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Deep Dive

Searching for Alpha

Go with the Stock Connect Flow, for a Sharpe of 4

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CITI'S TAKE

Since its launch in 2014, the Stock Connect Scheme has played an increasingly important role in both China A-shares and Hong Kong stock markets. As investors eagerly seek new alpha generation opportunities, we investigate several trading strategies utilizing Stock Connect flows and holdings data.

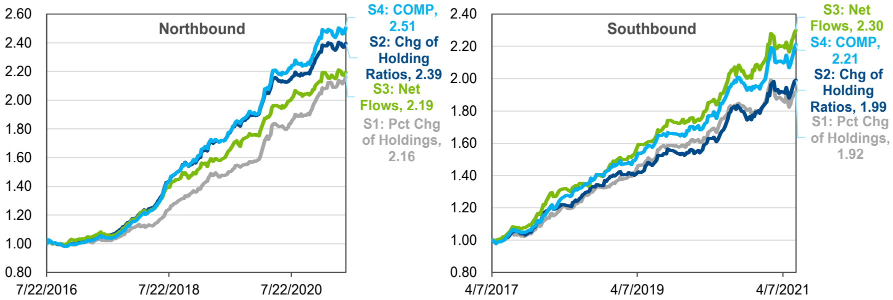
Sharpe Ratio surpassing 3.0 for both Northbound and Southbound — We examine four trading strategies based on the relative momentum of stock holdings and flows via the stock connect scheme. That is, buying the stocks with the highest inflows, and selling stocks with the highest outflows. We found strong evidence of alpha in the signals, with Long-Short Sharpe surpassing 3.0 (before transaction costs) for both Northbound (NB) and Southbound (SB) trading directions.

Composite signal strongest for Northbound — The COMP signal which combines three individual signals posted the best NB returns, consistently performing well with an annualized return of 20.6% and Sharpe of 3.7.

Both Net Flow and Composite signals strong for Southbound — The Net Flows signal outperformed in annualized returns (+22.3%) and risk-adjusted returns (Sharpe: 3.1), followed closely by COMP (annualized return: +21.2%, Sharpe: 3). They also consistently outperformed when looking at individual historical years. Hence we recommend using either Net Flows or the COMP signal for a SB strategy.

Transaction cost sensitivity — The signals are high turnover by nature. We analyze their performance with various transaction cost assumptions and show that in practice they can still generate alpha.

Figure 1. Long-Short Performance for Stock Connect Signals



Source: Citi Research, Wind, Worldscope, DataStream, HKEX

See Appendix A-1 for Analyst Certification, Important Disclosures and Research Analyst Affiliations.

Contents

Stock Connect Scheme

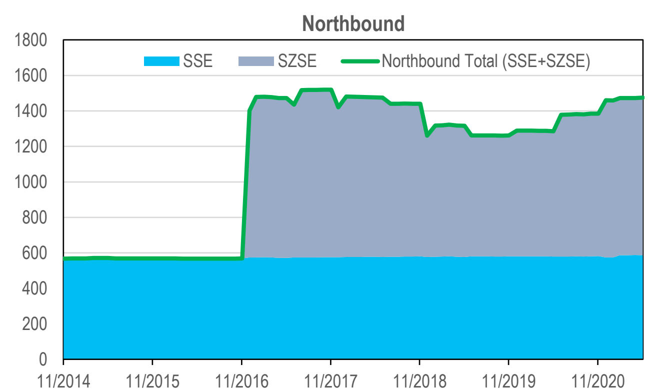
The Stock Connect scheme is a cross-border investment channel that connects the China A-share stock exchanges (Shanghai/Shenzhen Stock Exchanges) and the Hong Kong Stock Exchange (HKEX). Under the program, eligible investors in each market are able to trade shares on the other market using their own local brokers and clearing houses. This provides a channel for foreign investors to invest in the China A-shares market and also gives onshore investors access to the Hong Kong stock market.

The Stock Connect program consists of two components in terms of trading direction: Northbound trading and Southbound trading.

- **Northbound trading**: all Hong Kong and overseas investors are able to trade eligible stocks listed on Shanghai Stock Exchange (SSE) and Shenzhen Stock Exchange (SZSE)
  - **Shanghai-Hong Kong Stock Connect**: launched on November 17, 2014, and includes eligible stocks listed in Shanghai Stock Exchange (SSE)
  - **Shenzhen-Hong Kong Stock Connect**: launched on December 5, 2016, and includes eligible stocks listed in Shenzhen Stock Exchange (SZSE)
- **Southbound trading**: only onshore institutional investors and individual investors with at least RMB 500,000 in their investment and cash accounts are eligible to trade eligible stocks listed on Hong Kong Exchange (HKEX)

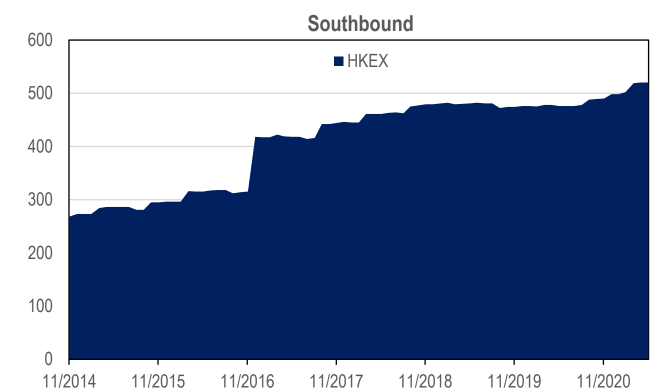
The list of eligible stocks has varied since inception of the Stock Connect program – Figure 2 and Figure 3 show the evolution of the number of stocks over time.

Figure 2. Number of eligible stocks over time – Northbound



Source: Citi Research, Wind, HKEX

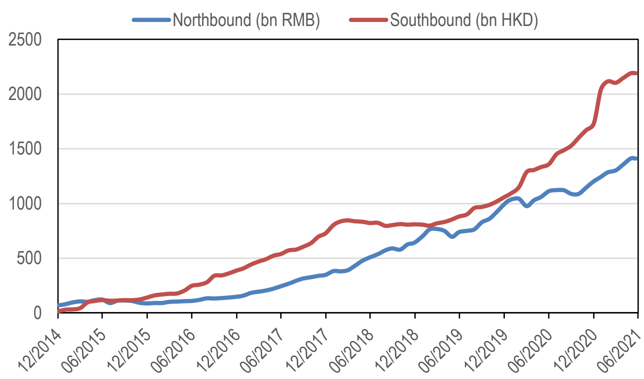
Figure 3. Number of eligible stocks over time – Southbound



Source: Citi Research, WIND, HKEX

Since the launch of the Stock Connect in 2014, investors have been very active in trading through the program as shown in Figure 4 below. Since 2014, the Stock Connect program has accumulated over RMB 1.3 trillion net buy flows via the Northbound trading (i.e., net buy of China-A shares), while the Southbound flow is even stronger, with over HKD 2.1 trillion net buy into Hong Kong listed stocks during the same time. The flows have been accelerating in recent years, with 2020 recording HKD 672 billion of Southbound flows – see Figure 5 for details.

Figure 4. Cumulative flows (net buy amount) via Stock Connect



Source: Citi Research, Wind, HKEX, data as of 6/21/2021

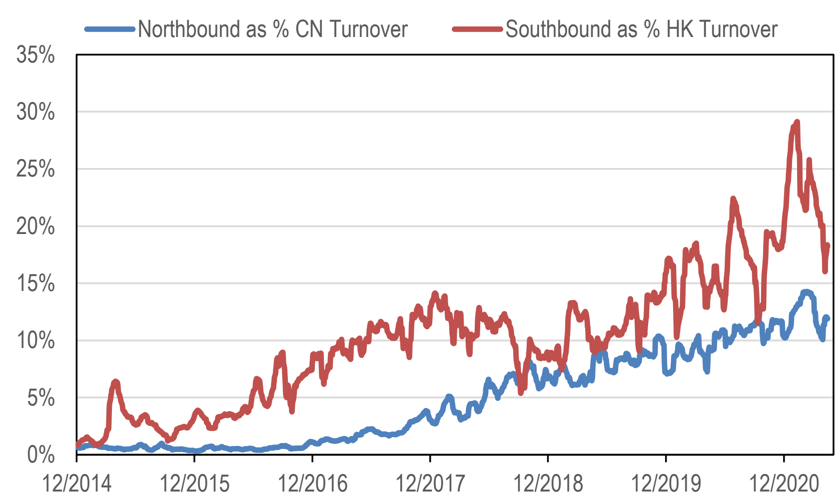
Figure 5. Net flows via Stock Connect by Year

Year	Northbound (bn RMB)	Southbound (bn HKD)
2014	69	13
2015	19	127
2016	61	246
2017	200	340
2018	294	83
2019	352	249
2020	209	672
2021 (YTD)	208	460
Total	1,410	2,191

Source: Citi Research, WIND, HKEX, data as of 6/21/2021

In Figure 6, we show Stock Connect turnover as % of total turnover of China A-shares and the HK market, respectively. As seen, the ratios of both directions have been consistently rising. We believe investor trading via Stock Connect will continue to play an important role in both China A-shares and Hong Kong markets.

Figure 6. Stock Connect turnover as % of total turnover of China A-shares and HK market (20-day rolling)



Source: Citi Research, WIND, HKEX

Trading Strategies

This report is not intended to be a thorough introduction of how the Stock Connect program is operated, but rather to focus on alpha strategies, i.e., we intend to provide insights on stock selection by utilizing holdings and flows related data of the Stock Connect. In this section, we will discuss several trading signals which we found to empirically offer strong performance in both absolute and risk-adjusted terms.

Exchange-disclosed data

As mentioned earlier, we intend to develop trading signals based on stock-level holdings and flows data. We firstly discuss what data is available below.

- Stock-level **holdings** data: HKEX discloses daily shareholdings via Stock Connect in aggregate as of the end of each trading date. The data has two components:

1. Connect holdings (i.e., number of stocks held), and

2. Connect holdings ratio as % of total float shares.

- Stock-level **flows** data: in terms of flows, we are referring to the net buy/sell amount by trading via Stock Connect. However, only data of the top 10 most traded stocks of each stock exchange is available (i.e., only data for 30 stocks per day, with 10 stocks from each of SSE, SZSE and HKEX). This clearly has insufficient data to make for a signal with broad coverage.

Note we only have data since March 17, 2017 as this is when the exchange first began to disclose this data.

Approximating flows data

Intuitively, strategies based on stock-level flows data can potentially give us an effective trading signal. However, because exchange-disclosed flow data only covers the top 10 most traded stocks, we don't have enough breadth to effectively use this data given its limited coverage. Alternatively, we can approximate a stock's flow by multiplying each stock's change in stock holding by its volume-weighted average price (VWAP) on the same day, calculated as follows:

3. Net flows via Stock Connect (on day *t*):

$$Flow_t = (Holdings_t - Holdings_{t-1}) \cdot VWAP_t$$

Methodology of the four signals

We propose three individual strategies based on the above datasets, i.e., Holdings, Holdings ratios, and Flows, respectively, as described below.

- **Signal 1 – Percent Change of Holdings** (based on data #1):

$$Percent\ Change\ of\ Holdings = \frac{Net\ Change\ in\ Number\ of\ Holdings}{Previous\ Number\ of\ \text{Holdings}}$$

- **Signal 2 – Change of Holding Ratios** (based on data #2):

$$Change\ of\ Holding\ Ratios = Lastest\ Holding\ Ratio - Previous\ Holding\ Ratio$$

- **Signal 3 – Net Flows** (based on data #3):

$$Net\ Flows\ during\ the\ Periods = \sum_{t=1}^{T} Flow_t$$

- **Signal 4 – COMP** (composite based on Signals 1-3 above):

  For each of the above three signals, we adopt a cross-sectional approach and calculate the normalized factor scores. We then equally weight the normalized factor scores to form a Composite factor.

At the end of every week, we compute the above signals and group stocks into quintile portfolios, with Q1 being the worst quintile (i.e. Short Basket) and Q5 being the best quintile (i.e. the Long Basket). We then compute the equal-weighted total returns for the respective quintile portfolios with a weekly rebalance frequency to evaluate their performance.

Backtest Performance

In this report, we adopt local currency returns (RMB returns for Northbound trading and HKD returns for Southbound trading) to evaluate performance of Long-Only, Long-Benchmark, and Long-Short strategies.

- **Long-only:** long all stocks in the top quintile (Q5), equal-weighted
- **Long-Bench:** same as Long-Only but as excess returns relative to benchmark
- **Long-Short:** long the top quintile (Q5) and simultaneously short the bottom quintile (Q1) on an equal weighted basis

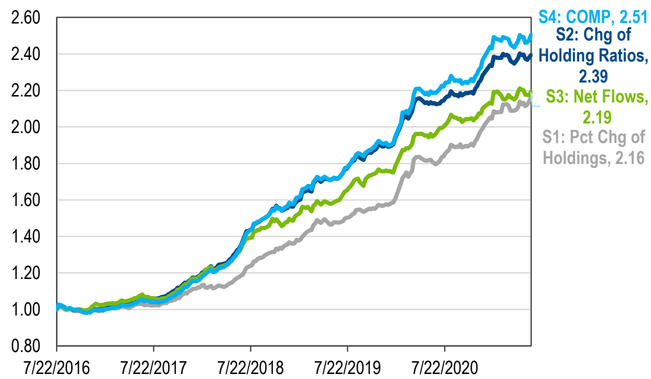
In the following discussions, we consider Long-Short performance of the proposed four signals, while the results for Long-only and Long-Bench scenarios can be found in Appendix 1 – Appendix 4. Unless otherwise specified, we assume zero transaction costs (results with non-zero transaction costs will be discussed later).

Figure 7 - Figure 14 show Long-Short performance of the proposed four signals. As seen,

- All the four signals posted strong returns consistently for both Northbound and Southbound trading, though on a risk-adjusted basis, they are generally stronger for the Northbound direction.
- For **Northbound**:
  - The COMP signal (S4) posted the best annualized returns (+20.6% per annum) with slightly higher volatility (+5.6% per annum) than the three individual signals. On a risk adjusted basis, its Sharpe ratio is as high as 3.7. On average, the COMP signal held 266 stocks on the long side.
  - Among the three individual signals and since 2016 (Figure 7 and Figure 9), S2 (Change of holding ratios) performed the best with the largest cumulative returns (+19.5% per annum) and lowest volatility (+5.1% per annum), hence the best Sharpe of 3.8, which is even higher than that of the COMP signal.
  - Looking at performance by year (Figure 11 and Figure 13), we can see that S2 did outperformed S1 and S3 by a large margin in early years during 2017-2019, while it slightly underperformed S1 in 2020 and 2021 YTD. On the other hand, the COMP signal has been consistently performing well. Hence, we recommend using COMP signal for a Northbound trading strategy.
- For **Southbound**:
  - The S3 signal (Net Flows) outperformed in terms of both absolute (+22.3% per annum) and risk-adjusted returns (Sharpe: 3.1), followed closely by the S4 (COMP) signal with +21.2% annualized return and a Sharpe of 3. On average, the COMP signal held 94 stocks on the long side.
  - Even when looking at performance by year (Figure 12 and Figure 14), both S3 and S4 mostly outperformed the others each year, hence we recommend using either Net Flows or the COMP signal for Southbound trading.

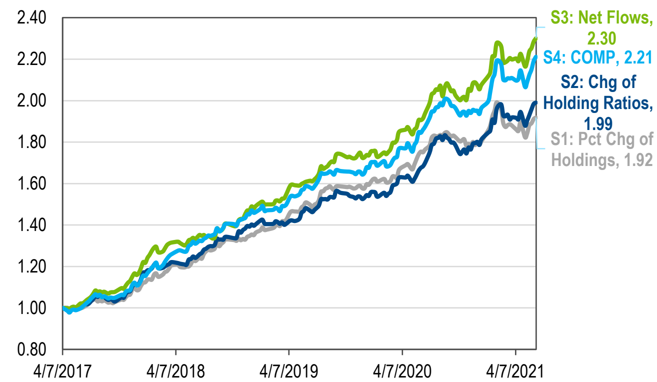
For Long-only and Long-Bench, we find S3 and S4 mostly outperforming for both Northbound and Southbound, see Appendix 1 - Appendix 4 for details.

Figure 7. Long-Short: Cumulative returns – Northbound



Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

Figure 8. Long-Short: Cumulative return – Southbound



Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

Figure 9. Long-Short: Performance Statistics – Northbound

Signal	Avg Return	Std. Dev	Hit Rate	T-stat	IR	Avg Turnover
S1: Pct Chg of Holdings	17.0%	5.3%	71.0%	6.59	3.18	76.6%
S2: Chg of Holding Ratios	19.5%	5.1%	71.5%	7.74	3.79	73.5%
S3: Net Flows	17.3%	5.4%	65.6%	6.59	3.19	66.1%
S4: COMP	20.6%	5.6%	71.5%	7.53	3.70	70.0%

Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

Figure 10. Long-Short: Performance Statistics – Southbound

Signal	Avg Return	Std. Dev	Hit Rate	T-stat	IR	Avg Turnover
S1: Pct Chg of Holdings	17.1%	6.6%	67.7%	4.95	2.60	66.3%
S2: Chg of Holding Ratios	18.1%	6.9%	64.0%	5.01	2.64	62.7%
S3: Net Flows	22.3%	7.1%	69.9%	5.85	3.14	56.1%
S4: COMP	21.2%	7.0%	66.7%	5.65	3.02	57.1%

Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

Figure 11. Long-Short: Annualized returns by year – Northbound

Year	S1: Pct Chg of Holdings	S2: Chg of Holding Ratios	S3: Net Flows	S4: COMP
2016	-2.2%	-0.4%	6.0%	-1.4%
2017	11.6%	16.3%	13.3%	15.0%
2018	21.5%	32.4%	26.5%	35.5%
2019	16.8%	22.2%	19.2%	21.8%
2020	28.2%	21.9%	20.5%	26.1%
2021	16.0%	8.9%	8.1%	10.6%

Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

Figure 12. Long-Short: Annualized returns by year – Southbound

Year	S1: Pct Chg of Holdings	S2: Chg of Holding Ratios	S3: Net Flows	S4: COMP
2016	-	-	-	-
2017	16.7%	23.3%	29.8%	20.9%
2018	21.9%	20.5%	23.2%	27.5%
2019	18.8%	11.5%	18.5%	17.1%
2020	12.5%	16.8%	18.8%	15.9%
2021	13.9%	22.0%	24.4%	28.7%

Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

Figure 13. Long-Short: Risk-adjusted returns by year – Northbound

Year	S1: Pct Chg of Holdings	S2: Chg of Holding Ratios	S3: Net Flows	S4: COMP
2016	-0.65	-0.07	1.07	-0.25
2017	3.40	5.30	3.80	4.32
2018	4.32	5.57	4.43	6.61
2019	3.48	4.28	3.42	4.23
2020	3.78	3.90	3.52	3.85
2021	2.62	1.65	1.29	1.62

Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

Figure 14. Long-Short: Risk-adjusted returns by year – Southbound

Year	S1: Pct Chg of Holdings	S2: Chg of Holding Ratios	S3: Net Flows	S4: COMP
2016	-	-	-	-
2017	3.23	3.45	5.16	3.37
2018	3.93	3.83	3.57	4.83
2019	3.45	2.17	3.45	3.04
2020	2.01	2.28	2.34	2.17
2021	1.17	1.99	2.23	2.45

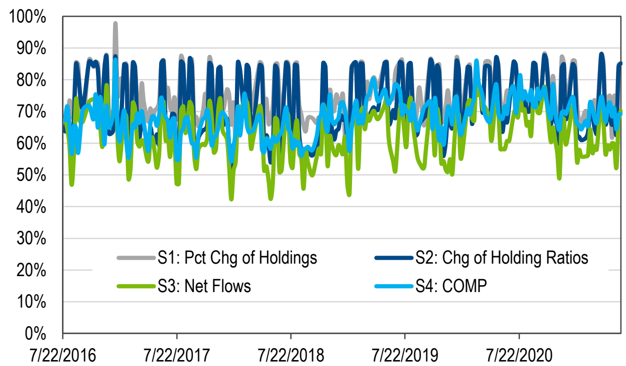
Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

Transaction Cost Sensitivity

Despite the encouraging performance offered by the proposed signals, we have to acknowledge that the results are before transaction costs. Unsurprisingly, the proposed signals are high-turnover strategies by nature, given the flows are highly sentiment driven and volatile. We can see in Figure 15 and Figure 16 that:

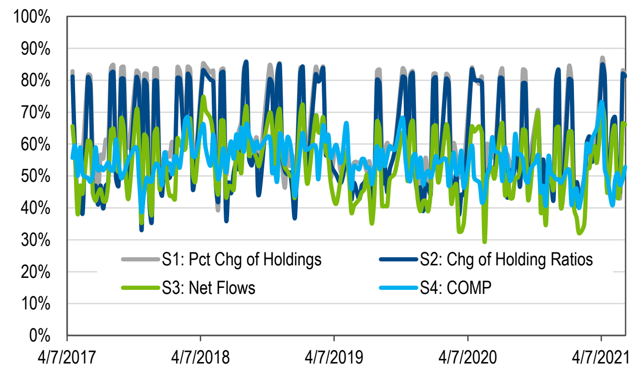
- For Northbound, the long-only portfolios can have turnover ratios of 60-75% per week (i.e., 28x-34x turnover per year).
- For Southbound, the turnover is slightly lower, ranging from 58-70% per week (i.e., 26x-31x turnover per year).

Figure 15. Weekly Turnover of the Long-only Portfolio – Northbound



Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

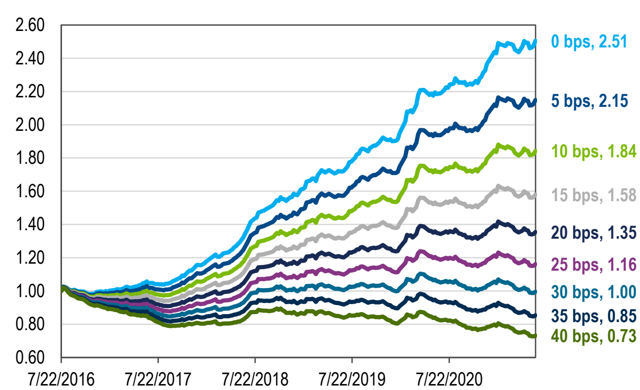
Figure 16. Weekly Turnover of the Long-only Portfolio – Southbound



Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

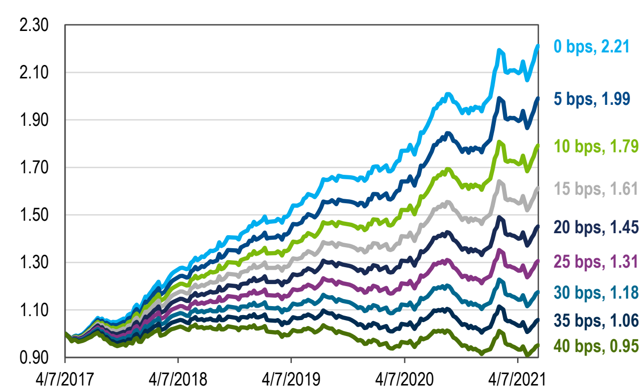
As a result, the real-world returns will be dampened due to high transaction costs from high turnover ratios, as illustrated in Figure 17 and Figure 18 which examine the performance sensitivity of the COMP signal with various transaction cost assumptions. As we can see, performance is indeed heavily impacted by transaction costs.

Figure 17. Long-Short: Cumulative returns of COMP – Northbound



Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

Figure 18. Long-Short: Cumulative return of COMP – Southbound



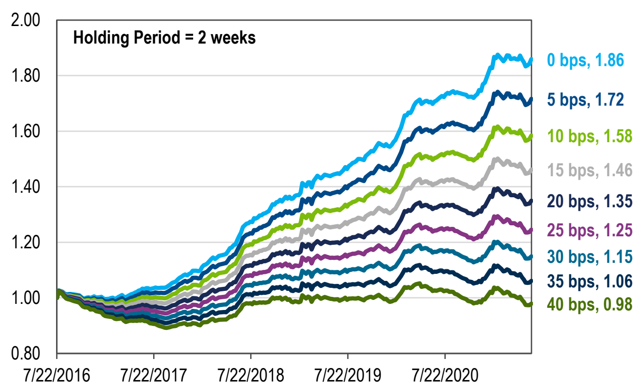
Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

Nevertheless, this doesn't necessarily mean we should abandon these strategies at all. Instead, we can partly tackle this high transaction costs issue (caused by frequent trades due to high portfolio turnovers) by trading at lower frequencies. This is illustrated in Figure 19 – Figure 22 where we plot the performance of the COMP strategy with holding periods of two and four weeks, respectively. As expected,

- Part of the alpha was lost when the holding period increases, this can be observed from the cases with no transaction costs assumption (i.e., transaction cost = 0 bps). Taking the Northbound trading as an example, the cumulative returns of the COMP signal dropped from +151% (Figure 17) to +86% (Figure 19) and +53% (Figure 21) when holding periods increased to 2 and 4 weeks, respectively.
- However, when the transaction cost increases to 25 bps and above, the benefits of cost savings (due to less trading) surpassed the loss in alpha (see the cases for 25 bps in Figure 17 vs Figure 19).

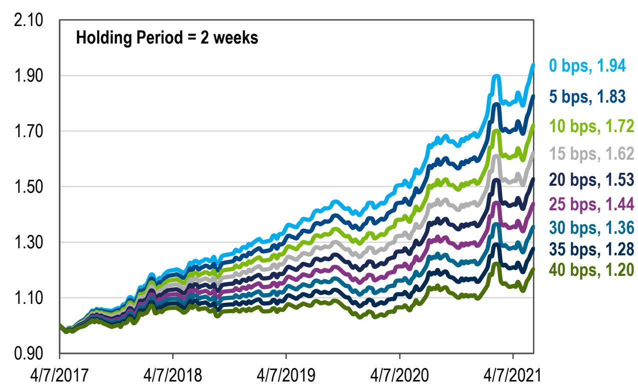
Clearly, there is a tradeoff between alpha decay and cost savings when the holding period increases. Hence, how to balance it plays an important role in real-world achievable returns, and we recommend investors to take into account their own specific transaction costs to decide the proper rebalancing frequency.

Figure 19. Long-Short: Cumulative returns of COMP – Northbound



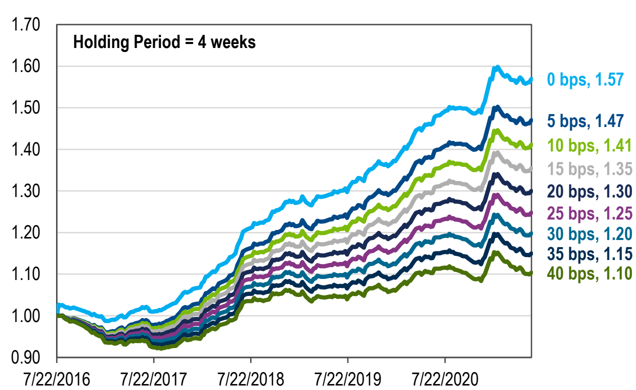
Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

Figure 20. Long-Short: Cumulative return of COMP – Southbound



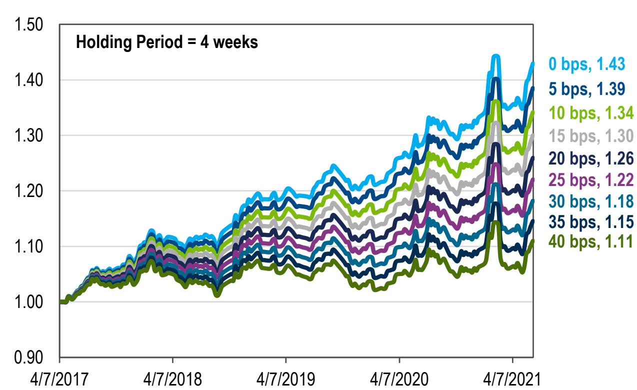
Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

Figure 21. Long-Short: Cumulative returns of COMP – Northbound



Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

Figure 22. Long-Short: Cumulative return of COMP – Southbound



Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

Correlation with Quant Styles

We investigate the correlation profiles of the proposed signals against the regular Quant Styles in Figure 23 - Figure 24. We can see that:

- Although the signals worked strongly in both Northbound and Southbound, their style exposures are very different:
  - For Northbound, the signals are positively correlated with most styles except for Value which is the only negatively correlated style, with Large Size and Price Momentum being the most positively correlated styles.
  - For Southbound, only Growth and Low Risk are positively correlated with the signals, while the rest styles are all on the negative side. In particular, Price Momentum is almost the most negatively correlated style as opposed to the case with Northbound.
  - We believe the discrepancies between NB and SB correlation profiles are related to the underlying investor appetites of each market. Northbound investors are pursuing Large Cap and high Price Momentum stocks which actually outperformed in the China A-shares market (which is dominated by retail investors) in the past couple of years. While in the Southbound market, we can see Low Risk and Growth stocks (such as Tech and Healthcare names) outperforming in past years.
- Correlations against the Quant Styles are modest, mostly within the range of -5% to 5% (except for those against the Large Size style). This indicates that the signals are good complements to the regular quant styles, and the performance may be further boosted with the potential diversification effects achieved by combining the signals with other quant styles.

Figure 23. Rank Correlation with Quant Styles – Northbound

	Value	Growth	Low Risk	Large Size	Quality	Price Mom.	Earn. Mom.
S1: Pct Chg of Holdings	-1.0%	0.7%	0.1%	0.7%	0.4%	0.5%	1.1%
S2: Chg of Holding Ratios	-1.3%	1.5%	1.8%	4.1%	2.4%	3.6%	1.3%
S3: Net Flows	-0.9%	1.7%	2.0%	8.3%	3.1%	5.0%	1.3%
S4: COMP	-1.4%	1.7%	1.8%	5.0%	2.5%	4.0%	1.5%

Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

Figure 24. Rank Correlation with Quant Styles – Southbound

	Value	Growth	Low Risk	Large Size	Quality	Price Mom.	Earn. Mom.
S1: Pct Chg of Holdings	-2.8%	3.8%	3.4%	-5.4%	0.0%	-4.7%	-2.2%
S2: Chg of Holding Ratios	-1.6%	2.5%	2.6%	-7.9%	-2.4%	-4.9%	-2.0%
S3: Net Flows	-3.3%	3.5%	3.0%	0.6%	0.5%	-0.9%	-1.1%
S4: COMP	-2.7%	3.1%	3.2%	-5.4%	-1.1%	-4.0%	-2.1%

Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

Conclusion

In this report, we investigate the performance of four trading strategies based on stock holdings and flows via the stock connect scheme. We found strong evidence of alpha in the proposed signals for both Northbound (NB) and Southbound (SB) trading directions.

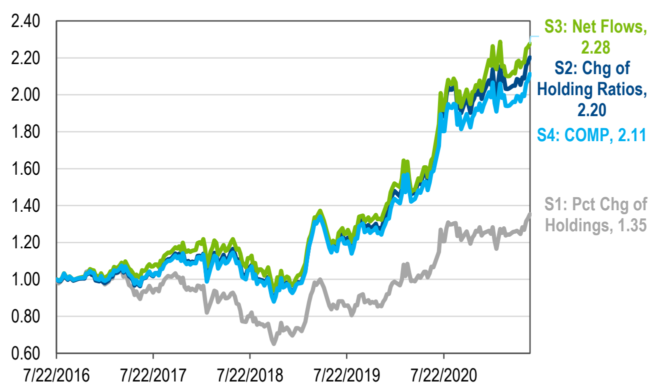
The signals are high turnover by nature and thus are expensive to trade at high frequencies. We analyze their performance with various transaction cost assumptions and show that in practice they can still generate alpha.

We also investigate the correlation profiles of the signals against regular quant styles. We find that the signals have very different style exposures in Northbound and Southbound directions. We also find that the signals are good complements to regular quant styles given their modest correlations.

Appendix 1

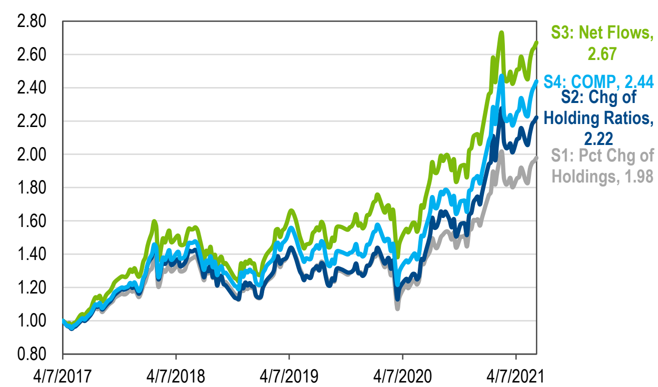
Performance of Long-only portfolios with no transaction costs

Figure 25. Long-only: Cumulative returns – Northbound



Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

Figure 26. Long-only: Cumulative return – Southbound



Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

Figure 27. Long-only: Performance Statistics – Northbound

Signal	Avg Return	Std. Dev	Hit Rate	T-stat	IR	Avg Turnover
S1: Pct Chg of Holdings	6.4%	22.1%	55.2%	0.86	0.29	75.9%
S2: Chg of Holding Ratios	17.4%	20.5%	57.5%	1.96	0.85	71.4%
S3: Net Flows	18.2%	19.6%	57.0%	2.11	0.93	62.6%
S4: COMP	16.5%	20.4%	57.0%	1.88	0.81	67.8%

Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

Figure 28. Long-only: Performance Statistics – Southbound

Signal	Avg Return	Std. Dev	Hit Rate	T-stat	IR	Avg Turnover
S1: Pct Chg of Holdings	17.9%	21.4%	62.4%	1.79	0.84	64.2%
S2: Chg of Holding Ratios	21.3%	23.8%	59.1%	1.90	0.90	59.8%
S3: Net Flows	26.8%	23.9%	61.8%	2.27	1.12	53.4%
S4: COMP	24.1%	22.9%	61.8%	2.16	1.05	54.3%

Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

Figure 29. Long-only: Annualized returns by year – Northbound

Year	S1: Pct Chg of Holdings	S2: Chg of Holding Ratios	S3: Net Flows	S4: COMP
2016	-0.9%	-2.8%	3.4%	-0.4%
2017	-5.6%	9.9%	13.5%	8.3%
2018	-25.3%	-14.6%	-16.3%	-14.5%
2019	34.3%	49.5%	49.0%	46.0%
2020	36.6%	48.3%	47.0%	47.2%
2021	17.6%	20.5%	22.1%	19.1%

Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

Figure 30. Long-only: Annualized returns by year – Southbound

Year	S1: Pct Chg of Holdings	S2: Chg of Holding Ratios	S3: Net Flows	S4: COMP
2016	-	-	-	-
2017	32.4%	38.5%	53.5%	38.8%
2018	-7.6%	-10.3%	-6.9%	-4.3%
2019	18.8%	19.1%	31.1%	22.6%
2020	20.6%	31.1%	29.0%	27.7%
2021	53.2%	62.7%	60.6%	71.8%

Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

Figure 31. Long-only: Risk-adjusted returns by year – Northbound

Year	S1: Pct Chg of Holdings	S2: Chg of Holding Ratios	S3: Net Flows	S4: COMP
2016	-0.08	-0.28	0.36	-0.05
2017	-0.36	0.76	1.17	0.65
2018	-0.93	-0.57	-0.67	-0.57
2019	1.45	2.39	2.60	2.19
2020	1.48	1.96	1.97	1.97
2021	0.88	1.07	1.08	0.99

Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

Figure 32. Long-only: Risk-adjusted returns by year – Southbound

Year	S1: Pct Chg of Holdings	S2: Chg of Holding Ratios	S3: Net Flows	S4: COMP
2016	-	-	-	-
2017	3.20	3.24	4.41	3.43
2018	-0.33	-0.39	-0.25	-0.16
2019	1.08	1.00	1.62	1.22
2020	0.78	1.12	1.06	1.05
2021	2.01	1.98	1.97	2.42

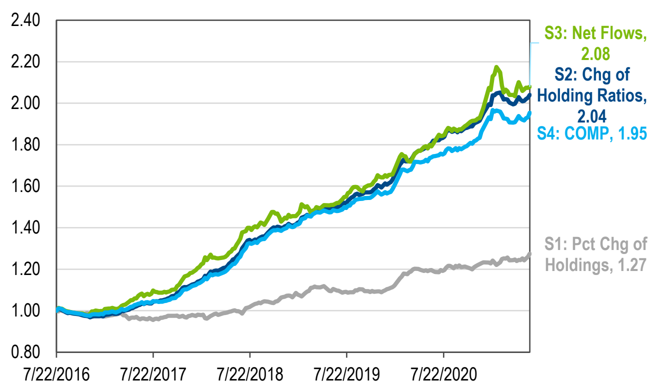
Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

Appendix 2

Performance of Long-Bench portfolios with no transaction costs

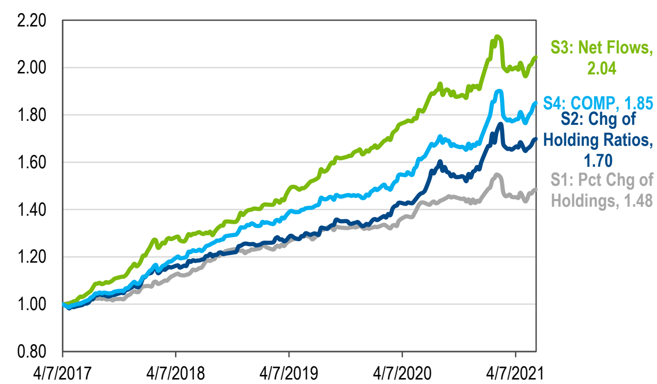
Note that the benchmark is the equal-weighted portfolio of the whole stock connect universe of each trading direction.

Figure 33. Long-Bench: Cumulative returns – Northbound



Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

Figure 34. Long-Bench: Cumulative return – Southbound



Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

Figure 35. Long-Bench: Performance Statistics – Northbound

Signal	Avg Return	Std. Dev	Hit Rate	T-stat	IR	Avg Turnover
S1: Pct Chg of Holdings	5.1%	4.1%	58.4%	2.72	1.24	75.9%
S2: Chg of Holding Ratios	15.6%	3.8%	72.4%	8.46	4.08	71.4%
S3: Net Flows	16.1%	5.9%	65.2%	5.63	2.71	62.6%
S4: COMP	14.6%	4.0%	70.1%	7.56	3.63	67.8%

Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

Figure 36. Long-Bench: Performance Statistics – Southbound

Signal	Avg Return	Std. Dev	Hit Rate	T-stat	IR	Avg Turnover
S1: Pct Chg of Holdings	10.0%	4.8%	63.4%	4.13	2.10	64.2%
S2: Chg of Holding Ratios	13.7%	6.5%	65.6%	4.06	2.09	59.8%
S3: Net Flows	18.9%	6.7%	69.9%	5.35	2.83	53.4%
S4: COMP	16.1%	6.0%	70.4%	5.12	2.68	54.3%

Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

Figure 37. Long-Bench: Annualized returns by year – Northbound

Year	S1: Pct Chg of Holdings	S2: Chg of Holding Ratios	S3: Net Flows	S4: COMP
2016	-4.7%	-6.6%	-0.7%	-4.4%
2017	-0.7%	15.2%	18.6%	13.4%
2018	9.1%	24.1%	21.2%	24.2%
2019	4.0%	15.2%	14.3%	12.5%
2020	11.9%	21.5%	20.1%	20.4%
2021	6.9%	9.4%	10.6%	8.1%

Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

Figure 38. Long-Bench: Annualized returns by year – Southbound

Year	S1: Pct Chg of Holdings	S2: Chg of Holding Ratios	S3: Net Flows	S4: COMP
2016	-	-	-	-
2017	10.2%	15.4%	28.0%	15.7%
2018	14.9%	12.3%	16.9%	19.8%
2019	7.6%	8.2%	19.1%	11.3%
2020	9.8%	19.6%	17.6%	16.1%
2021	5.4%	13.2%	11.4%	18.9%

Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

Figure 39. Long-Bench: Risk-adjusted returns by year – Northbound

Year	S1: Pct Chg of Holdings	S2: Chg of Holding Ratios	S3: Net Flows	S4: COMP
2016	-2.03	-2.69	-0.20	-1.54
2017	-0.21	6.44	4.83	5.01
2018	2.17	5.61	3.31	5.80
2019	0.92	5.20	2.97	4.35
2020	2.63	5.22	3.69	4.38
2021	1.45	1.67	0.96	1.32

Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

Figure 40. Long-Bench: Risk-adjusted returns by year – Southbound

Year	S1: Pct Chg of Holdings	S2: Chg of Holding Ratios	S3: Net Flows	S4: COMP
2016	-	-	-	-
2017	3.59	3.51	6.87	4.46
2018	3.93	2.62	2.99	4.41
2019	1.98	1.88	4.16	2.80
2020	2.25	2.72	2.75	2.68
2021	0.56	1.04	0.85	1.52

Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

Appendix 3

Performance of Long-only portfolios based on COMP signal with various transaction costs assumptions

Figure 41. Long-only: Cumulative returns – Northbound

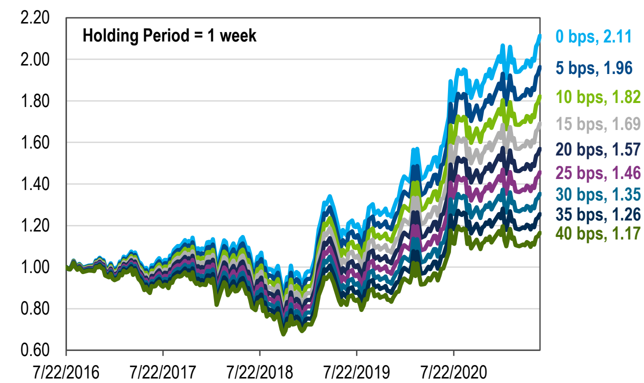


Figure 42. Long-only: Cumulative return – Southbound

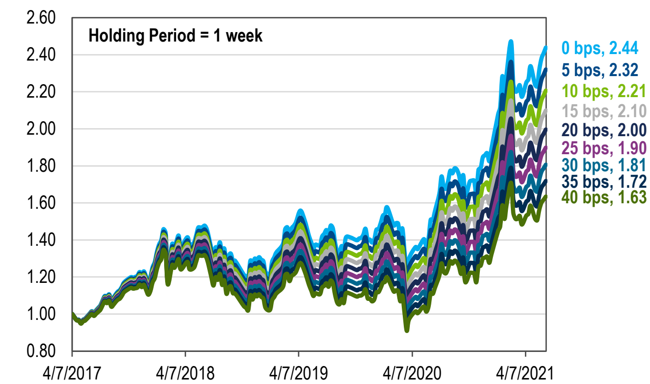


Figure 43. Long-only: Cumulative returns – Northbound

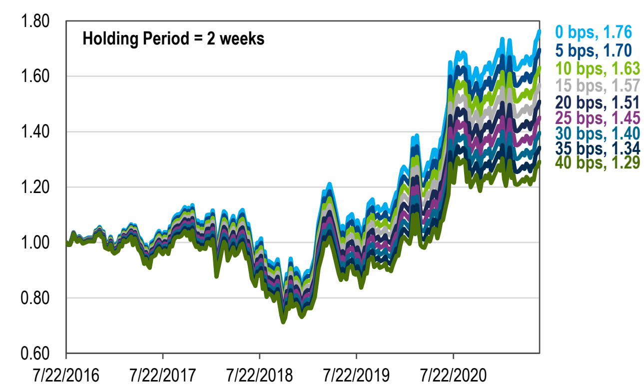


Figure 44. Long-only: Cumulative return – Southbound

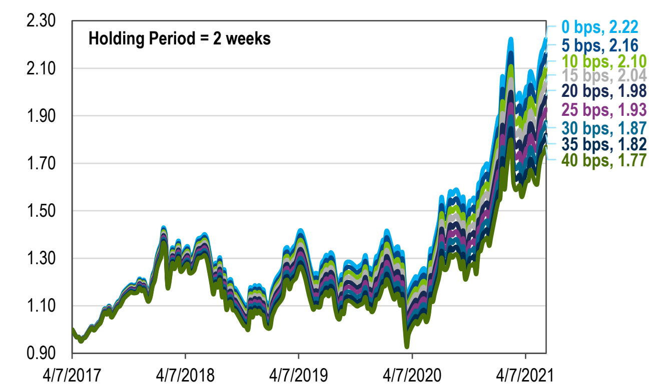


Figure 45. Long-only: Cumulative returns – Northbound

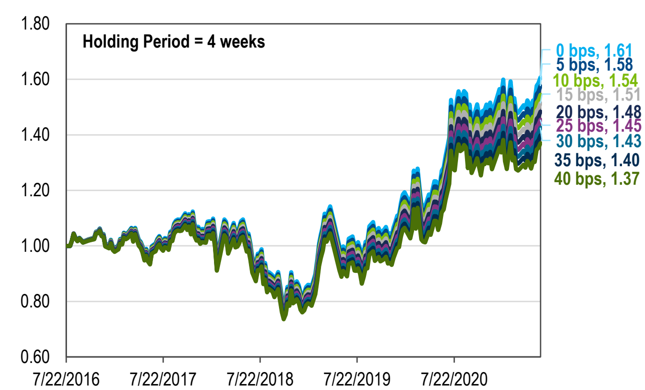
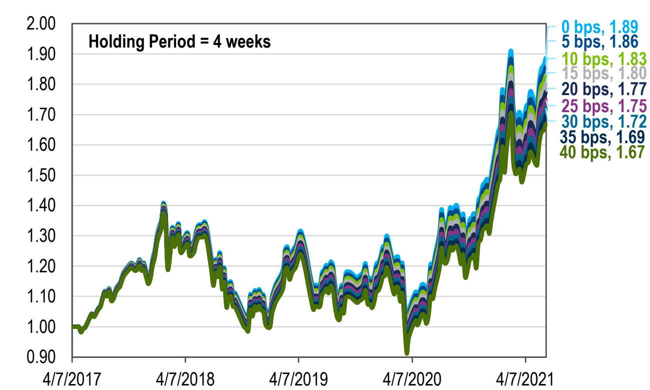


Figure 46. Long-only: Cumulative return – Southbound



Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

Appendix 4

Performance of Long-Bench portfolios based on COMP signal with various transaction costs assumptions

Note that the benchmark is the equal-weighted portfolio of the whole stock connect universe of each trading direction.

Figure 47. Long-Bench: Cumulative returns – Northbound

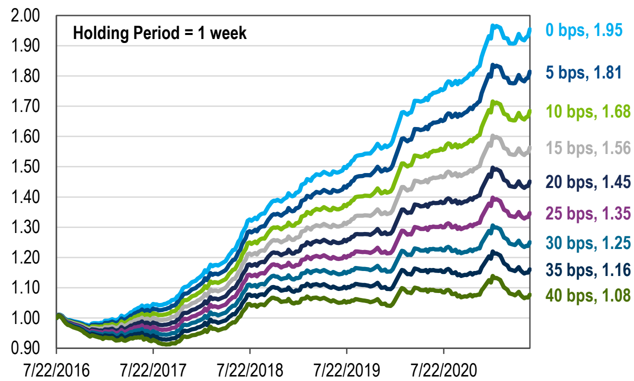


Figure 48. Long-Bench: Cumulative return – Southbound

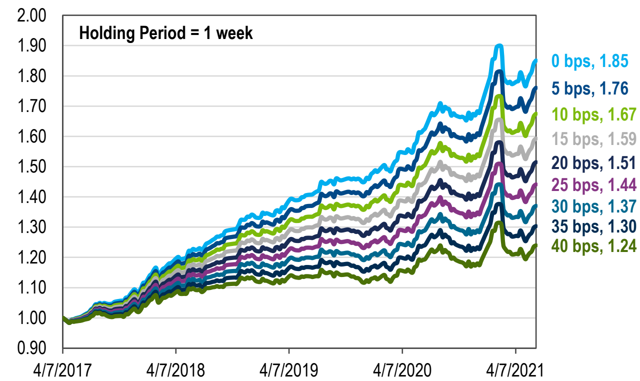


Figure 49. Long-Bench: Cumulative returns – Northbound

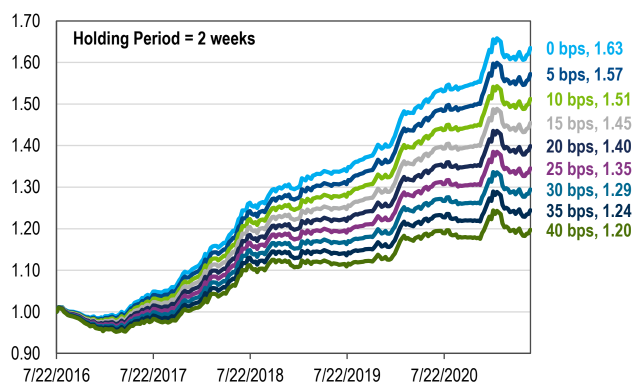


Figure 50. Long-Bench: Cumulative return – Southbound

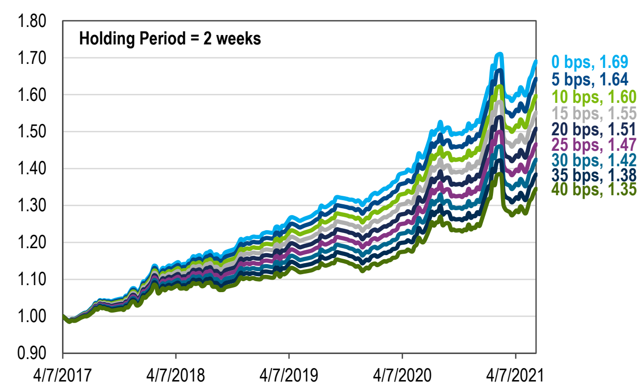


Figure 51. Long-Bench: Cumulative returns – Northbound

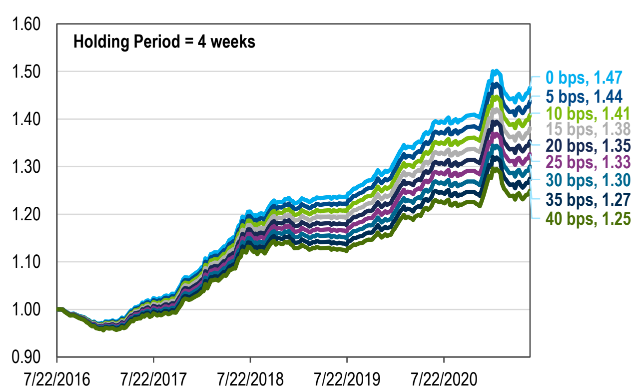
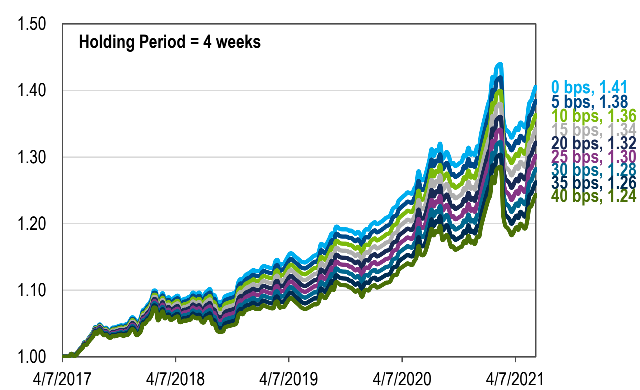


Figure 52. Long-Bench: Cumulative return – Southbound



Source: Citi Research, Wind, Backtest period of Northbound:7/22/2016 – 6/11/2021

Source: Citi Research, Wind, Backtest period of Southbound:4/7/2017 – 6/11/2021

Previously Published Research

Figure 53. Research Reports (since 2009)

Report	Date Published
Searching for Alpha: Pairs Trading – Applying Machine Learning to Pairs Trading	29-Mar-2021
Regime Modelling using Futures Positioning: Futures vs. Cash – A Distinct but Meaningful Relationship	09-Mar-2021
ESG Insights: The ESG 'Premium' – How does ESG compare to other Factors?	18-Feb-2021
Searching for Alpha: Asia Earnings Surprise – Predicting Asia Earnings Surprises	01-Feb-2021
ESG Insights: Where Machines do it Better – Inferred ESG Ratings Data	14-Jan-2021
Searching for Alpha: China A Alpha – Smoothing Price Momentum	30-Oct-2020
Under the Microscope: Overlapping Momentum	16-Oct-2020
Equity Markets Positioning Model – Introducing the EMP	14-Sep-2020
Searching for Alpha: Combining ESG and Risk Premia – A Double Screen Approach	11-Sep-2020
Searching for Alpha: Factoring Short Interest – Measuring and Profiting from Information in Shorts	8-Sep-2020
Searching for Alpha: Machine Learning – Attributing Higher-Order Interactions: SHAP Value as Factor Selection Criterion	28-May-2020
Searching for Alpha: Machine Learning – Leveraging Return Forecasts	28-Feb-2020
Searching for Alpha: China A Alpha - Sector-relative Value Is Powerful, Choose Sector Mappings Wisely	21-Feb-2020
Searching for Alpha: Machine Learning – Beyond Random Forests for Stock Selection	03-Oct-2019
Searching for Alpha: Earnings Surprise: Managing Expectations	23-Sep-2019
Searching for Alpha: Machine Learning – Interpreting Machine Learning Predictions	5-Mar-2019
Searching for Alpha: GAAP vs. Non-GAAP - Which Earnings does the Market Price?	7-Feb-2019
Searching for Alpha: Style Crowding in Asia - Getting Ahead of the Crowd	21-Nov-2018
Searching for Alpha: Earnings Surprise – Using Machine Learning to Forecast Earnings Surprises & Returns	17-Sep-2018
Searching for Alpha: The ESG Edge – A Step Forward	13-Sep-2018
Searching for Alpha: Machine Learning – Interacting Machine Learning and Factors	3-Sep-2018
Measuring the Crowded Trade: Introduction to our Crowding Composite for Individual Stocks	3-May-2018
Searching for Alpha: Profiting from Capex – Look to Capex Announcements	14-Mar-2018
Searching for Alpha: Tactical Style Rotation – Using Risk and Return to Manage Style Exposure	7-Sep-2017
Searching for Alpha: Big Data – Navigating New Alternative Datasets	10-Mar-2017
Searching for Alpha: Betting Against Accurate Beta	13-Feb-2017
Searching for Alpha: Competitive Advantage – Survival of the Fittest	19-Sep-2016
Searching for Alpha: Financial Strength Redux	9-Sep-2016
Searching for Alpha: Dynamic Style Weighting – Risk-Based Equity Style Allocation	14-Apr-2016
No Shorts Please: Long-Only Pure Style Portfolios	4-Mar-2016
Industry Alpha insights: Banks – One Size Does Not Fit All	18-Feb-2016
Under the Microscope: Stock Momentum Conflation	21 Sep-2015
Searching for Alpha: Macro Moves Markets	15-Sep-2015
Searching for Alpha: Style Performance, Trading Volumes and Investor Agreement	23-Mar-2015
World Radar Screen: Refining Our Global Search for Alpha	13-Mar-2015
Searching for Alpha: Networking with Analysts: Modelling Analyst Forecast Dependence	18-Feb-2015
The Rise of Low Risk Investing: Is it Getting Crowded Out There	01-Oct-2014
Under the Microscope: Five Innovations in Momentum Investing	27-Mar-2014
Searching for Alpha: Timing Price Momentum	07-Mar-2014
Equity Risk Premia Investing: A New Methodology For Monitoring Style Performance	27-Nov-2013
Stock Market Country Selection: Changes to a Well Established Model	23-Jul-2013
Searching for Alpha: Digging for Dividends – QUARI QUality with A Reliable Income	02-Jul-2013
Global Theme Machine: An Objective Way of Identifying Attractive Investment Themes	24-Jun-2013
Searching for Alpha: Purifying Analyst Recommendations – Removing Beta to get to the Alpha	25-Mar-2013
Searching for Alpha: Tangible Benefits of Intangibles – Brand, Respect & Intellectual Capital	06-Nov-2012
Low-Risk Portfolio Strategies: Sharpe Ratio Maximisation and Multi-Asset Applications	09-Mar-2012
Macro Risk and Style Rotation: A Guide Rather than a Prescription	28-Feb-2012
Searching for Alpha: Accruals Volatility – A New Approach to Quality Investing	14-Sep-2011
Industry Alpha Insights: Four Approaches to Tactical Industry Selection	24-Aug-2011
Industry Alpha Insights: Quantifying Industry Specific Fundamentals	17-Mar-2011
Low-Risk Equity Portfolios: More than just Minimum Variance	18-Nov-2010
Under the Microscope: Measuring Systemic Risk – The Absorption Ratio	15-Nov-2010
Under the Microscope: Optionality in Valuation	14-Jun-2010
Searching for Alpha: Earnings Surprise – Still Profiting from Surprises	31-Mar-2010
Searching for Alpha: Optimising Style Rotation Strategies	15-Oct-2009

Source: Citi Research

Citi Quant Research Team

Figure 54. Citi Quantitative Research Teams

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Appendix A-1

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	12 Month Rating			Catalyst Watch		
Data current as of 31 Mar 2021	**Buy**	**Hold**	**Sell**	**Buy**	**Hold**	**Sell**
Citi Research Global Fundamental Coverage (Neutral=Hold)	57%	35%	8%	25%	66%	9%
% of companies in each rating category that are investment banking clients	64%	64%	55%	67%	62%	69%
Citi Research Quantitative World Radar Screen Model Coverage	30%	40%	30%			
% of companies in each rating category that are investment banking clients	42%	33%	29%			
Citi Research Quantitative Latam Radar Screen Model Coverage	21%	59%	20%			
% of companies in each rating category that are investment banking clients	83%	66%	61%			
Citi Research Quantitative Asia Radar Screen Model Coverage	20%	60%	20%			
% of companies in each rating category that are investment banking clients	42%	29%	17%			
Citi Research Quantitative Australia Radar Screen Model Coverage	65%	0%	35%			
% of companies in each rating category that are investment banking clients	48%	0%	30%			

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