Performance Surprises

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What we'll discuss

- Situations where the results don't necessarily align with our expectations.
- Some, you'll already know about
- Some, you may not
- Please share your thoughts and own experiences with "Performance Surprises"!



We'll look at three topics

#1 Nonsensical Returns Returns that *just don't look right* #2 Why you
need daily
valuations
If you're calculating
daily returns

#3 Linking short returns? Beware: your standard linking won't work



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#1 Nonsensical Returns Returns that *just don't look right* #2 Why you need daily valuations If you're calculating daily returns

#3 Linking short returns?
Beware: your standard linking won't work



#1 Nonsensical returns

- If you've worked in performance measurement long enough, chances are you've encountered these situations
- They typically occur during highly volatile markets



From a skeptical portfolio manager

- This scenario dates back three decades
- A PM from a Chicago, Illinois-based firm was not shy about her disdain for time-weighting
- She crafted this example, to demonstrate why it is problematic



Her scenario

Date	Activity	Position	Value
January 1	Buy 1,000 STAR @ \$1/share	1,000 STAR @ \$1	\$1,000
June 30		1,000 STAR @ \$100	\$100,000
July 1	\$1,000,000 inflow; Buy 1,000 DOG @ \$1,000/share	1,000 STAR @ \$100 1,000 DOG @ \$1,000	\$1,100,000
December 31		1,000 STAR @ \$100 1,000 DOG @ \$100	\$200,000



Let's calculate the portfolio's return

- But before we do, do you think it will be:
 - Positive or negative?
 - Large or small?



Calculating the TWRR

• We'll start w/the first half of the year:

$$R_{Portfolio1}^{FirstHalf} = \frac{V_E}{V_B} - 1 = \frac{100,000}{1,000} - 1 = 9,900\%$$

• Next the second half:

$$R_{Portfolio1}^{SecondHalf} = \frac{200,000}{1,100,000} - 1 = -81.82\%$$



We now geometrically link our two returns $R_{Portfolio1}^{FullYear} = \prod (R_i + 1) - 1$ = (9,900% + 1)(-81.82% + 1) - 1= (1,718.18%)

- What you expected?
- We lost a significant amount of money, but have a sizable positive return?



Let's start with the \$1 million

Date	Activity	Position	Value
January 1	Buy 1,000,000 STAR @ \$1/share	1,000,000 STAR @ \$1	\$1,000,000
June 30		1,000,000 STAR @ \$100	\$100,000,000
July 1	Sell 999,000 shares of STAR (proceeds \$99,900,000); Buy 1,000 DOG @ \$1,000/share; outflow \$98.9 million	1,000 STAR @ \$100 1,000 DOG @ \$1,000	\$1,100,000
December 31		1,000 STAR @ \$100 1,000 DOG @ \$100	\$200,000



Calculating the TWRR for Portfolio 2

 $R_{Portfolio2}^{FirstHalf} = \frac{100,000,000}{1,000,000} = 9,900\%$

• Again, we start w/the first half of the year:

• And now the second half:

 $R_{Portfolio2}^{SecondHalf} = \frac{200,000}{1,100,000} - 1 = -81.82\%$



We geometrically link our two returns

 $R_{Portfolio2}^{FullYear} =$

=(9,900% + 1)(-81.82% + 1) - 1 = (1,718.18%)

- What you expected?
- Why is it that we earned a great deal of money, but have the same return as Portfolio 1?



#2 Calculate daily; value daily

- For 20 + years, we've seen a shift to daily returns
- But many don't always value daily
- E.g. while it's common to value equities daily, not so with fixed income
- Does this create a problem?



Consider this:

What Actually Occurs (daily pricing)						
Start-of-Month Holdings/Values						
Holdings	Shares	Price	Starting Value	Returns		
A	5,000	10	50,000			
В	5,000	20	100,000			
Cash			10,000			
Total			160,000			
	Portfo	lio Valu	e BEFORE Trade	es		
А	5,000	11	55,000	Return: fro		
В	5,000	18	90,000	start to jus		
Cash			10,000	before trad		
Total			155,000	-3.13%		
	Tr	ading:	Sell A; Buy C			
Sell A	5,000	11	55,000			
Buy C	10,000	6	60,000			
Cash			5,000			
	Portfo	lio Val	ue AFTER Trade	S		
В	5,000	18	90,000			
С	10,000	6	60,000			
Cash			5,000			
Total			155,000			
End-of-Month Holdings/Values						
В	5,000	19	95,000	Return fro		
С	10,000	7	70,000	after trade		
Cash			5,000	end of mon		
Total			170,000	9.68%		
Mor	nthly Retu	r <mark>n (ch</mark> ai	n-linked) 🧲	6.25%		

	What System Thinks (monthly pricing)								
	Start-of-Month Holdings/Values								
	Holdings	Shares	Price	Starting Value	Returns				
	А	5,000	10	50,000					
	В	5,000	20	100,000					
	Cash			10,000					
	Total			160,000					
	Portfolio Value BEFORE Trades								
m	A	5,000	10	50,000	Return: from				
st	В	5,000	20	100,000	start to just				
es	Cash			10,000	before trades				
	Total			160,000	0.00%				
	Trading: Sell A; Buy C								
	Sell A	5,000	11	55,000					
	Buy C	10,000	6	60,000					
	Cash			5,000					
		Portfo	lio Val	ue AFTER Trades	5				
	B	5,000	20	100,000					
	С	10,000	6	60,000					
	Cash			5,000					
	Total			165,000					
		End-of-	Month	Holdings/Value	es				
m	В	5,000	19	95,000	Return from				
to	С	10,000	7	70,000	after trade to				
th	Cash			5,000	end of month				
	Total			170,000	3.03%				
	Moi	nthly Retu	m (chai	n-linked)	3.03%				



What's occurring

- Table is broken into two parts:
 - Left-hand side shows daily pricing; we capture exactly what is going on
 - Right-hand side is an example where monthly valuations/pricing is done.
- We don't show every day of the month, as this detail isn't necessary to demonstrate what is happening.
- There is a single day when trading occurs:
 - W sell our full position in A [whose share price went from \$10 to \$11]
 - And use the proceeds (plus \$5,000 from cash) to purchase shares of C.



What's occurring

- Note that this day's events demonstrate the problem with monthly pricing.
- Because neither A nor B was priced before the trade, when we calculate the portfolio's value up until just before the trade occurs, its 0.00 percent.
- After the trade, we capture what A has risen to, and those proceeds go into C. Security B is still not priced, so the starting value for the second part of the month is actually overstated (\$165,000 vs. \$155,000).



What's occurring

- We value the portfolio at the end of the month.
- For simplicity, cash's value is unchanged through the month.
- We see that because the right-hand side didn't revalue, the monthly return is invalid.



Looking at it in a simpler way

- Because there are no cash flows, the month's return is simply VE/VB-1, or 170,000/160,000-1 which equals 6.25 percent.
- This means that if you used a monthly return method, you would have gotten the correct return (because there are no external cash flows).
- But, if you calculate returns daily, with monthly pricing, an erroneous return results.



Consequently ...

- You need to either use daily pricing or calculate returns using a monthly method.
- An alternative, if you're going to use a daily method, would be to re-price on days when trading takes place, as well as when external flows are "large."



#3 Linking short positions

- I discovered this surprise about 15 years ago, during a review of a firm's performance measurement system
- Note: *how* to calculate returns on shorts is somewhat controversial.
- This is how $V_E O_B V_B = \frac{V_B O_B V_B}{|V_B|} = \frac{-70.04 (-73.00)}{73.00} = 4.05\%$
- Perhaps at a future meeting we'll discuss alternatives, but for now, we'll use this approach



The surprise

- No flows
- Geometrically linking the daily returns yields a monthly return of 3.93%
- However, using only the starting and ending values yields 4.05%
- Why the difference?

M	onthly Pe	erforma	nce Data		
Date	V _B	V _E	ROR b Monthl	oased on y V _B & V _E	
7/1-7/31/2008	-73.00	-70.04	4.	05%	
	Daily	/ Perfor	mance Da	ata	
Date	V _B	VĔ	Daily returns	Standard link daiy returns	
7/31/2008	-71.00	-70.04	1.35%	1.013521	Why are thes
7/30/2008	-70.20	-71.00	-1.14%	0.988604	different?
7/29/2008	-69.32	-70.20	-1.27%	0.987305	With no cash
7/28/2008	-70.24	-69.32	1.31%	1.013098	flows return f
7/25/2008	-70.04	-70.24	-0.29%	0.997144	month should
7/24/2008	-71.52	-70.04	2.07%	1.020694	linking of dail
7/23/2008	-71.16	-71.52	-0.51%	0.994941	returns. Yes
7/22/2008	-70.96	-71.16	-0.28%	0.997182	
7/21/2008	-70.44	-70.96	-0.74%	0.992618	
7/18/2008	-70.16	-70.44	-0.40%	0.996009	
7/17/2008	-69.24	-70.16	-1.33%	0.986713	
7/16/2008	-07.84	-69.24	-2.06%	0.979363	
7/15/2008	-68.64	-67.84	1.17%	1.011655	
7/14/2008	-68.80	68.64	0.23%	1.002326	
7/11/2008	-69.68	-68.09	1.26%	1.012629	
7/10/2008	-69.56	-69.68	0.17%	0.998275	
7/9/2008	-70.16	-69.56	0.85%	1.008552	
7/8/2008	-69.76	-70.16	-0.57%	0.994266	
7/7/2008	-70.36	-69.76	0.85%	1.008528	
7/3/2008	-70.68	-70.36	0.45%	004527	
7/2/2008	-72.32	-70.68	2.27%	1.02 677	
7/1/2008	-73.00	-72.32	0.93%	1.009315 3.9	3%



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With long positions

- The geometric linking works as expected
- The linked return matches the return derived from the starting and ending values

Monthly Performance Data							
Date	V _B	VE	ROR based on Monthly V _B & V _E				
7/1-7/31/2008	73.00	70.04	-4.	.05%			
Daily Performance Data							
Data	v	V_	Daily	Standard linking			
Dale	۷B	ΨE	returns	of daiy returns			
7/31/2008	71.00	70.04	-1.35%	0.986479			
7/30/2008	70.20	71.00	1.14%	1.011396			
7/29/2008	69.32	70.20	1.27%	1.012695			
7/28/2008	70.24	69.32	-1.31%	0.986902			
7/25/2008	70.04	70.24	0.29%	1.002856			
7/24/2008	71.52	70.04	-2.07%	0.979306			
7/23/2008	71.16	71.52	0.51%	1.005059			
7/22/2008	70.96	71.16	0.28%	1.002818			
7/21/2008	70.44	70.96	0.74%	1.007382			
7/18/2008	70.16	70.44	0.40%	1.003991			
7/17/2008	69.24	70.16	1.33%	1.013287			
7/16/2008	67.84	69.24	2.06%	1.020637			
7/15/2008	68.64	67.84	-1.17%	0.988345			
7/14/2008	68.80	68.64	-0.23%	0.997674			
7/11/2008	69.68	68.80	-1.26%	0.987371			
7/10/2008	69.56	69.68	0.17%	1.001725			
7/9/2008	70.16	69.56	-0.86%	0.991448			
7/8/2008	69.76	70.16	0.57%	1.005734			
7/7/2008	70.36	69.76	-0.85%	0.991472			
7/3/2008	70.68	70.36	-0.45%	0.995473			
7/2/2008	72.32	70.68	-2.27%	0.977323			
7/1/2008	73.00	72.32	-0.93%	0.990685 -4.05%			

If positions are all long, we get what we expect: the linking of daily returns matches the monthly



Making sense of it ...

- We know that geometric linking results in the compounding of returns
- But, with short positions, we aren't actually *compounding*. More like *decompounding*.
- And so, we need a way to deal with shorts



To solve this dilemma

• I came up with two formulas to use, depending on the number of periods being linked:

 $R_{EvenNumberOfPeriods}^{InverseLinking} = \left[\prod_{i=1}^{n} (r_n - 1) - 1\right] \times (-1)$ $R_{OddNumberOfPeriods}^{InverseLinking} = \left[\prod_{i=1}^{n} (r_n - 1) + 1\right]$

• I refer to this approach as "inverse linking"



With inverse linking

- Our linked return ties with the return we derived based on the starting and ending values
- NOTE: there's actually a simpler formula, that works for both even and odd # of periods; I just can't find it.

$7/1-7/31/2008$ -73.00 -70.04 4.05% Daily Performance DataDate V_B V_E Daily returnsInverse Daily Returns $7/31/2008$ -71.00 -70.04 1.35% -0.986 $7/30/2008$ -70.20 -71.00 -1.14% -1.011 $7/29/2008$ -69.32 -70.20 -1.27% -1.012 $7/28/2008$ -70.24 -69.32 1.31% -0.986 $7/25/2008$ 70.04 70.24 0.20% 1.002	
Daily Performance Data Date V _B V _E Daily returns Inverse Daily Ref Daily Ref 7/31/2008 -71.00 -70.04 1.35% -0.986 7/30/2008 -70.20 -71.00 -1.14% -1.011 7/29/2008 -69.32 -70.20 -1.27% -1.012 7/28/2008 -70.24 -69.32 1.31% -0.9866	
Daily Performance Data Date V _B V _E Daily returns Inverse Daily Re 7/31/2008 -71.00 -70.04 1.35% -0.986 7/30/2008 -70.20 -71.00 -1.14% -1.011 7/29/2008 -69.32 -70.20 -1.27% -1.012 7/28/2008 -70.24 -69.32 1.31% -0.986 7/25/2008 70.04 70.24 0.20% 1.002	
Date V_B V_E Daily returnsInverse Daily Re7/31/2008-71.00-70.041.35%-0.9867/30/2008-70.20-71.00-1.14%-1.0117/29/2008-69.32-70.20-1.27%-1.0127/28/2008-70.24-69.321.31%-0.9867/25/2008-70.24-0.20%1.002	
7/31/2008 -71.00 -70.04 1.35% -0.986 7/30/2008 -70.20 -71.00 -1.14% -1.011 7/29/2008 -69.32 -70.20 -1.27% -1.012 7/28/2008 -70.24 -69.32 1.31% -0.986 7/25/2008 -70.24 -69.32 1.31% -0.986	-inking turns
7/30/2008 -70.20 -71.00 -1.14% -1.011 7/29/2008 -69.32 -70.20 -1.27% -1.012 7/28/2008 -70.24 -69.32 1.31% -0.986 7/25/2008 70.04 70.24 0.20% 1.002	479
7/29/2008 -69.32 -70.20 -1.27% -1.012 7/28/2008 -70.24 -69.32 1.31% -0.986 7/25/2008 70.04 70.24 0.20% 1.002	396
7/28/2008 -70.24 -69.32 1.31% -0.986	695
	902
1/23/2008 -70.04 -70.24 -0.29% -1.002	856
7/24/2008 -71.52 -70.04 2.07% -0.979	306
7/23/2008 -71.16 -71.52 -0.51% -1.005	059
7/22/2008 -70.96 -71.16 -0.28% -1.002	818
7/21/2008 -70.44 -70.96 -0.74% -1.007	382
7/18/2008 -70.16 -70.44 -0.40% -1.003	991
7/17/2008 -69.24 -70.16 -1.33% -1.013	287
7/16/2008 -67.84 -69.24 -2.06% -1.020	637
7/15/2008 -68.64 -67.84 1.17% -0.988	345
7/14/2008 -68.80 -68.64 0.23% -0.997	674
7/11/2008 -69.68 -68.80 1.26% -0.987	371
7/10/2008 -69.56 -69.68 -0.17% -1.001	725
7/9/2008 -70.16 -69.56 0.86% -0.991	448
7/8/2008 -69.76 -70.16 -0.57% -1.005	734
7/7/2008 -70.36 -69.76 0.85% -0.991	472
7/3/2008 -70.68 -70.36 0.45% -0.995	473
7/2/2008 -72.32 -70.68 2.27% -0.977	323
7/1/2008 -73.00 -72.32 0.93% -0.990685	4.05%

Monthly Performance Data

If we inverse the linking (i.e., instead of ADDING 1 to the daily returns, we SUBTRACT 1), and if the number of periods is even, then multiply by -1, we match the true return. (Note: if the number of periods is odd, then ADD 1 and don't multiply)



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Surprises usually mean one of two things

- You did something wrong
 - Wrong formula
 - Data has issues
- You've discovered something for which either an explanation or an adjustment is in order



The moral of the story ...

- Mathematics often yield surprises, and we occasionally encounter them in our world of investment performance measurement.
- It's important for performance measurement professionals to be aware of these scenarios, as they can arise and may influence your decisions.



YOUR THOUGHTS? QUESTIONS?







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