows affect return calculation
    - Credits/Penalizes manager for 'Capital at Work'.

Solve for R: $V_1 = V_0(1 + R) + \sum C(1 + R)^{\frac{TD-D}{TD}}$

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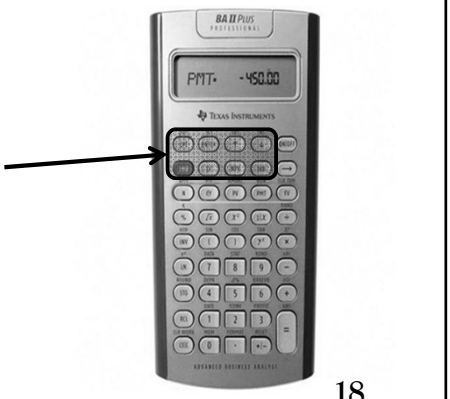
Money-Weighted Returns

- Also known as: "IRR."
- Measures the constant rate of return that would cause a series of cash flow to equal.
- *The Trial & Error approach is a waste of time!*

Note: <u>Calculation</u> of MWR is <u>new</u> to Principles...

Steps:

1. Calculate net cash flows at each period.
2. Use the Cash Flow calculator



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MWR Tips

Things to remember:

- Think of each flow as the accounting relationship between the investor and his/her portfolio.
- Initial contributions/investments are negative.
- Subsequent contributions are negative.
- Withdrawals are positive.
- Income received by the investor is positive. Income that is received into the portfolio is ignored.
- Ending value is positive (assumed to be withdrawn)
- Interim values are ignored

MWR Example

- Initial portfolio value is $1,000 (T0)
- Additional $200 is invested at T1
- $50 in dividends are received by investor at T2 & T3
- Portfolio value is $1,350 at T4
- Assume all cash flows occur at annual intervals.

MWR Example continued

First, get in the habit of clearing your work before and/or after working a Cash Flow problem ("CF", "2nd", "CE/C")

Steps:

1. CF0: "CF", -1000, "ENTER", ↓
2. CF1: -200, "ENTER", ↓, ↓
3. CF2: 50, "ENTER", ↓, ↓
4. CF3: 50, "ENTER", ↓, ↓
5. CF4: 1350, "ENTER", "IRR", "CPT" → 5.2(%)

Note 1: Steps 2 & 3 can be replaced with: 50, "enter", ↓, 2, "enter", ↓

Note 2: IRR must be "annualized" for the number of CF periods in a year.

[Divide by 100 if necessary, + 1, raise to the periodicity of CFs/yr] = $\left[1 + \left(\frac{5.2}{100}\right)\right]^4 - 1 = \mathbf{22.5}\%$

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Time-Weighted Rates of Return

1. Calculate sub-period returns:
   R = (EMV – BMV – CFs)/BMV or
   R = (EMV – (BMV + CF))/(BMV + CF)

2. Chain-link sub-period returns
   TWR = $(1 + r_1) \times (1 + r_2) \times \ldots (1 + r_n) - 1$

TIP: If possible, do the addition/subtraction in your head…
(1 + 3%) × (1 – 2%) – 1 = 0.94%
simplifies to… 1.03 × 0.98 – 1 = 0.94%

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Unit Value Pricing

- Closely related to the TWRR
- Used in pooled investment vehicles, such as mutual funds and hedge funds.
- NAV = $\frac{Value}{Shares}$
- Shares are subscribed or redeemed at the NAV, so contributions & withdrawals have no net affect on the NAV.
- Returns can be calculated as $R = \frac{NAV_1}{NAV_0} - 1$, so cash flow adjustments are only needed with dividends/ distributions.
- Any two NAVs can be used to calculate a return:

$$R_{year} = \frac{NAV_{12}}{NAV_0} - 1$$

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Approximate TWR Methods

- Linked IRR Method (Modified BAI):
  - Use MWRR with more frequent valuations, and chain-link.
- Original (Simple) Dietz formula: $R = \frac{V_1 - V_0 - \sum CFs}{V_0 + \frac{\sum CFs}{2}}$
  - Simplifying assumption is that all cash flows occur in the middle of the month.
- Modified Dietz formula: $R = \frac{V_1 - V_0 - \sum CFs}{V_0 + \sum(w \times CFs)}$
  - Represents a 'first-order approximation' of the MWRR for a single sub-period.

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Real-World Application

- GIPS requires:
  - Daily time-weighting of cash flows (1/1/2005)
  - Monthly valuations (1/1/2001)
  - Effective 1/1/2010, additional valuation on the date of all large cash flows
- Modified Dietz: $R_{MDietz} = \frac{EMV - BMV - CF}{BMV + \sum_{i=1}^{n} Wi \times CF_i}$

Note: In practice, most firms/systems use Modified Dietz, and will re-value and chain-link for any "large" cash flows.

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Composite Returns

- Composite: An aggregate average of one or more portfolios representing a similar investment strategy.
- GIPS® requires an asset-weighted average using:
  - Beginning-of-period market values, or…
  - A method using beginning-of-period values and external cash flows.
- Examples:
  - Beginning market values
  - Average Capital Base (denominator of Modified Dietz)
  - The "Aggregate method"

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Segment-Level Performance

- For the Exam:

  - Total portfolio returns should be the asset-weighted aggregate of the segment-level returns.
  - Approximate TWRs will usually not reconcile.
  - Valuation frequency must be the same to reconcile.

- For the Real World:
  - All buys, sells, transfers, and income are treated like “cash flows”.

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