

Problem Set 9  
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The worksheet version of the answer can be found [here](#) (use Yale email to access).

a. Conceptual questions

(i). The costs of implementing a real-world portfolio is the execution costs, while the costs of failing to implement are the opportunity costs.

- The execution costs stem from the many sources of illiquidity, including the exogenous transactions costs (brokerage fees, order-processing costs, transaction taxes), demand pressure (search costs), inventory risk (compensation for market makers), private information (compensation for potentially being an insider), and locating a counterparty.
- The opportunity costs is the paper profit on securities you decided not to buy (or did not buy because your limit order was never hit)

The two costs combine together to form the shortfall of a particular trading strategy. For each strategy, we need to estimate the likely trading costs,  $E(TC)$ , and compare it to the benefits of trading.

(ii). For all traders, the cost of trading can be divided into proportional costs and non-proportional costs. For large institutional traders, most of this cost originates from non-proportional costs. Factors that affect the price impact costs include the size of the order, speed of execution, and value of shares outstanding.

(iii). These costs can be mitigated through adjusting the large size of the trade into smaller sizes, adjusting the time period that these trades would occur in, and adjusting the original strategy by including transaction costs in the model.

b. The total trading costs, net returns, and dollar net profits of each strategy, assuming a portfolio size (NAV) of \$1 billion dollars for each portfolio, is listed as follows.

	SMB	HML	UMD	Combo	STREV
Total dollar costs (million, optimized)	0.41	0.66	1.69	1.47	6.37
Total costs (% , optimized)	0.49	0.79	2.03	1.76	7.64
Net return (annualized %)	1.27	3.26	3.56	5.14	-4.71
Dollar profits (\$ million)	12.65	32.59	35.62	51.40	-47.09

c. The total trading costs, net returns, and dollar net profits of each strategy, assuming a fund size (NAV) of \$2 billion dollars for each portfolio, is listed as follows.

	SMB	HML	UMD	Combo	STREV
Total dollar costs (million, optimized)	0.89	1.45	3.88	3.35	15.57
Total costs (% , optimized)	0.53	0.87	2.33	2.01	9.34
Net return (annualized %)	1.22	3.187	3.27	4.89	-6.41
Dollar profits (\$ million)	24.42	63.53	65.38	97.80	-128.29

Explanation:

There are sizable differences across the anomalies in terms of the change in trading costs and net returns because for different strategies, the optimal trading frequency should be different when given different fund sizes. Therefore, when doubling the fund sizes without adjusting corresponding trading frequencies, we see a different impact on the trading costs.

- d. The break-even fund size is listed below. Goal Seek is used to calculate the break-even NAV. However, STREV seems to return unstable / negative break-even NAV value.

	SMB	HML	UMD	Combo	STREV
Break-even NAV (billion)	102.19	153.78	26.60	54.63	0.00

- e. The break-even fund size from 1926 to 2015 is listed below. We can see that the change in break-even NV per unit change in return (additional last row) is highest for SMB and lowest for STREV.

	SMB	HML	UMD	Combo	STREV
Break-even NAV (billion)	263.89	215.86	56.16	98.69	0.22

- f. The fund size that maximizes dollar profits is listed below. We can see that although the Combo portfolio has the highest average return on paper, with trading cost in consideration, it doesn't actually provide the highest dollar profits. In fact, HML, with only slightly above 50% of Combo's on paper average return, provides the highest dollar profits in reality. This may come from the fact that, to include momentum / UMD, the trading frequency / turnover is very high, and therefore the total trading cost is very high relative to the return, therefore lowering the final dollar amount.

	SMB	HML	UMD	Combo	STREV
Break-even NAV (billion)	124.95	102.42	26.42	46.79	0.10
Net return (annualized %)	1.01	1.72	2.62	3.36	0.54
Dollar profits (\$ million)	1257.82	1762.56	693.52	1570.74	0.53

- g. The net return improvement by reducing turnover by 25% can be seen below for each strategy and the extra break-even capacity reducing turnover by 25% is shown below. Liquidity is most important for SMB with the highest break-even capacity increase. This makes sense because for value strategy to work the portfolio by definition will contain

assets that are comparably harder to trade, where the value only presents itself in the long-term, and therefore require high liquidity.

	SMB	HML	UMD	Combo	STREV
Net Return Improvement (\$ million)	1.3	2.2	5.8	5.0	23.0
Increase in Break-even Capacity (billion)	294.8	236.7	66.9	108.8	1.0

- h. The net return improvements and increase in break-even capacity when the turnover is reduced by 25% and the mean gross return decreased by  $0.25 \times (\text{original turnover}\%)$  is as follows. Comparing the breakeven point in part h with that of part g, we see that the break-even fund size in part h is across the board smaller, though both are higher than part e. This tells us that, under the current assumption, trading cost (part g) seems to outweigh opportunity cost opportunity cost (part h).

	SMB	HML	UMD	Combo	STREV
Net Return Improvement (\$ million)	0.6	1.1	3.2	2.8	15.5
Increase in Break-even Capacity (billion)	273.8	221.3	60.6	101.5	0.5

- i. The net return improvements and increase in break-even capacity when we increase the daily volume by twice is shown below. Liquidity is again most important for SMB with the highest break-even capacity increase. This makes sense because for value strategy to work the portfolio by definition will contain assets that are comparably harder to trade, where the value only presents itself in the long-term, and therefore require high liquidity.

	SMB	HML	UMD	Combo	STREV
Net Return Improvement (\$ million)	0.3	0.6	2.0	1.7	11.3
Increase in Break-even Capacity (billion)	263.9	215.9	56.2	98.7	0.2

- j. The net return improvements and increase in break-even capacity after the adjustment of the mean gross returns is shown below. Liquidity is again most important for SMB with the highest break-even capacity increase. This makes sense because for value strategy to work the portfolio by definition will contain assets that are comparably harder to trade, where the value only presents itself in the long-term, and therefore require high liquidity.

	SMB	HML	UMD	Combo	STREV
Net Return Improvement (\$ million)	-14.4	-15.9	-11.7	-30.7	-35.8
Increase in Break-even Capacity (billion)	-122.0	-2.5	23.7	-1.7	-0.2