Calculating Long/Short Portfolios PMAR Conference – 2025 North America, Europe



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What we'll cover

- 1. Mechanics of selling short
- 2. About using absolute value when calculating return
- 3. Short positions and leverage
- 4. Leveraged return vs. cash return
- 5. Types of portfolios involving shorts/leverage
- 6. Considerations for cash flows; general framework for handling derivatives
- 7. Questions



Selling securities short

When an investor sells securities short:

- The investor sells assets they do not (typically) own
- Securities are borrowed from a broker
- The investor will profit if they can acquire shares at a lower price than the short sell price
- The broker typically requires collateral for the trade:
 - Cash proceeds of short sale
 - An initial margin requirement (typically 50% of sale value)
 - Investor is entitled to interest on cash proceeds and initial margin



Short sale example

Assume the investor shorts one share of XYZ at \$100

- \$100 cash proceeds plus \$50 initial margin are placed into margin account
- Assume 4% interest for the period and XYZ drops to \$90/share
 - Margin account increases to \$156; original \$150 + \$6 interest
 - Investor purchases stock at \$90, closes the short position, and has \$66 remaining
 - Original cash outlay was \$50 → investor has earned \$16 profit (\$10 from price movement, \$6 in interest)



Why we don't use absolute value to calculate return: consider two investors

Investor A

- Sells 100 shares short of stock ABC at \$27
- Buys 100 shares to cover stock ABC @32
- Return is $\frac{-2700 (-3200)}{-2700} = -18.52\%$
- If we use absolute value: $\frac{-2700 (-3200)}{|-2700|} = 18.52\%$
- Returns are zero sum (really, negative sum) game
- Thus, both investors can't possibly earn 18.52%!

Investor B

- Initial cash \$2700
- Buys 100 shares of ABC at \$27
- Sells 100 shares of ABC at \$32

• Return is
$$\frac{3200-2700}{2700} = 18.52\%$$

 These investors with opposing viewpoints/goals and with "linked" trades must earn equal and opposite returns!



Short positions and leverage

- A portfolio or fund may contain *long positions* (positive units), *short positions* (negative units) or both
- We may refer to the return on a portfolio with only short positions as a *liability return*
- The return on a portfolio containing long and short positions may be referred to as a *surplus return*



Example: British pension fund (1)

Holding	BMV	EMV		Return
Assets	£175,000,000	£189,000,000	8.00%	Return on Assets
Liabilities	-£80,000,000	-£89,600,000	12.00%	Return on Liabilities
Total Fund	£95,000,000	£99,400,000	4.63 %	Surplus Return

Notice that the surplus return is outside the range from the asset return and the liability return...



Example: British pension fund (2)

Holding	BMV	EMV		Return
Assets	£175,000,000	£162,750,000	-7.00%	Return on Assets
Liabilities	-£80,000,000	-£76,000,000	-5.00%	Return on Liabilities
Total Fund	£95,000,000	£86,750,000	-8.68%	Surplus Return

Notice that the surplus return is outside the range from the asset return and the liability return...



Example: British pension fund (3)

Holding	BMV	EMV		Return
Assets	£175,000,000	£189,000,000	8.00%	Return on Assets
Liabilities	-£80,000,000	-£76,000,000	-5.00%	Return on Liabilities
Total Fund	£95,000,000	£113,000,000	18.95 %	Surplus Return

Notice that the surplus return is outside the range from the asset return and the liability return...



Example: British pension fund (4)

Holding	BMV	EMV		Return
Assets	£175,000,000	£169,750,000	-3.00%	Return on Assets
Liabilities	-£80,000,000	-£84,000,000	5.00%	Return on Liabilities
Total Fund	£95,000,000	£85,750,000	-9.7 4%	Surplus Return

Notice that the surplus return is outside the range from the asset return and the liability return...



Another example: simple portfolio, one long position, one short position

	Start of Period			End of	f Period	I	Contribution		
Asset	Shares	Price	Value	Weight	Price	Value			
Stock A	500	26	13000	2166.67%	27	13500	500	3.85%	83.33%
Stock B	-400	31	-12400	-2066.67%	30	-12000	400	-3.23%	66.67%
Total			600	100.00%		1500		150.00%	150.00%

- Two ways to calculate total return:
 - 1. Net long positions and short positions
 - 2. Weighted average of long- and short-position returns (i.e., by contribution)

Sum of contributions to return should equal total return



Another example: simple portfolio, one long position, one short position

	Start of Period		End of	End of Period		Return	Contribution		
Asset	Shares	Price	Value	Weight	Price	Value			
Stock A	500	26	13000	2166.67%	27	13500	500	3.85%	83.33%
Stock B	-400	31	-12400	-2066.67%	30	-12000	400	-3.23%	66.67%
Total			600	100.00%		1500		150.00%	150.00%

• Notice that:

- 1. Each asset only had small price movement
- 2. Thus, return of each asset was small
- 3. Yet overall return is quite large

Large weights \rightarrow large contribution to return... asset contributions to return are better tool to explain overall return than asset returns



Problem (1): Stock B had a gain of \$400, yet return was negative???

	Start of Period			End of	f Period		Return	Contribution	
Asset	Shares	Price	Value	Weight	Price	Value			
Stock A	500	26	13000	2166.67%	27	13500	500	3.85%	83.33%
Stock B	-400	31	-12400	-2066.67%	30	-12000	400	-3.23%	66.67%
Total			600	100.00%		1500		150.00%	150.00%

- Explanation:
 - 1. Yes, the price dropped, thus the negative return (even though we made money)
 - 2. The short position is a liability... as time passes, you want the liability to decrease, which it did hence the positive contribution to return



Problem (2): Stock B had a loss of \$400, yet return was positive???

	Start of Period			End of	End of Period			Contribution	
Asset	Shares	Price	Value	Weight	Price	Value			
Stock A	500	26	13000	2166.67%	27	13500	500	3.85%	83.33%
Stock B	-400	31	-12400	-2066.67%	32	-12800	-400	3.23%	-66.67%
Total			600	100.00%		700		16.67%	16.67%

- Explanation:
 - 1. Yes, the price increased, thus the positive return (even though we lost money)
 - 2. The short position is a liability... as time passes, you want the liability to decrease, which it did not hence the negative contribution to return



Leveraged return vs. cash return

Leverage is the use of borrowing (sometimes called *margin*) to magnify gain/loss relative to one's equity position

- The *leveraged return* (aka *levered* return) is the actual return based on the invested capital
- The *cash basis return* is the unleveraged return on the underlying asset Goal is to earn a cash return higher than cost of borrowing



Example of leverage

Assume we have \$450 million to invest but want to invest \$600 million to buy a hotel

- We borrow \$150 million at 5% interest per year; thus a borrowing cost of \$7.5 million/year
- R_{CB} is the cash basis return; i.e., return on \$600 million
- R_{LE} is the leveraged return; i.e., return on \$450 million



Example of leverage (cont.)

If the amount earned on the \$600 million is \$50 million:

- R_{CB} is \$50 million divided by \$600 million = 8.33%
- R_{LE} is \$42.5 million divided by \$450 million
 - = 9.44%
 - The 8.33% cash return is higher than the 5% cost of borrowing
 - By borrowing, the investor has amplified the return to 9.44%



Example of leverage (1)

	Start of Pe	eriod	End of Period	Return	Contribution
Asset	Value	Weight	Value		
Hotel	\$600,000,000	133.33%	\$650,000,000	8.33%	11.11%
Borrowed Cash	-\$150,000,000	-33.33%	-\$157,500,000	5.00%	-1.67%
Total	\$450,000,000	100.00%	\$492,500,000	9.44%	9.44%

Observations:

- Asset return of 8.33% was higher than 5% cost of borrowing (success!)
- If we had \$600 million to invest, our return would be 8.33%... we used leverage to <u>amplify</u> to a higher return of 9.44%
- If we partnered to buy the hotel, our amount earned would be 37.5 million... we used leverage to earn a higher amount of 42.5 million



Example of leverage (2)

Start of Period			End of Period	Return	Contribution
Asset	Value	Weight	Value		
Hotel	\$600,000,000	133.33%	\$610,000,000	1.67%	2.22%
Borrowed Cash	-\$150,000,000	-33.33%	-\$157,500,000	5.00%	-1.67%
Total	\$450,000,000	100.00%	\$452,500,000	0.56%	0.56%

Observations:

- Asset return of 1.67% was lower than 5% cost of borrowing (failure!)
- If we had \$600 million to invest, our return would be 1.67%... we used leverage so our return was limited to only 0.56%
- If we partnered to buy the hotel, our amount earned would be 7.5 million... we used leverage, limiting our amount earned to 2.5 million



Example of leverage (3)

	Start of Pe	eriod	End of Period	Return	Contribution
Asset	Value	Weight	Value		
Hotel	\$600,000,000	133.33%	\$550,000,000	-8.33%	-11.11%
Borrowed Cash	-\$150,000,000	-33.33%	-\$157,500,000	5.00%	-1.67%
Total	\$450,000,000	100.00%	\$392,500,000	-12.78%	-12.78%

Observations:

- Asset return of -8.33% was lower than 5% cost of borrowing (failure!)
- If we had \$600 million to invest, our return would be -8.33%... we used leverage so our return loss was <u>amplified</u> to -12.78%
- If we partnered to buy the hotel, our amount lost would be 37.5 million... we used leverage, increasing our amount lost to 57.5 million



Leverage ratio

We can define the leverage ratio (L) as:

MVofM arg inDebt MVofM arg inDebt + MVofEquity

• As margin increases in relation to equity, the leverage ratio becomes larger

The leveraged return R_{LE} can be written:

$$R_{LE} = \frac{R_{CB} - iL}{1 - L}$$

• As the leverage ratio gets larger the denominator of R_{LE} gets smaller, increasing R_{LE}



Summarizing:

$$R_{LE} = \frac{R_{CB} - iL}{1 - L}$$

- $R_{LE} > R_{CB}$ when return on assets exceeds cost of borrowing
- R_{LE} > 0 when is greater than i * L (cost of borrowing x leverage ratio)



Strategies that involve short-selling

We may generalize the types of strategies that use short positions:

- Long-short portfolios: any mix of long and short positions
- Short-extension strategy: long assets of (100+x)% and short assets of x%
- Market-neutral strategy: offsetting of long assets and short assets with net exposure to cash



Defining the security-level weights

Individual positions may have positive, negative or zero market values. We define the weight of security j in the portfolio as:

$$w_j = \frac{v_0(j)}{V_0}$$

Weights may be positive or negative!



Defining the security-level returns

Returns are defined as:

$$r(j) = \frac{\Delta v(j)}{v_0(j)}$$

As a result:

• The return defined in this way is independent of whether the security is held long or short



Obtaining the total portfolio return using contribution

Total portfolio return is the sum of the contributions from individual securities

$$R = \sum_{j} w(j) r(j)$$

As a result:

• The contribution to return will depend on whether the security is held long or short



Short-extension and Long-Short examples

		Short-Extension	n Portfolio		
	Start of P	eriod	End of Period	Return	Contribution
Asset	Value	Weight	Value		
Long	\$230,000,000	125.00%	\$235,000,000	2.17%	2.72%
Short	-\$46,000,000	-25.00%	-\$42,000,000	-8.70%	2.17%
Total	\$184,000,000	100.00%	\$193,000,000	4.89%	4.89%

Long-Short Portfolio including Cash								
	Start of Period		End of Period	Return	Contribution			
Asset	Value	Weight	Value					
Long	\$140,000,000	116.67%	\$134,400,000	-4.00%	-4.67%			
Short	-\$40,000,000	-33.33%	-\$32,700,000	-18.25%	6.08%			
Cash	\$20,000,000	16.67%	\$20,400,000	2.00%	0.33%			
Total	\$120,000,000	100.00%	\$122,100,000	1.75%	1.75%			



Using cash as leverage; market-neutral examples

Long-Short Portfolio using Cash Leverage								
	Start of Period		End of Period	Return	Contribution			
Asset	Value	Weight	Value					
Long	\$130,000,000	144.44%	\$142,000,000	9.23%	13.33%			
Short	-\$30,000,000	-33.33%	-\$35,000,000	16.67%	-5.56%			
Cash	-\$10,000,000	-11.11%	-\$10,200,000	2.00%	-0.22%			
Total	\$90,000,000	100.00%	\$96,800,000	7.56%	7.56%			

Market Neutral Portfolio									
	Start of Period		End of Period	Return	Contribution				
Asset	Value	Weight	Value						
Long US Equities	\$60,000,000	86956.52%	\$62,400,000	4.00%	3478.26%				
Short US Equities	-\$60,010,000	-86971.01%	-\$62,530,420	4.20%	-3652.78%				
Long CA Equities	\$30,000,000	43478.26%	\$29,250,000	-2.50%	-1086.96%				
Short CA Equities	-\$29,953,000	-43410.14%	-\$29,243,114	-2.37%	1028.82%				
Cash	\$32,000	46.38%	\$32,640	2.00%	0.93%				
Total	\$69,000	100.00%	-\$90,894	-231.73%	-231.73%				



A few words regarding cash flows

- Short positions erode the market value of long positions
- With a smaller total market value, the distortion due to cash flows may be dramatic
- This will be especially true for market-neutral portfolios
- Whenever cash flows occur, portfolio return will not equal sum of contributions...
- Thus, more frequent valuations may be needed



A general framework for calculating performance on derivatives

- Visualize the derivative as a substitute for direct investment in underlying assets
- Use "leg-level" exposures and notional values
- Over time, value each leg as appropriate
- Remember the framework for defining weights and returns for long and short positions
- Use traditional methods for return measurement and attribution





