China Quantitative Strategy

Launching QuantRebalance: Identifying Opportunities from MSCI Lifting China A-shares' Inclusion Factor

QUANTWISE $\left[\begin{smallmatrix} q \\ w \end{smallmatrix}\right]$

We incorporate mathematical modeling with analysis of historical trading patterns to measure share price sensitivity to MSCI lifting China A-shares' inclusion factor. Our strategy aims to capture alpha opportunities that are neutral to market direction and macro risks.

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We incorporate mathematical modeling with analysis of historical trading patterns to measure share price sensitivity to MSCI lifting China A-shares' inclusion factor. Our strategy aims to capture alpha opportunities that are neutral to market direction and macro risks.

QuantRebalance: MSCI has announced that it will lift China A-shares' inclusion factor step-by-step in May, August, and November this year. Whilst this event's impact at the index level has been extensively discussed, we believe its implications at the cross-sectional stock level are not yet well understood, and see potential alpha opportunities. Our QuantRebalance trading strategies, in backtesting, have historically generated a +11% absolute return over the 3 months before MSCI actually implements its inclusion factor increase, and have also outperformed in the two MSCI China A-share implementations last year, as shown in **Exhibit 1**. In contrast, the conventional wisdom of buying the index closer to MSCI implementations has historically led to a slightly negative return, impaired by crowded trade positions and exposure to macro risks.

Our approach is unique and intended to be market-neutral. We first developed a mathematical model to help us understand the dynamics of how share prices react to passive fund inflows, and identify factors that in theory are effective. Next, we look at historical trading patterns, and the backtesting supports our mathematical model findings. Finally, our long-short strategies trade on the performance divergence between those stocks that are most and those stocks that are least impacted by the event.

Findings from QuantRebalance: 1) Stocks with lower *Relative Liquidity* (ADTV divided by free-float market cap) have been more positively impacted from passive fund inflows. 2) Stocks with lower *Volatility* and a narrower *High-to-low Price Spread* are more frequent

beneficiaries from passive fund inflows. 3) Stocks with high *Foreign Ownership* are more likely to outperform the index.

Stock implications: China A-shares with the highest and lowest sensitivity to the MSCI implementation in May 2019 in **Exhibit 4** and **Exhibit 5** .

Exhibit 1:

MS QuantRebalance versus Country Index Performance before MSCI Implements its Inclusion Factor Increase

Source: MSCI, Thomson Reuters, Rimes, Morgan Stanley Research. The portfolios are equal weighted. The performance data provided is a hypothetical illustration of mathematical principles; it does not predict or project the performance of an investment or investment strategy. Past performance is no guarantee of future results.

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Executive Summary

What we are trying to achieve

MSCI has announced that it will increase the weight of China A shares in the MSCI Indexes by lifting the inclusion factor from 5% to 20% in 3 steps this year - May 31st, August 31st, and November 30th. Whilst the operation's impact on the overall index level has been extensively discussed, its implications at the cross-sectional stock level are not yet well understood, in our view. We see potential alpha opportunities on the back of this event.

In this report, we combine analysis of prior trading patterns and mathematical modeling – QuantRebalance – to systematically identify these potential opportunities. In contrast to the conventional wisdom of buying the China A-share index ahead of this event, our trading strategy aims to be neutral to market direction and macro risks. Here we utilize a long/short strategy of the top versus bottom quintile stocks, ranked by sensitivity to MSCI inclusion. In **Exhibit 4** and **Exhibit 5** , we list the China A-shares with the highest and lowest sensitivity to the MSCI implementation in May 2019.

What We Have Done Differently?

Traditional quantitative studies, in general, backtest a large pool of factors, and then rely on statistical evidence to select the factors that go into the trading strategy.

Here, we adopt a different philosophy: we first construct a mathematical model to simulate the pricing dynamics, and then use the linear and nonlinear output of the mathematical model to identify the few factors that in theory are effective. Finally, we look at historical trading patterns to see whether they support our findings based on our mathematical model.

Exhibit 2:

MS QuantRebalance Trading Strategy: Key Performance Metrics

MS QuantRebalance *Trading Strategy* *Key Metrics*	**Average Return** *over the 3-month hoziron* *before MSCI rebalancing date* *1st Quintile - 5th Quintile*	**Hit Ratio** *# of historical precedents* *where QuantRebalance* *backtested return is pos+*
All historical precedents *in EM / Asia (17 cases)*	+ **11** %	**15** out of **17**
Major countries' precedents *in EM / Asia (9 cases)*	+ **12** %	**9** out of **9**

Source: MSCI, Thomson Reuters, Rimes, Morgan Stanley Research. The portfolios are equal weighted. The performance data provided is a hypothetical illustration of mathematical principles; it does not predict or project the performance of an investment or investment strategy. Past performance is no guarantee of future results.

The Conventional Wisdom

Why not simply buy the index? The conventional wisdom of buying the index before MSCI implementations is associated with significant risk, in our view.

1) Crowded trade: While many investors trade with similar positions at the same time, it ultimately leads to a race of who enters and exits the trade earlier than others.

2) Macro risks: Investors are also exposed to macro risks, whose impacts on market directions are not associated with the MSCI event. Indeed, our backtesting shows that average country index performance has been flat over the time horizon before MSCI actually implements its inclusion factor increase.

Time Horizons of Our Trading Strategy

We conduct our model backtesting based on trading the three-month time horizon before the MSCI's implementation of an inclusion factor increase (also in-line with the intervals for MSCI's A-share inclusions). In the following section of this report, we list the stock screens with the highest and lowest sensitivity to the MSCI inclusion factor increase based on our model, three-month before the May implementation.

However, we also see potential alpha opportunities to trade ahead of the August and November events this year applying QuantRebalance model. We will revisit our model later this year, reflecting the change of stock universe and factor inputs.

Exhibit 3:

Illustrations of the time horizons of our trading strategy versus MSCI China A shares weight increase timeline

Stocks within China A Shares	MSCI Inclusion Factor Increase		
China A Large Cap (ex ChiNext)	5% → 10%	10% → 15%	15% → 20%
ChiNext Largest Cap	0% → 10%	10% → 15%	15% → 20%
China A Mid Cap (ex ChiNext)			0% → 20%
ChiNext Mid Cap			0% → 20%

Source: MSCI, Morgan Stanley Research.

Stock Implications: Highest and Lowest Sensitivity to MSCI Inclusion Factor Increase in May 2019

We list China A-shares with the highest and lowest sensitivity, by quintile, to the MSCI inclusion factor increase implementation in May 2019. The stocks are ranked by their average daily traded value in both of the stock screens.

Exhibit 4:

China A Shares: Stocks with the Highest Sensitivity to MSCI Weight Increase in May 2019

#	Ticker	Company	GICS Sector	MS Stock Rating	MS Target Price Up/Downside	Price Last	ADTV Mn US$
1	600519.SS	KWEICHOW MOUTAI A (HK-C)	Consumer Staples	OW	14%	781.9	364
2	000858.SZ	WULIANGYE YIBIN A (HK-C)	Consumer Staples	EW	(25%)	77.3	256
3	600036.SS	CHINA MERCH BK A (HK-C)	Financials	OW	(5%)	32.7	203
4	000333.SZ	MIDEA GROUP CO A (HK-C)	Consumer Discretionary	EW	(10%)	49.0	192
5	600276.SS	JIANGSU HENGRUI A (HK-C)	Health Care	OW	22%	72.3	189
6	000002.SZ	CHINA VANKE CO A (HK-C)	Real Estate	EW	(4%)	29.7	175
7	002415.SS	HANGZHOU HIKVIS A (HK-C)	Information Technology	OW	(3%)	36.0	156
8	000887.SZ	INNER MONGOL YIL A(HK-C)	Consumer Staples	OW	7%	28.0	134
9	600585.SS	ANHUI CONCH A (HK-C)	Materials	OW	32%	37.2	114
10	600104.SS	SAIC MOTOR CORP A (HK-C)	Consumer Discretionary	EW	5%	28.5	111
11	601888.SS	CHINA INTL TRVL A (HK-C)	Consumer Discretionary	EW	7%	63.7	85
12	002304.SZ	JIANGSU YANGHE A (HK-C)	Consumer Staples	OW	8%	120.8	85
13	600690.SS	QINGDAO HAIER A (HK-C)	Consumer Discretionary	EW	(14%)	17.4	69
14	601988.SS	BANK OF CHINA A (HK-C)	Financials	OW	7%	3.9	68
15	600029.SS	CHINA STH AIRL A (HK-C)	Industrials	EW	(18%)	8.4	65
16	002714.SZ	MUYUAN FOODSTUFF A(HK-C)	Consumer Staples	-	-	50.6	64
17	000538.SZ	YUNNAN BAIYAO A (HK-C)	Health Care	EW	24%	89.0	51
18	000895.SZ	HENAN SHUANGHUI A (HK-C)	Consumer Staples	EW	4%	25.1	46
19	600406.SS	NARI TECHNOLOGY A (HK-C)	Industrials	OW	2%	19.2	45
20	600019.SS	BAOSHAN IRON A (HK-C)	Materials	OW	13%	7.7	45
21	600009.SS	SHANGHAI INTL AI A(HK-C)	Industrials	OW	10%	58.9	45
22	600900.SS	CHINA YANGTZE A (HK-C)	Utilities	OW	11%	16.3	41
23	600000.SS	SHANGHAI PUDONG A (HK-C)	Financials	EW	(6%)	12.0	41
24	002142.SZ	BANK OF NINGBO A (HK-C)	Financials	-	-	19.9	38
25	601006.SS	DAQIN RAILWAY A (HK-C)	Industrials	OW	45%	8.9	34
26	600660.SS	FUYAO GROUP A (HK-C)	Consumer Discretionary	EW	(12%)	25.0	29
27	601169.SS	BANK OF BEIJING A (HK-C)	Financials	-	-	6.6	29
28	600606.SS	GREENLAND HLDGS A (HK-C)	Real Estate	-	-	7.2	29
29	603288.SS	FOSHAN HAITIAN A (HK-C)	Consumer Staples	EW	(16%)	78.6	28
30	600741.SS	HUAYU AUTO SYS A (HK-C)	Consumer Discretionary	OW	14%	21.1	27
31	600886.SS	SDIC POWER HLDGS A(HK-C)	Utilities	-	-	8.2	27
32	600066.SS	ZHENGZHOU YUTON A (HK-C)	Industrials	EW	(11%)	14.1	22
33	600808.SS	MAANSHAN IRON A (HK-C)	Materials	OW	11%	4.0	20
34	000656.SZ	JINKE PPTY GRP A (HK-C)	Real Estate	-	-	6.2	14
35	000581.SZ	WEIFU HIGH-TECH A (HK-C)	Consumer Discretionary	-	-	21.4	14
36	601021.SS	SPRING AIRLINES A (HK-C)	Industrials	OW	17%	35.7	14
37	600674.SS	SICHUAN CHUANT A (HK-C)	Utilities	EW	(14%)	9.3	12
38	601098.SS	CHINA STH PUBL A (HK-C)	Communication Services	-	-	13.6	11
39	600999.SS	CHINA RES SANJIU A(HK-C)	Health Care	OW	30%	26.1	11
40	600583.SS	OFFSHORE OIL A (HK-C)	Energy	OW	(1%)	6.1	11
41	002563.SZ	ZHEJIANG SEMIR A (HK-C)	Consumer Discretionary	-	-	10.5	10
42	603833.SS	OPPEIN HOME GRP A (HK-C)	Consumer Discretionary	-	-	101.9	9
43	600023.SS	ZHEJIANG ZHENENG A(HK-C)	Utilities	-	-	4.9	9
44	002493.SZ	RONGSHENG PETRO A (HK-C)	Materials	EW	(19%)	11.4	9
45	600018.SS	SHANGHAI INTL PO A(HK-C)	Industrials	EW	18%	6.1	8
46	600688.SS	SINOPEC SHANGHAI A(HK-C)	Materials	UW	(52%)	5.5	7
47	600642.SS	SHENERGY CO A (HK-C)	Utilities	-	-	5.5	6
48	600998.SS	JOINTOWN PHARMA A (HK-C)	Health Care	EW	28%	15.6	5

Source: MSCI, Rimes, Morgan Stanley Research. Data as of March 4, 2019. For important disclosures regarding companies that are the subject of this screen, please see the Morgan Stanley Research Disclosure Website at www.morganstanley.com/researchdisclosures.

Exhibit 5:

China A Shares: Stocks with the Lowest Sensitivity to MSCI Weight Increase in May 2019

#	Ticker	Company	GICS Sector	MS Stock Rating	MS Target Price Up/Downside	Price Last	ADTV Mn US$
1	600030.SS	CITIC SECURITIES A(HK-C)	Financials	UW	(41%)	24.5	442
2	000725.SZ	BOE TECH GROUP A (HK-C)	Information Technology	OW	(21%)	4.3	426
3	000063.SZ	ZTE CORP A (HK-C)	Information Technology	-	-	30.3	377
4	002230.SZ	IFLYTEK CO A (HK-C)	Information Technology	UW	(41%)	36.9	177
5	600518.SS	KANGMEI PHARMA A (HK-C)	Health Care	-	-	11.2	159
6	603799.SS	ZHEJIANG HUAYOU A (HK-C)	Materials	-	-	38.5	140
7	002456.SS	O FILM TECH CO A (HK-C)	Information Technology	UW	(44%)	14.2	138
8	600570.SS	HUNDSUN TECH A (HK-C)	Information Technology	-	-	88.3	133
9	600516.SS	FANGDA CARBON A (HK-C)	Industrials	-	-	22.7	117
10	600487.SS	HENGTONG OPTIC A (HK-C)	Information Technology	-	-	22.0	114
11	002797.SZ	FIRST CAPITAL A (HK-C)	Financials	-	-	7.7	107
12	600837.SS	HAITONG SEC A (HK-C)	Financials	UW	(38%)	13.1	106
13	000050.SZ	TIANMA MICROELE A (HK-C)	Information Technology	UW	(33%)	16.2	105
14	002460.SZ	JIANGXI GANFENG A (HK-C)	Materials	-	-	27.2	100
15	000776.SZ	GF SECURITIES A (HK-C)	Financials	UW	(36%)	17.1	99
16	601108.SS	CAITONG SEC A (HK-C)	Financials	-	-	10.8	95
17	000413.SZ	DONGXU OPTOELEC A (HK-C)	Information Technology	-	-	5.8	74
18	601377.SS	INDUSTRIAL SEC A (HK-C)	Financials	-	-	7.1	71
19	601111.SS	AIR CHINA A (HK-C)	Industrials	EW	(7%)	9.9	67
20	000100.SZ	TCL CORP A (HK-C)	Consumer Discretionary	-	-	3.5	63
21	600958.SS	ORIENT SEC CO A (HK-C)	Financials	-	-	12.8	61
22	601788.SS	EVERBRIGHT SEC A (HK-C)	Financials	-	-	13.7	54
23	002195.SZ	SHANGHAI 2345 A (HK-C)	Information Technology	-	-	4.9	52
24	600816.SS	ANXIN TRUST CO A (HK-C)	Financials	-	-	7.8	50
25	600111.SS	CHINA NORTHERN A (HK-C)	Materials	-	-	10.9	47
26	002673.SZ	WESTERN SEC CO A (HK-C)	Financials	-	-	10.6	47
27	002202.SZ	XINJIANG GOLDW A (HK-C)	Industrials	UW	(21%)	14.6	46
28	600109.SS	SINOLINK SEC CO A (HK-C)	Financials	-	-	10.2	46
29	000166.SZ	SHENWAN HONGY A (HK-C)	Financials	-	-	5.7	43
30	000728.SZ	GUOYUAN SEC CO A (HK-C)	Financials	-	-	9.9	41
31	000783.SZ	CHANGJIANG SEC A (HK-C)	Financials	-	-	7.4	41
32	002926.SZ	HUAXI SECURITIES A(HK-C)	Financials	-	-	11.2	40
33	601800.SS	CHINA COMMU CON A (HK-C)	Industrials	EW	12%	12.6	40
34	600705.SS	AVIC CAPITAL CO A (HK-C)	Financials	-	-	6.1	37
35	601198.SS	DONGXING SEC CO A (HK-C)	Financials	-	-	13.6	36
36	600839.SZ	CITIC GUOAN INF A (HK-C)	Communication Services	-	-	4.8	34
37	002500.SZ	SHANXI SEC CO A (HK-C)	Financials	-	-	8.4	34
38	002465.SZ	GUANGZHOU HAIGE A (HK-C)	Information Technology	OW	32%	9.8	33
39	600188.SS	YANZHOU COAL A (HK-C)	Energy	-	-	10.8	31
40	600362.SS	JIANGXI COPPER A (HK-C)	Materials	UW	(37%)	15.9	29
41	600061.SS	SDIC CAPITAL CO A (HK-C)	Financials	-	-	13.6	29
42	600118.SS	CHINA SPACESAT A (HK-C)	Industrials	-	-	22.6	27
43	600256.SS	GUANGHUI ENER A (HK-C)	Energy	OW	24%	4.3	27
44	600739.SS	LIAONING CHENG A (HK-C)	Consumer Discretionary	-	-	14.0	26
45	600909.SS	HUAAN SECURITIES A(HK-C)	Financials	-	-	6.7	25
46	601997.SS	BANK OF GUIYANG A (HK-C)	Financials	-	-	13.6	23

Source: MSCI, Rimes, Morgan Stanley Research. Data as of March 4, 2019. For important disclosures regarding companies that are the subject of this screen, please see the Morgan Stanley Research Disclosure Website at www.morganstanley.com/researchdisclosures.

Factor Selection and Mathematical Modeling: A One-page Overview

Factors that are included in the QuantRebalance strategy:

1. Relative Liquidity (lower is preferred): the trailing 3-month ADTV divided by free-float market cap (adjusted by the delta of inclusion factor increase).

2. High-Low Price Spread (lower is preferred): the 3-month average of intraday high-to-low price spread.

3. Price Volatility (lower is preferred): the trailing 3-month daily price volatility.

4. Foreign Ownership (higher is preferred, and only applied to China A-shares): defined as the % of free-float outstanding shares owned through Shanghai-Hong Kong and Shenzhen-Hong Kong Stock Connect and QFII.

Exhibit 6:

QuantRebalance Factor Efficacies versus Conventional Wisdom: Average Returns Over the 3-month Horizon before MSCI Country Inclusion or Weight Increase
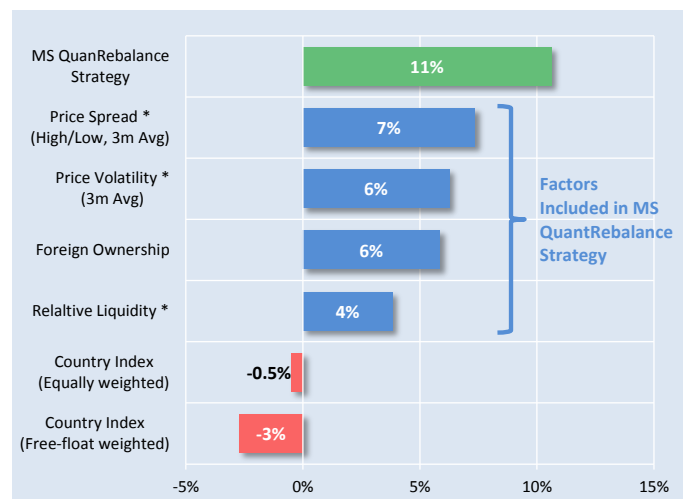
Source: MSCI, Rimes, Morgan Stanley Research.

We endeavor to simulate the impact of passive fund inflows on a share price by looking at the distribution of the potential buyers and sellers of the stock as a function of the share price. In **Exhibit 7** , we define P as the stock's share price and V as the volume, and we assume $B(P)$ as the potential volume of buyers of the stock at price P, and $S(P)$ as the potential volume of sellers of the stock at price P.

Conclusion from our mathematical model: The square of share price return is proportionate to the amount of 1) passive fund inflows, and inversely proportionate to 2) liquidity of the stock, 3) curvature of the volume-price distribution curve, and 4) price spread between the buyers and sellers.

Exhibit 7:

Illustration of our mathematical model: Simulation of the impact of passive flow on share price movement
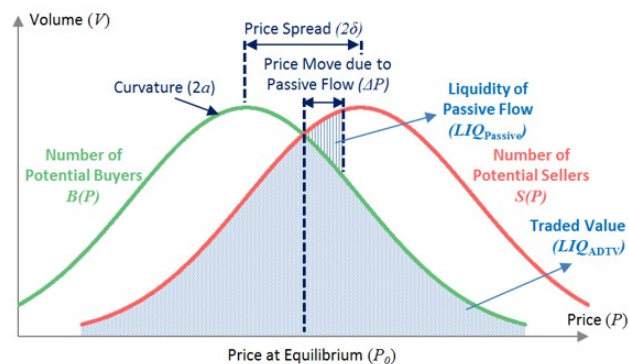
Mathematical Equations that Describe the Price Dynamics of BOJ

$$LIQ_{Passive} = \int_{P_0}^{P_0+\Delta P} \{S(P) - B(P)\}dP$$

$$LIQ_{ADTV} = \int \min\{S(P), B(P)\}\,dP$$

Solution to the Equation Set

$$\Delta^2 \propto \frac{LIQ_{Passive}}{LIQ_{ADTV}}\frac{1}{a\delta}$$

Source: Morgan Stanley Research.

QuantRebalance I: Model Development and Performance

Model Overview

- Objective: In this report, we introduce QuantRebalance, a Morgan Stanley proprietary trading strategy that aims to identify China domestic stocks with the highest and lowest sensitivity to the upcoming MSCI inclusion factor increase.

- Inputs of the model include four factors: 1) Relative Liquidity (ADTV / Free-float); 2) Price Volatility; 3) Price Spread (High-to-Low); and 4) Foreign Ownership.

- Outputs of the model are the rankings of China domestic stocks on the basis of their share price sensitivity to MSCI inclusion factor increase.

- Universe selection: We use the pro forma MSCI China A Large Cap Index constituent list provided by MSCI. As of the date of publication, there are 253 constituent stocks in the MSCI China A Large Cap Index.

- Forecast horizon: Our strategy has shown to be effective over three-month time horizon before the MSCI implementation time.

- Factor weighting: All factors are equally weighted. We intentionally choose not to try optimize our performance through factor weightings, which may raise concerns of 'data overfitting'.

Exhibit 8:

QuantRebalance Model Methodology

QuantRebalance Methodology

Step 1: Mathematical Modeling
We construct a mathematical model to simulate the impact of MSCI country index rebalancing on a share price, and solve the equations under both linear and non-linear approximations.

Step 2: Factor Identification
We then identify factors that in theory are effective, leveraging on the understanding sourced from the mathematical modeling.

Step 3: Historical Backtesting
We then use backtesting to determine our findings based on our mathematical model. We look at historical trading patterns in all the 17 historical precedents of MSCI country inclusion or weight increase.

Step 4: Stock Screening
Stocks are systematically ranked based on our multi-factor model.

Stock Screen of Highest Sensitiviy
(Stocks ranked in the top quintile of the QuantRebalance model)

Stock Screen of Lowest Sensitiviy
(Stocks ranked in the bottom quintile of the QuantRebalance model)

Source: Morgan Stanley Research.

Historical Precedents

- Model backtesting time horizon: We analyze a total sample size of 17 historical events since 1996, where MSCI increased a country's inclusion factor in its regional indices. In particular, the overall back-testing horizon is a combination of two different sample sets, detailed as follows.

- Sample Subset #1: Country index inclusion factor increase with a large number of stocks that were affected (>50): these events are more ideal for our long-short trading strategies to be tested.
- Sample Subset #2: Country index inclusion factor increase with a smaller number of stocks that were affected (<30): these events are less ideal for our long-short trading strategies to be tested.

Exhibit 9:

Historical Precedents of MSCI Country Inclusion Factor Increase in Emerging Markets since 1996

#	Country	Index inclusion or weight increase date	# of stocks within the index*	Comments
Subset #1: Country index inclusion factor increase with a large number of stocks that were affected (>50)				
1	China A	31-Aug-18	225	Inclusion factor from 2.5% to 5%
2	China A	31-May-18	226	Inclusion factor from 0% to 2.5%
3	Taiwan	3-Jun-02	90	Inclusion factor from 80% to 100%
4	Taiwan	1-Dec-00	75	Inclusion factor from 65% to 80%
5	Taiwan	1-Jun-00	76	Inclusion factor from 50% to 65%
6	Malaysia	1-Jun-00	74	One-step country index inclusion
7	Korea	1-Sep-98	108	Inclusion factor from 50% to 100%
8	Korea	3-Sep-96	115	Inclusion factor from 20% to 50%
9	Taiwan	3-Sep-96	78	Inclusion factor from 0% to 50%
Subset #2: Country index inclusion factor increase with a small number of stocks that were affected (<30)				
10	Pakistan	1-Jun-17	16	One-step country index inclusion
11	Qatar	2-Jun-14	13	One-step country index inclusion
12	UAE	2-Jun-14	10	One-step country index inclusion
13	Egypt	1-Jun-01	15	One-step country index inclusion
14	Russia	1-Dec-97	14	One-step country index inclusion
15	Czech	3-Sep-96	21	One-step country index inclusion
16	Hungary	3-Sep-96	9	One-step country index inclusion
17	China	3-Sep-96	24	One-step country index inclusion

Source: MSCI, Morgan Stanley Research.

QuantRebalance versus Conventional Wisdom

We show in **Exhibit 10** the QuantRebalance backtested performance, based on the long/short returns of the top versus bottom quintile. On average, QuantRebalance has delivered a +11% return over the 3-month time horizon before MSCI implementing inclusion factor increase. Moreover, we have also overlaid the QuantRebalance performance in major countries' events, where there were a large number of stocks in the universe at the time: QuantRebalance has delivered a positive return in all nine cases.

In contrast, the conventional wisdom of buying the index before MSCI implementations have been associated with tremendous risks,

as shown in **Exhibit 11** . In particular, in our view, there are two key risks: **1) Crowded trade:** While many investors trade with similar positions at the same time, it ultimately leads to a race of who enters and exits the trade earlier than others. **2) Macro risks:** investors are also exposed to macro risks, whose impacts on market directions are not associated with the MSCI event.

We show in **Exhibit 12** and **Exhibit 13** the backtested performance of our MS QuantRebalance factor efficacies versus conventional wisdom. By individual QuantRebalance factors, the top quintile stocks have outperformed their bottom quintile peers by 4-7ppts over the 3-month time horizon before the MSCI's implementing inclusion factor increase.

Exhibit 10:

MS QuantRebalance Trading Strategy Backtested Performance (Q1-Q5) in Historical Precedents*
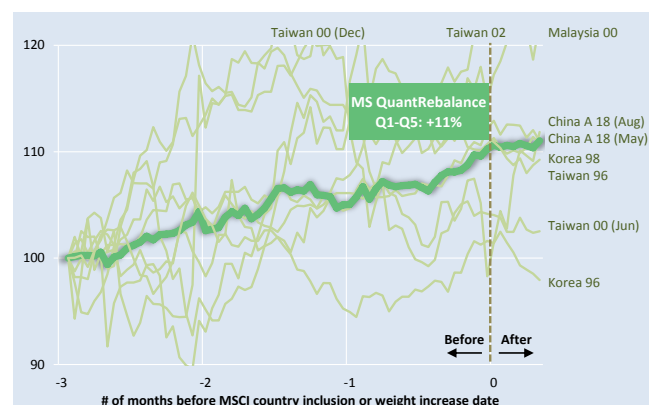
Source: MSCI, Rimes, Morgan Stanley Research. *We take the average of all 17 historical precedents to calculate the mean performance.

Exhibit 11:

Country Index Performance in Historical Precedents*
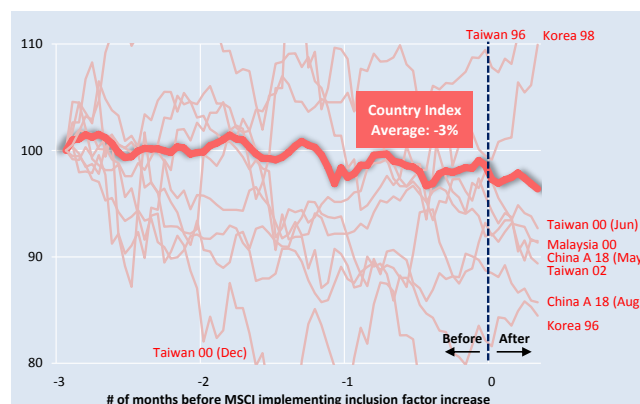
Source: MSCI, Rimes, Morgan Stanley Research. *We take the average of all 17 historical precedents to calculate the mean performance.

Exhibit 12:

QuantRebalance Factor Efficacies versus Conventional Wisdom in All Historical Precedents

Source: MSCI, Rimes, Morgan Stanley Research. The factor performances are the long/short factor returns of the top versus bottom quintile, over the 3-month time horizon before the MSCI inclusion factor increase. *Lower value is preferred. ^Foreign ownership is only applied to the prior China A-shares MSCI events.

Exhibit 13:

QuantRebalance Factor Efficacies versus Conventional Wisdom in Major Countries' Events
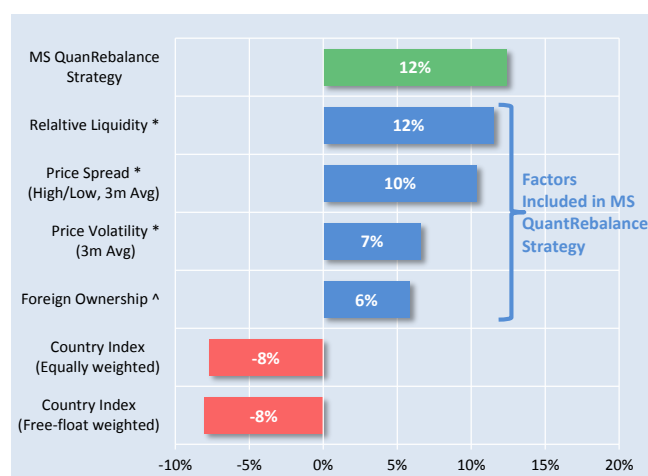
Source: MSCI, Rimes, Morgan Stanley Research. The factor performances are the long/short factor returns of the top versus bottom quintile, over the 3-month time horizon before the MSCI inclusion factor increase. *Lower value is preferred. ^Foreign ownership is only applied to the prior China A-shares MSCI events.

Robustness Check #1: Backtested Performance ranked by Quintiles

We show in **Exhibit 14** the QuantRebalance backtested performance, based on the long/short returns of the top quintile versus country index. On average, the top quintile stocks have outperformed the country index by +6% over the 3-month time horizon before the MSCI inclusion factor increase.

Exhibit 14:

MS QuantRebalance Trading Strategy Backtested Performance (Q1-Index) in Historical Precedents*
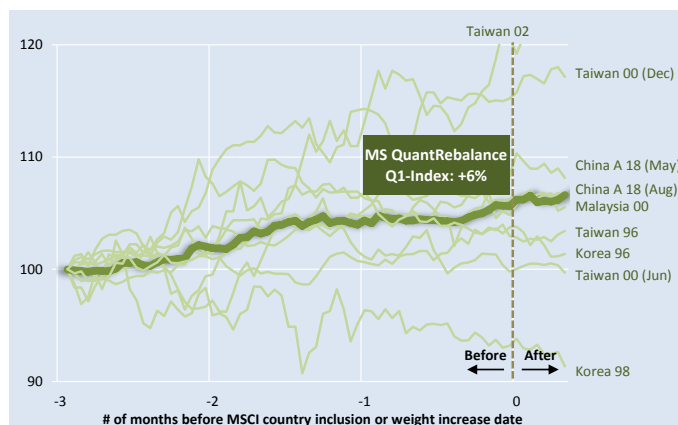
Source: MSCI, Rimes, Morgan Stanley Research. *We take the average of all 17 historical precedents to calculate the mean performance.

Exhibit 15:

QuantRebalance Performance by Quintile
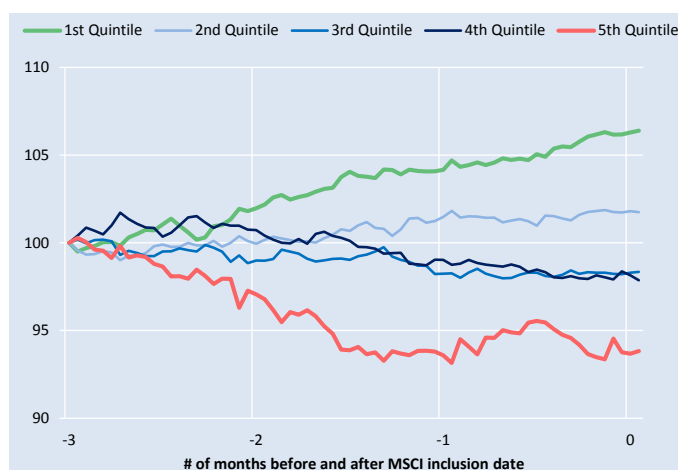
Source: MSCI, Rimes, Morgan Stanley Research. The factor performances are the long/short factor returns of the quintile group of stocks versus median stock returns, over the 3-month time horizon before the MSCI inclusion factor increase.

Robustness Check #2: Backtested Performance Adjusted For Market Impact

We show in **Exhibit 16** the QuantRebalance performance (Q1-Q5) versus its country index returns over the 3-month time horizon before MSCI inclusion factor increases. The QuantRebalance's historical performance has a slightly negative correlation with an R-squared of 24%. Within the QuantRebalance factors, both the low volatility factor and the narrow high-to-low price spread factors tend to generate outperformance when market is down. However, market impacts, overall, only explain less than a quarter of the alpha generated by QuantRebalance.

Exhibit 16:

QuantRebalance Performance (Q1-Q5) versus Country Index Returns

Source: MSCI, Rimes, Morgan Stanley Research. The factor performances are the long/short factor returns of the top versus bottom quintile, over the 3-month time horizon before the MSCI inclusion factor increase.

Exhibit 17:

QuantRebalance Performance (Q1-Index) versus Country Index Returns

Source: MSCI, Rimes, Morgan Stanley Research. The factor performances are the long/short factor returns of the top versus bottom quintile, over the 3-month time horizon before the MSCI inclusion factor increase.

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QuantRebalance II: Factors that Gauge Share Price Sensitivity to MSCI Implementing Inclusion Factor Increase

Relative Liquidity

Regarding the liquidity factor, the Average Daily Trading Volume (ADTV) is the most commonly used financial metric, which tracks the liquidity of the average daily traded volume (e.g., over the last 3 months). In theory, stocks with lower liquidity are more sensitive to

passive flow per unit of liquidity, but on the other hand they also receive lower amounts of liquidity due to their smaller weight in the index. We divide ADTV by free-float market cap to measure the size-adjusted relative liquidity.

There are stock outliers in relation to 'Relative Liquidity' irrespective of its absolute liquidity. We plot in **Exhibit 19** and **Exhibit 20** the scatter chart of stock liquidity (ADTV) versus free-flow market cap amongst all China domestic stocks, where we overlaid the lines that correspond to the 10th percentile and 90th percentile relative liquidity on the same log-log charts. The distance between the two lines dictates the effective spread of relative liquidity stocks, and the outliers are those stocks that lie below the green line (with low Relative Liquidity) and above the red line (with high Relative Liquidity).

Exhibit 18:

Definition of Relative Liquidity (Lower is Preferred in QuantRebalance)

$$\text{Relative Liquidity} = \frac{\text{Average Daily Traded Value}}{\text{Market Cap}_{\text{Free-float}} \times \delta_{\text{Inclusion Factor}}} \propto \frac{\text{Liquidity}_{\text{ADTV}}}{\text{Liquidity}_{\text{Passive}}}$$

Source: Morgan Stanley Research

Exhibit 19:

MSCI China A: Scatter Chart of Stock Liquidity (ADTV) versus Free-flow Market Cap, Present

Source: MSCI, Thomson Reuters, Rimes, Morgan Stanley Research. Data as of March 1st, 2019.

Exhibit 20:

MSCI China A: Scatter Chart of Stock Liquidity (ADTV) versus Free-flow Market Cap, One-year Ago
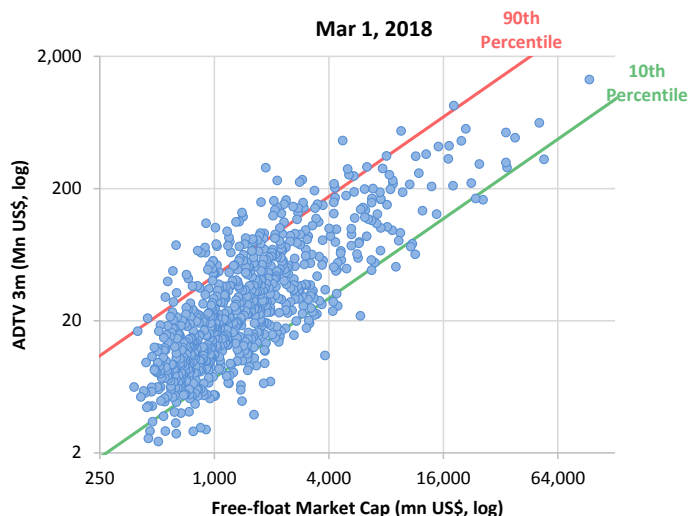
Source: MSCI, Thomson Reuters, Rimes, Morgan Stanley Research. Data as of March 1st, 2018.

Lower-Volatility & Narrower High-Low Price-Spread

The intuitive explanation — Lower-volatility and/or narrower-price-spread stocks imply that the stocks contain less company-specific swing factors (e.g., news flows, earnings volatility, etc.). In other words, to the 'signal' of passive fund inflows, these stocks are associated with less company-specific 'noise'. Hence, the 'signal-to-noise' ratio would be higher, all other parameters being equivalent.

The mathematical explanation — We have identified these two factors as a result of our mathematical modeling. Our mathematical models show that these two factors are directly correlated with stocks' sensitivity to passive fund inflows. For details of mathematical deduction, please see the **QuantRebalance IV: Mathematical Modeling and Solutions** . In particular, we show in **Exhibit 21** and **Exhibit 22** the illustration of how stocks having higher volatility is related to a steeper selling pressure and hence a lower sensitivity to passive fund inflows, and vice versa.

Exhibit 21:
Illustration of how higher volatility is related to a steeper selling pressure and hence a lower sensitivity to MSCI flow
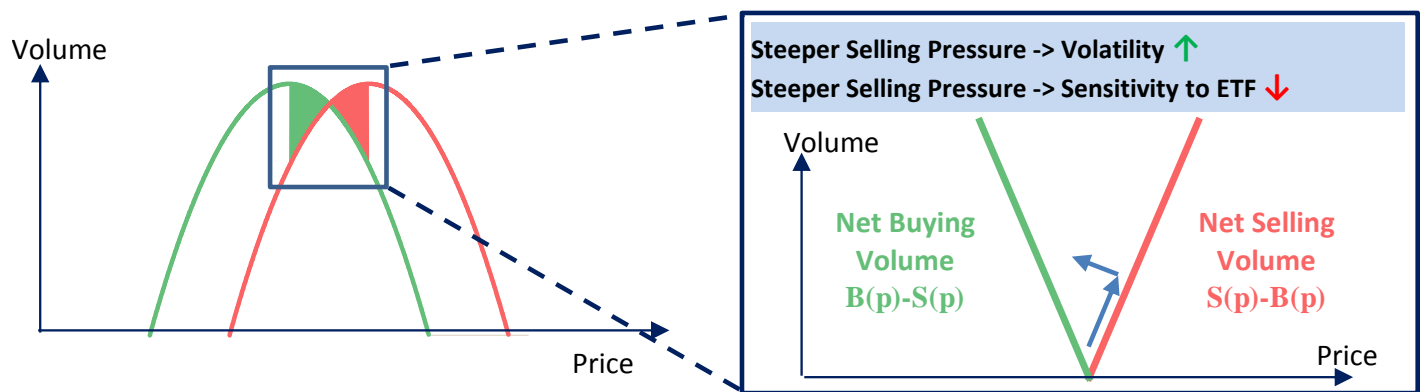
Source: Morgan Stanley Research

Exhibit 22:
Illustration of how lower volatility is related to a flatter selling pressure and hence a lower sensitivity to MSCI flow
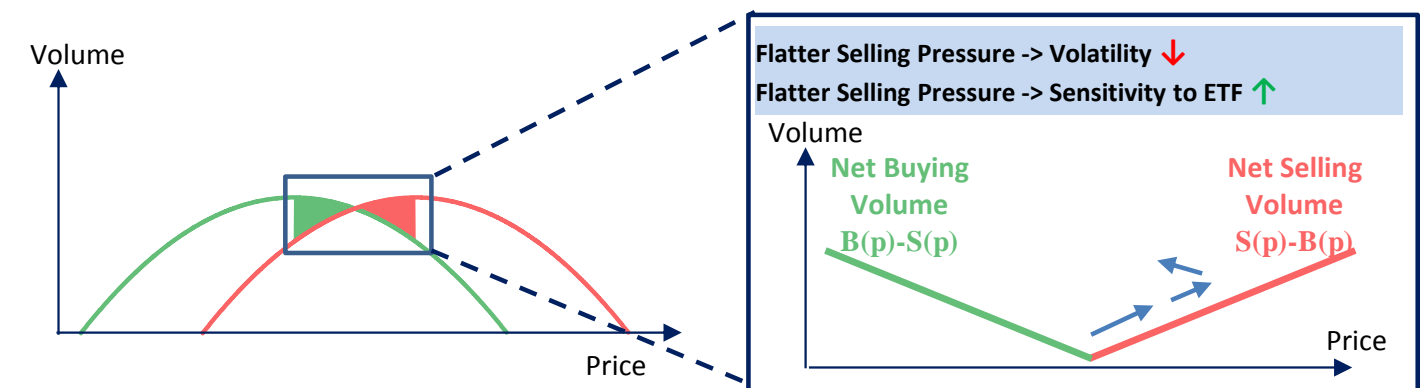
Source: Morgan Stanley Research

China A-Shares' Foreign Ownership

China A-shares with high foreign ownership are more likely to outperform index, as active long-only fund managers likely adjust their portfolios' tracking error in light of MSCI rebalancing, i.e., increase holdings of the top China A-shares they already own.

We show in **Exhibit 23** and **Exhibit 24** the performance divergence of China A-shares between those stocks with high foreign ownership versus those with low foreign ownership.

Foreign investors have a concentrated holdings amongst China A-shares. We have constructed a database tracking the foreign holding through the daily Northbound Stock Connect data and quarterly QFII filing. Next, we assess the foreign holding as a percentage of the total tradeable shares and apply a threshold of 10% shareholding, above which we define as 'high foreign ownership' categories. As of date of this publication, the QFII holding percentage has not been disclosed, thus we look at the latest disclosed numbers as of the end of third quarter in 2018. As shown in **Exhibit 25**, foreign holdings are concentrated in the few stocks each sector (except in Real Estate and Energy where there are no stocks with foreign ownership above 10%).

Exhibit 23:

China A-shares Performance Before MSCI Implementation of Inclusion Factor Increase in May 2018: High vs. Low Foreign Ownership

Source: Wind, Thomson Reuters, Datastream, Morgan Stanley Research.

Exhibit 24:

China A-shares Performance Before MSCI Implementation of Inclusion Factor Increase in August 2018: High vs. Low Foreign Ownership
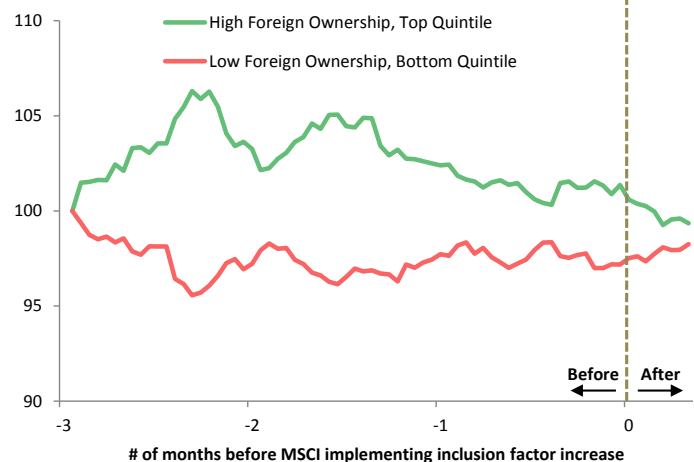
Source: Wind, Thomson Reuters, Datastream, Morgan Stanley Research.

Exhibit 25:

Number of stocks in high and low foreign ownership categories
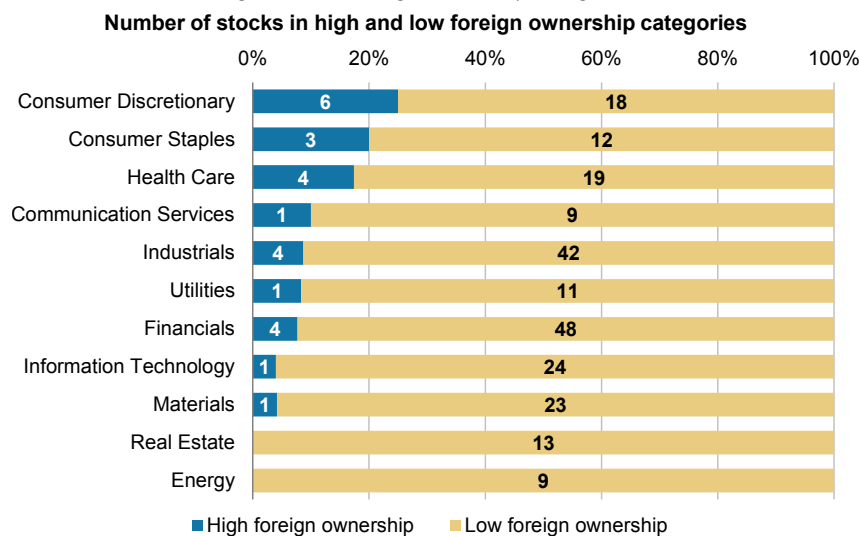
Source: Wind, Thomson Reuters, Datastream, Morgan Stanley Research. Data as of March 1, 2019. We assess the foreign holding as a percentage of the total tradeable shares and apply a threshold of 10% shareholding, above which we define as 'high foreign ownership' categories.

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QuantRebalance III: Our Analysis on Foreign Ownership of China A-shares

Key conclusion

Foreign investors tend to hold the China A-shares with a higher ROE than its sector peers in all sectors. However, these stocks do not necessarily trade at a higher valuation premium versus their sectors peers.

Exhibit 26:

Market cap composition in high and low foreign ownership categories

Market cap composition in high and low foreign ownership categories

■ High foreign ownership ■ Low foreign ownership
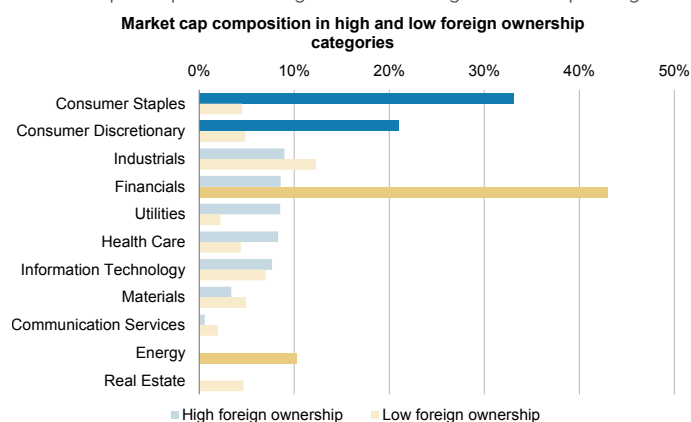
Source: Wind, Thomson Reuters, Datastream, Morgan Stanley Research. Market cap as of Feb. 28, 2019.

Sector Skew

High foreign ownership categories are overweight in the Consumer Discretionary, Consumer Staples, Health Care, and Utilities sectors, as shown in **Exhibit 26**, and in contrast, are underweight in the Financials, Energy, and Real Estate sectors.

Exhibit 27:

Equally-weighted composition in high and low foreign ownership categories

Sector composition in high and low foreign ownership categories

■ High foreign ownership ■ Low foreign ownership
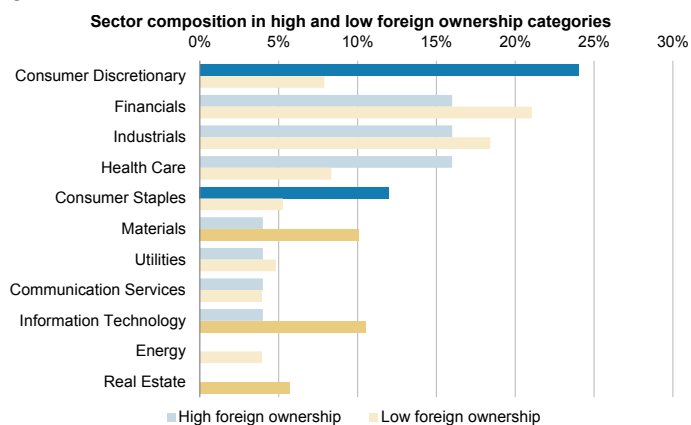
Source: Wind, Thomson Reuters, Datastream, Morgan Stanley Research

ROE, Valuation and Growth Skew

Stocks of high foreign ownership tend to have a higher ROE compared to their sector peers, as shown in **Exhibit 28** . And interestingly, the valuation comparison is mixed in the four sectors where data is available. We do note that stocks of high foreign ownership generally have a narrower valuation range versus stocks of low foreign ownership.

In **Exhibit 30** , we show the correlation between P/E valuation versus long-term growth rate. It appears that high foreign ownership categories show a more direct relationship between P/E valuation and long-term growth prospects.

Exhibit 28:

ROE comparison for high and low foreign ownership categories

Source: Wind, Thomson Reuters, Datastream, Morgan Stanley Research. Market data as of Feb 28, 2019.
Note: Sectors with data unavailable in high foreign ownership categories info are left blank.

Exhibit 29:

P/E valuation comparison for high and low foreign ownership categories
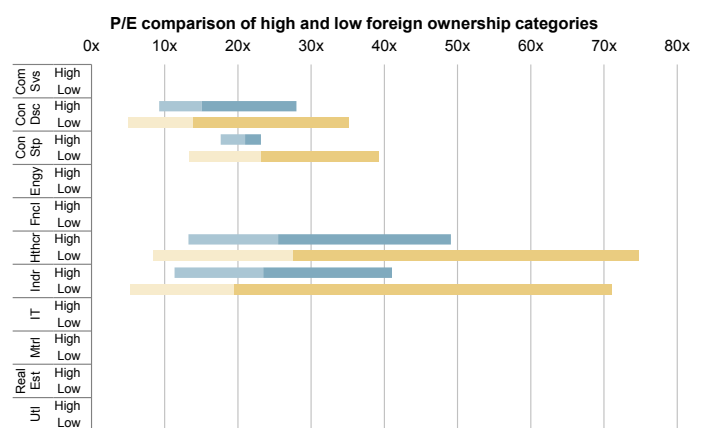
Source: Wind, Thomson Reuters, Datastream, Morgan Stanley Research. Market data as of Feb 28, 2019.
Note: Sectors with data unavailable in high foreign ownership categories info are left blank.

Exhibit 30:

PE valuation vs. long-term growth rate for high and low foreign ownership categories
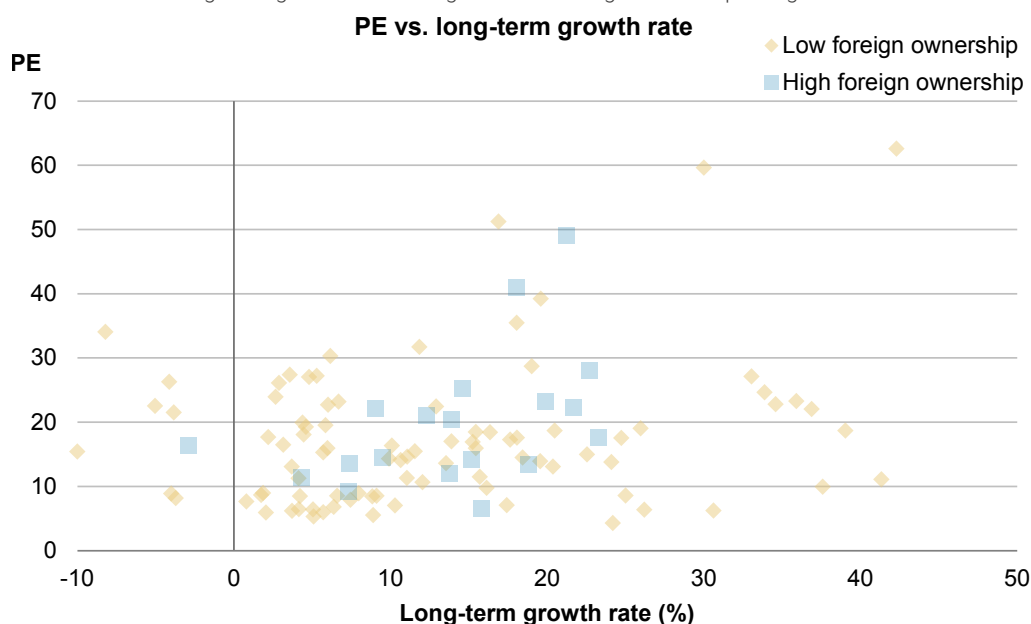
Source: Wind, Thomson Reuters, Datastream, Morgan Stanley Research. Market data as of Feb 28, 2019.

QuantRebalance IV: Mathematical Modeling and Solutions

Step 1: Building the Relationship

Exhibit 31:

Illustration and Derivation of QuantRebalance Strategy (1)
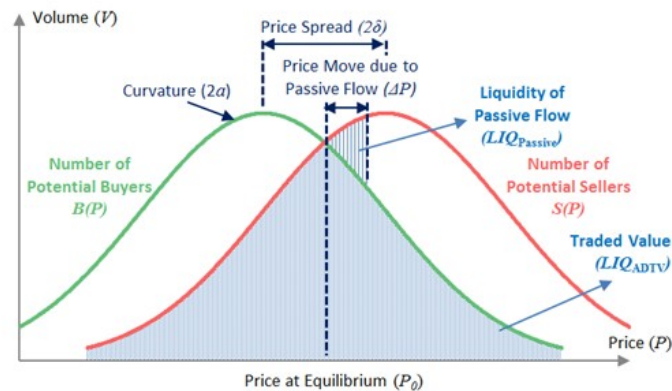
Symbol definitions - Let P be the stock's share price and V the volume. We define $B(P)$ as the potential volume of buyers of the stock at price P, and $S(P)$ the potential volume of sellers of the stock at price P. The traded share price P_0 is the price at equilibrium absent passive fund inflows, where $B(P_0) = S(P_0)$.

Main equation (1) on Passive Flow Liquidity and Price Move - The passive fund inflows add an extra liquidity $LIQ_{Passive}$ on the buying side, indiscriminately as a function of share price, lifting the traded share price from P_0 to $P_0 + \Delta P$. The relationship between $LIQ_{Passive}$ and ΔP, $B(P)$, $S(P)$ is bonded by the following equation, as shown in the shaded area of vertical stripes.

$$LIQ_{Passive} = \int_{P_0}^{P_0 + \Delta P} \{S(P) - B(P)\}dP \qquad \text{Eq. (1)}$$

Main equation (2) on Stock's ADTV – The stock's liquidity itself, measured by ADTV, is proportional to the total volume, where buyers and seller meet their supply and demand of shares. The relationship between LIQ_{ADTV} and $B(P)$, $S(P)$, absent the impact from Passive fund inflows, is bonded by the following equation, as shown in the shaded area of vertical stripes.

$$LIQ_{ADTV} = \int \min\{S(P), B(P)\}\, dP \qquad \text{Eq. (2)}$$

Normalization: Let p be the log of the share price, normalized against its share price at equilibrium P_0. Hence, the price at equilibrium under the normalized log scale is at $p = 0$.

$$p = \log P - \log P_0$$

Correspondingly, we define the price return Δ under the normalized log scale.

$$\Delta = \log(1 + \Delta P / P_0)$$

Substituting p into Equations (1) and (2),

$$LIQ_{Passive} = P_0 \int_0^{\Delta} \{S(p) - B(p)\}e^p\, dp \qquad \text{Eq. (1')}$$

$$LIQ_{ADTV} = P_0 \int \min\{S(p), B(p)\}\, e^p\, dp \qquad \text{Eq. (2')}$$

Source: Morgan Stanley Research

Step 2: Taylor Expansion and Linearization

Exhibit 32:

Illustration and Derivation of QuantRebalance Strategy (2)
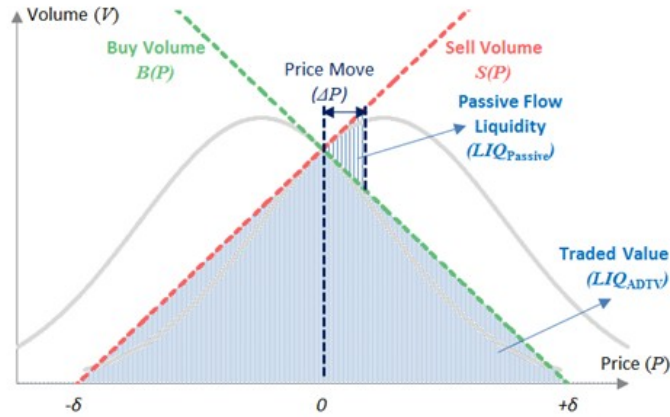
Taylor Expansion: We assume the price movement is a localized effect i.e. the share price movement is relatively small compared to the scale of the $B(p)$ and $S(p)$. This is valid given we are modeling daily returns. Hence, we apply the Taylor Expansion Law to the buying / selling volume distribution curves:

$$\begin{cases} B(p) = B(0) + \dfrac{\partial B}{\partial p}p + \dfrac{1}{2!}\dfrac{\partial^2 B}{\partial p^2}p^2 + \dfrac{1}{3!}\dfrac{\partial^3 B}{\partial p^3}p^3 + \cdots \\[2mm] S(p) = S(0) + \dfrac{\partial S}{\partial p}p + \dfrac{1}{2!}\dfrac{\partial S}{\partial p^2}p^2 + \dfrac{1}{3!}\dfrac{\partial^3 S}{\partial p^3}p^3 + \cdots \end{cases}$$

Solving the Problem under Linear Approximation: Under the linear approximation, $B(p)$ and $S(p)$ are expressed as,

$$\begin{cases} B(p) = a \times (\delta - p) \\ S(p) = a \times (\delta + p) \end{cases} \quad (-\delta \leq p \leq \delta)$$

Substituting $B(p)$ and $S(p)$ into Equations (1') and (2'), we have

$$LIQ_{\text{Passive}} = P_0 \int_0^\Delta 2ape^p \, dp \qquad \text{Eq. (1-1)}$$

$$LIQ_{\text{ADTV}} = P_0 \left[\int_0^\delta (\delta - p)e^p \, dp + \int_{-\delta}^0 (\delta + p)e^p \, dp \right] \qquad \text{Eq. (2-1)}$$

Solving the integral functions Equations (1-1) and (2-1), we have

$$LIQ_{\text{Passive}} = 2aP_0 \left(\Delta e^\Delta - e^\Delta + 1 \right) \qquad \text{Eq. (1-2)}$$

$$LIQ_{\text{ADTV}} = aP_0 \left(e^\delta + e^{-\delta} - 2 \right) \qquad \text{Eq. (2-2)}$$

Applying Taylor Expansion Law to the exponential functions, we have

$$LIQ_{\text{Passive}} = aP_0 \Delta^2 + o(\Delta^2) \qquad \text{Eq. (1-3)}$$

$$LIQ_{\text{ADTV}} = aP_0 \delta^2 + o(\delta^2) \qquad \text{Eq. (2-3)}$$

Conclusion: Share price return is proportionate to the square root of passive fund inflows liquidity, and inversely proportionate to the square root of ADTV.

$$\Delta^2 = \frac{LIQ_{\text{Passive}}}{LIQ_{\text{ADTV}}} \delta^2 \qquad \text{Eq. (3)}$$

Source: Morgan Stanley Research.

Step 3: Now Let's Go Nonlinear

Exhibit 33:

Illustration and Derivation of QuantRebalance Strategy (3)
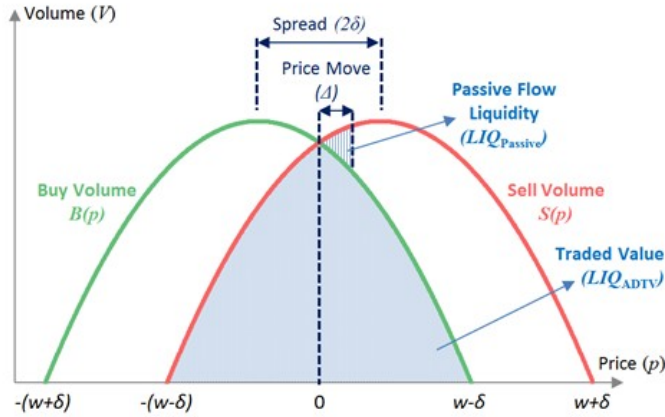
Solving the Problem adding the 2ⁿᵈ order Taylor term i.e. parabolic approximation: Under the parabolic approximation, $\underline{B(p)}$ and $S(p)$ are expressed as,

$$\begin{cases} B(p) = a \times [-(p + \delta)^2 + w^2] \\ S(p) = a \times [-(p - \delta)^2 + w^2] \end{cases}$$

Where δ denotes the spread between the buying and selling volume curves, and w denotes the width of the curves. Substituting $B(p)$ and $S(p)$ into Equations (1') and (2'), we have

$$LIQ_{Passive} = P_0 \int_0^{\Delta} 4a\delta p e^p \, dp \qquad \text{Eq. (1-4)}$$

$$LIQ_{ADTV} = aP_0 \left[\int_0^{w-\delta} [-(p+\delta)^2 + w^2] e^p \, dp \right. \\ \left. + \int_{-(w-\delta)}^0 [-(p-\delta)^2 + w^2] e^p \, dp \right] \qquad \text{Eq. (2-4)}$$

Solving the integral functions Equations (1-4) and (2-4), we have

$$LIQ_{Passive} = 4a\delta P_0 \left(\Delta e^{\Delta} - e^{\Delta} + 1 \right) \qquad \text{Eq. (1-5)}$$

$$LIQ_{ADTV} = 2aP_0 \left[e^{w-\delta}(w-1) + e^{-(w-\delta)}(w+1) - 2\delta \right] \qquad \text{Eq. (2-5)}$$

Applying Taylor Expansion Law to the exponential functions, and assume $w \gg \delta$, we have

$$\Delta^2 = \frac{LIQ_{Passive}}{LIQ_{ADTV}} \frac{w^3}{\delta} \qquad \text{Eq. (4)}$$

Note that the total area under $B(p)$ and $S(p)$ is constant i.e. $aw^3 = constant$. Our final solution becomes,

$$\boxed{\Delta^2 \propto \frac{LIQ_{Passive}}{LIQ_{ADTV}} \frac{1}{a\delta}}$$

Source: Morgan Stanley Research.

Appendix: QuantRebalance versus Conventional Wisdom: Performance in All Historical Precedents

Exhibit 34:

QuantRebalance versus Conventional Wisdom: Performance in All Historical Precedents

#	Country	Date	MS QuanRebalance (Q1 - Q5)	MS QuanRebalance (Q1 - Index)	Country Index (Free-float weighted)	Country Index (Equally weighted)
1	China A	31-Aug-18	11%	7%	(12%)	(12%)
2	China A	31-May-18	13%	10%	(8%)	(3%)
3	Taiwan	3-Jun-02	21%	19%	(6%)	2%
4	Taiwan	1-Dec-00	32%	16%	(25%)	(24%)
5	Taiwan	1-Jun-00	4%	0%	(8%)	(13%)
6	Malaysia	1-Jun-00	17%	6%	(3%)	(4%)
7	Korea	1-Sep-98	1%	(6%)	(1%)	(3%)
8	Korea	3-Sep-96	1%	4%	(18%)	(16%)
9	Taiwan	3-Sep-96	11%	3%	8%	4%
10	Pakistan	1-Jun-17	16%	2%	(6%)	(5%)
11	Qatar	2-Jun-14	(24%)	1%	16%	23%
12	UAE	2-Jun-14	7%	7%	29%	31%
13	Egypt	1-Jun-01	18%	13%	(1%)	1%
14	Russia	1-Dec-97	22%	10%	(27%)	(26%)
15	Czech	3-Sep-96	(4%)	(9%)	9%	22%
16	Hungary	3-Sep-96	23%	5%	10%	14%
17	China	3-Sep-96	10%	19%	(4%)	2%

Source: MSCI, Rimes, Morgan Stanley Research. The factor performances are the long/short factor returns of the top versus bottom quintile, over the 3-month time horizon before the MSCI inclusion factor increase.

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(as of February 28, 2019)

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Stock Rating Category	Coverage Universe		Investment Banking Clients (IBC)			Other Material Investment Services Clients (MISC)	
	Count	% of Total	Count	% of Total IBC	% of Rating Category	Count	% of Total Other MISC
Overweight/Buy	1115	36%	296	42%	27%	526	38%
Equal-weight/Hold	1379	44%	325	46%	24%	639	46%
Not-Rated/Hold	46	1%	6	1%	13%	6	0%
Underweight/Sell	585	19%	82	12%	14%	225	16%
Total	3,125		709			1396	

Data include common stock and ADRs currently assigned ratings. Investment Banking Clients are companies from whom Morgan Stanley received investment banking compensation in the last 12 months. Due to rounding off of decimals, the percentages provided in the "% of total" column may not add up to exactly 100 percent.

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