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## Quantitative Investing in China A Shares

Two decades of reform and the recent inclusion of A shares in benchmark MSCI indices have made China's onshore equity market more accessible and more visible to non-Chinese investors. We can now all appreciate that this market is too big to ignore and diversifying enough to consider a distinct asset class in its own right. The potential excess returns available to quantitative investment strategies are less obvious, but very real. For example, the historical outperformance of non-momentum factors such as size, value and reversal was strong in A shares, but close to non-existent in the U.S. over the same period. By contrast, momentum was not a useful factor in A shares, but performed well in the U.S. except for 2009. The uniquely strong performance of a "turnover" factor in A shares indicates the scale of the profits being left on the table by overactive, short-term, trend-following investors. The analysis shows that the China A shares opportunity set is arguably as rich as that of the developed markets 20 years ago, in the heyday of quant investing—but that success is not a matter of simply transporting U.S. equity factor models to this new market.

## Executive Summary

- China's A-share market is too big to ignore: with some 3,500 listed companies across all 11 Global Industry Classification Standards sectors and an end-2018 market capitalization of over \$8 trillion, it is the second-biggest equity market in the world, representing the second-biggest economy.
- Two decades of reform and the recent inclusion of A shares in benchmark MSCI indices have made China's onshore equity market more accessible and more visible to non-Chinese investors.
- As well as its size, A shares' low correlation with other equity markets, including other Asian and emerging markets, makes a strong case for considering it as an asset class and a portfolio allocation in its own right.
- We believe that part of that allocation could be managed with quantitative strategies, as certain characteristics of the A-shares market make it well suited to this approach.
  - The A-shares market has excellent infrastructure to support quantitative portfolio management.
  - A-shares trading and investment is dominated by small retail investors, revealed in regular survey evidence to be poorly informed about company fundamentals and significantly biased toward short-term herding; these investors contribute to over 80% of the total trading volume, but receive just 10% of the profits.
  - Analysis of factor performance in A shares and the U.S. markets since 2006 reveals that factor performance has varied drastically between the two markets.
  - For example, simple factors like size, value and reversal performed strongly in A shares, despite not working at all in U.S. markets over the same period.
  - By contrast, momentum performed poorly in A shares and better in U.S. equities.
  - The uniquely strong performance of a "turnover" factor in the A-shares market indicates the excess returns potentially available to those systematically taking the other side of retail over-trading.
  - A simple composite strategy that equally invests in size, value, reversal and turnover factors delivered very strong results.
  - The analysis shows that the China A-shares opportunity set is arguably as rich as that of the developed markets 20 years ago, in the heyday of quant investing—but that success is not a matter of simply transporting U.S. equity factor models to this new market.

### THREE SIMPLE FACTORS THAT CONTINUE TO PERFORM WELL IN CHINA, DESPITE FADING IN THE U.S. MARKET

Cumulative and annualized returns and risk for the size, value and reversal factors in the China and U.S. equity markets, 2006 – 2018



Source: Juyuan, Kenneth R. French (<http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html>), Neuberger Berman. Data as of December 31, 2018.

The size factor is created by going long companies with low market capitalization and short companies with higher market capitalization; the value factor is created by going long stocks with low price-to-book ratios and short stocks with high ratios; and the reversal factor is created by going long stocks with the worst one-month returns and short those with the best. Annualized return and volatility data are calculated based on historical returns of respective portfolios from 2006 to 2018, using monthly returns. The China market includes substantially all A shares, excluding only those with the lowest liquidity. The U.S. market includes all of the stocks in the Center for Research in Security Prices (CRSP) database. All portfolios are hypothetical long-short portfolios gross of transaction costs. For illustrative and discussion purposes only. While these data series are not reflective of actual investment returns, they are factors constructed using a disciplined methodology and, in our view, can be used as proxies for Alternative Risk Premia. The performance shown does not represent the performance of any Neuberger Berman product or strategy and does not reflect the fees and expenses associated with managing a portfolio. Investing entails risks, including possible loss of principal. **Past performance is no guarantee of future results.** See Hypothetical Backtested Performance Disclosures for more information on Fama/French Factors.

We on the Quantitative and Multi-Asset Class team at Neuberger Berman have two fundamental beliefs about the China A-share market: (i) it is significant and distinct enough to be considered an asset class in its own right and (ii) a quantitative investment approach is very well suited to it.

The first is becoming a widely accepted view. The second requires further evidence and argument, but it is arguably quite intuitive. The advantages of quantitative investing, in whichever market, lie in the systematic identification of rewarded risks; that means quantitative investing begins with a focus on risk, and removes human biases from decision-making in order to take advantage of human biases in the market. In a volatile market arguably dominated by over-trading retail investors such as in China A shares, these characteristics may be especially powerful.

## **The A-Shares Market is Big, Growing and Increasingly Accessible**

Colleagues in our China Equity Group wrote in detail about the size and scope of China's onshore equity market last year in the run-up to its inclusion in MSCI's China and Emerging Markets indices at the end of May 2018.<sup>1</sup>

To foreign investors, Chinese equities include China A shares, B shares, H shares, Red-chips, P chips and foreign-listed Chinese companies such as Alibaba. Among those, the China A-share market—stocks listed and traded in Shanghai and Shenzhen stock exchanges and denominated in RMB—is many times larger than the rest of the markets combined. With some 3,500 listed companies across all 11 Global Industry Classification Standards sectors and an end-2018 market capitalization of over \$8 trillion, it is the second-biggest equity market in the world, representing the second-biggest economy.

Less than 4% of that market is owned by foreign investors, however, because it has become accessible only gradually. The process began in 2002 with the establishment of the Qualified Foreign Institutional Investors (QFII) program, succeeded by the Renminbi Qualified Foreign Institutional Investors (RQFII) program in 2011. These programs allowed a limited quota of A shares to be purchased by registered entities. In the meantime, China has adopted international standards for reporting transparency and disclosure for its listed companies, and greatly eased constraints on foreign ownership of local financial institutions. For example, Neuberger Berman was among the first foreign asset managers to acquire the license to own a Wholly Owned Foreign Enterprise (WOFE) in Shanghai to conduct private fund management business in China.

Then, in 2014, the arrival of the Shanghai-Hong Kong Stock Connect channel enabled investors with Hong Kong Stock Exchange accounts to buy A shares. The Shenzhen-Hong Kong Connect channel followed in 2016. The daily quota for both channels now stands at \$15.5 billion. The success of these programs enabled MSCI's decision to include A Shares in its indices; most recently, it has decided to increase the inclusion factor of China A shares to 20%, as well as including some ChiNext-listed companies in 2019 and mid-cap A shares in 2020. MSCI estimates that by August 2019, the weight of China A shares in the MSCI Emerging Market index will be around 2.1%, rising to around 3.3% in 2020. In the event of full inclusion, China A shares could exceed 16% of the Emerging Market Index.<sup>2</sup>

We are now at the point where investing in China A shares is no longer operationally onerous for non-Chinese investors. Indeed, it is the growth and opening-up of the onshore China equity market that has enabled me to return to my home country, after 21 years of studying, teaching, researching and working in the U.S., with a non-Chinese asset manager, where I am part of a growing team of locally based, onshore equity and bond investors.

<sup>1</sup> Bin Yu, "China: The Anatomy of an Equity Market" (February 2018), at <https://www.nb.com/pages/public/global/insights/china-the-anatomy-of-an-equity-market.aspx>

<sup>2</sup> See [https://www.msci.com/documents/1296102/12275477/China\\_A\\_Further\\_Weight\\_Increase\\_Feb\\_2019\\_Presentation.pdf/e9cf153a-2e4f-a110-2699-9d8163e917c2](https://www.msci.com/documents/1296102/12275477/China_A_Further_Weight_Increase_Feb_2019_Presentation.pdf/e9cf153a-2e4f-a110-2699-9d8163e917c2) and [https://www.msci.com/documents/1296102/8328554/Consultation\\_on\\_China\\_A\\_Shares\\_Inclusion\\_Sep\\_2018.pdf/a015ebd8-fb4b-2337-dec7-886556f12aa4](https://www.msci.com/documents/1296102/8328554/Consultation_on_China_A_Shares_Inclusion_Sep_2018.pdf/a015ebd8-fb4b-2337-dec7-886556f12aa4)

## The A-Shares Market Exhibits Low Correlation With Other Equity Markets

The A-shares market is big, growing and increasingly accessible. It is also quite distinct from other markets. It is even different from the offshore H-share market, which is dominated by the largest state-owned companies (SOEs) such as banks, energy and telecom companies. Chinese companies in the consumer, health care and industrial sectors are almost always listed as A shares.

A shares also come with RMB exposure, which offers both attractive appreciation potential and, because of the government's objective of maintaining a stable exchange rate, one of the lowest levels of volatility in the currency markets: over the last 10 years, USDCNY volatility was 2.60% annualized, whereas USDBRL volatility was close to 16%, USDJPY, USDEUR and USDKRW volatilities close to 10%, USDINR some 8%, and USDTWD around 4%.

In 2005, reforms greatly increased the market's free float and the benchmark Shanghai-Shenzhen 300 Index (CSI 300) was launched. Between 2006 and 2018, the CSI 300 returned 11.56% per year, while the S&P 500, MSCI EAFE and MSCI Emerging Markets indices returned 7.75%, 2.99% and 4.89%, respectively. This outperformance came with very high volatility—27.16% for the CSI 300 versus a range of 18 – 21% for the other three. However, given the fact that A shares still exhibit such low correlation with other markets (figure 1), even as other emerging markets have converged with those of the developed world, this is a potentially attractive risk to assume for the purposes of equity portfolio diversification.

**FIGURE 1. CHINA A SHARES EXHIBIT LOW CORRELATION WITH OTHER MARKETS, EVEN OTHER ASIAN AND EMERGING MARKETS**

	China A shares	MSCI Emerging Markets Index	MSCI Pacific ex Japan Index	MSCI Hong Kong Index	MSCI Japan Index	MSCI USA Index	MSCI Europe Index	MSCI World Index
China A shares	1	0.41	0.45	0.48	0.23	0.22	0.27	0.3
Emerging-market equities	0.41	1	0.96	0.87	0.71	0.55	0.8	0.86
World equities	0.3	0.86	0.8	0.74	0.94	0.62	0.93	1

Source: Bloomberg, Neuberger Berman. Data as of December 31, 2018. Correlation data are calculated based on historical returns of respective MSCI indices for the past 10 years, using weekly USD returns. [https://www.msci.com/documents/1296102/8328554/Consultation\\_on\\_China\\_A\\_Shares\\_Inclusion\\_Sep\\_2018.pdf/a015ebd8-fb4b-2337-dec7-886556f12aa4](https://www.msci.com/documents/1296102/8328554/Consultation_on_China_A_Shares_Inclusion_Sep_2018.pdf/a015ebd8-fb4b-2337-dec7-886556f12aa4)

## The A-Shares Market is Dominated by Momentum-Biased Retail Investors

Having sought to make the case for China A shares as a distinct equity portfolio allocation, we will now explain why we think investors should use a quantitative approach for at least part of that allocation.

In practical terms, the market has excellent infrastructure to support quantitative portfolio management. High-quality price and trade-volume data, fundamental data, analysts' forecast data and other China-specific data are readily available, and non-traditional, unstructured "Big Data" are also increasingly accessible. Brokers offer trading algorithms that are comparable to those offered in developed markets.

In strategy terms, we believe that the composition of the market makes it very favorable to institutional investors in general and quantitative approaches in particular.

According to the Shanghai Stock Exchange Factbook of 2018, non-institutional, retail investors contributed 80% of A shares' trading volume in 2017, but took just 10% of the total profits. The Shenzhen Stock Exchange's 2017 annual retail investor survey, based on survey results from 15,890 investors from 307 cities, offers some clues as to why that was.

More than three-quarters of the sample were small investors with less than RMB500,000 (\$74,600) to invest, more than half held fewer than three stocks, the average portfolio had only five, and the most commonly cited sources of information were internet media and technical analysis. Those investors nursing trading losses were more likely to trade and make investment decisions based on rumors than on company disclosures or research reports issued by financial institutions. Indeed, outside of large-cap stocks listed offshore, China equities receive very sparse analyst coverage; even if retail investors looked for good fundamental information on individual companies, they would be unlikely to find very much.

Since active management is a zero-sum game as a whole, the existence of a large number of what appear to be poorly informed, trigger-happy retail investors who leave 90% of the market's profit on the table suggests that active management can potentially harvest a high level of excess return from A shares.

We believe a quantitative approach should be a particularly powerful way to extract those excess returns, as this investment style is premised on systematically seeking out opportunities created by irrational trading behavior—and it is especially effective when that behavior is itself systematic and consistent. That is certainly the case in China A shares, where 46.9% of the investors surveyed by The Shenzhen Stock Exchange in 2017 claim to be short-term trend followers and only 8.5% claim to be contrarians, despite this market exhibiting strong, short-run reversals that, over time, render short-term trend-following a money-losing strategy.

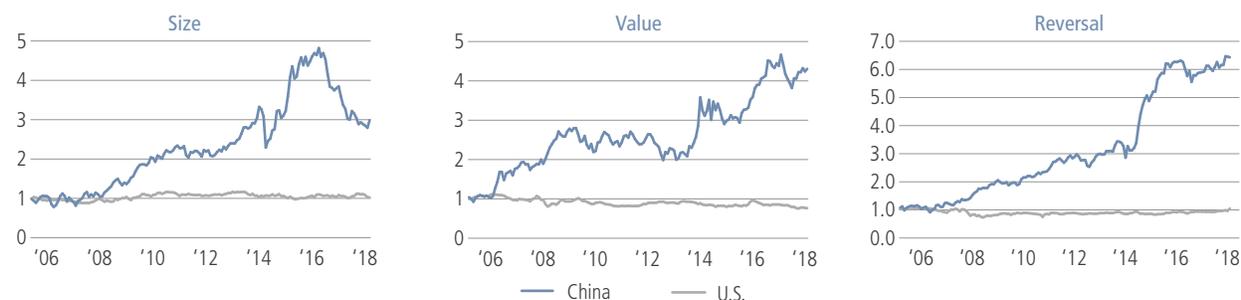
### Factor Performance in A Shares Reveals the Opportunity for Quantitative Investors

We can start to gauge the extent of this active, quantitative investment opportunity by looking at the performance of some simple factors in the A-shares market. What we find is that, over the long term, they have performed much better than their equivalents in developed markets.

Figure 2 shows returns to the size, value and reversal factors. It shows that these factors performed strongly in China over the past 12 years, but have ceased to work in the U.S. market.

**FIGURE 2. THREE SIMPLE FACTORS THAT CONTINUE TO PERFORM WELL IN CHINA, DESPITE FADING IN THE U.S. MARKET**

Cumulative and annualized returns and risk for the size, value and reversal factors in the China and U.S. equity markets, 2006 – 2018



	Size		Value		Reversal	
	China	U.S.	China	U.S.	China	U.S.
<b>Ann. Ret.</b>	8.13%	0.18%	11.88%	-2.04%	15.39%	0.37%
<b>Ann. Vol.</b>	20.87%	8.30%	20.34%	9.02%	15.46%	10.53%
<b>IR</b>	0.39	0.02	0.58	-0.23	1.00	0.04

Source: Juyuan, Kenneth R. French ([http://mba.tuck.dartmouth.edu/pages/faculty/ken\\_french/index.html](http://mba.tuck.dartmouth.edu/pages/faculty/ken_french/index.html)), Neuberger Berman. Data as of December 31, 2018. The size factor is created by going long companies with low market capitalization and short companies with higher market capitalization; the value factor is created by going long stocks with low price-to-book ratios and short stocks with high ratios; and the reversal factor is created by going long stocks with the worst one-month returns and short those with the best. Annualized return and volatility data are calculated based on historical returns of respective portfolios from 2006 to 2018, using monthly returns. The China market includes substantially all A shares, excluding only those with the lowest liquidity. The U.S. market includes all of the stocks in the Center for Research in Security Prices (CRSP) database. All portfolios are hypothetical long-short portfolios gross of transaction costs. For illustrative and discussion purposes only. While these data series are not reflective of actual investment returns, they are factors constructed using a disciplined methodology and, in our view, can be used as proxies for Alternative Risk Premia. The performance shown does not represent the performance of any Neuberger Berman product or strategy and does not reflect the fees and expenses associated with managing a portfolio. Investing entails risks, including possible loss of principal. **Past performance is no guarantee of future results.** See Hypothetical Backtested Performance Disclosures for more information on Fama/French Factors.

Not all simple factors work in China, however. When we look at momentum, for example, we find negative annualized returns in both the China and U.S. markets between 2006 and 2018. The main reason for the poor performance in the U.S., however, was an unprecedented crash for the momentum factor in 2009. Strip that out by starting in 2010, and we find consistent momentum performance delivering a 3.38% annualized return in the U.S., with momentum in China lagging at 1.92% annualized (figure 3).

Recall that the one factor out of the four we have examined that does not appear to reward investors in China A shares—momentum or trend-following—is the very factor dominating the risk assumed by nearly half of the retail investors surveyed by The Shenzhen Stock Exchange. That partially explains the poor performance of those investors.

### FIGURE 3. THE MOMENTUM FACTOR HAS PERFORMED BETTER IN THE U.S. THAN IN CHINA

Cumulative and annualized returns and risk for the momentum factor in the China and U.S. equity markets, 2006 – 2018



	Momentum 2006 – 2018		Momentum 2010 – 2018	
	China	U.S.	China	U.S.
<b>Ann. Ret.</b>	-3.99%	-1.66%	1.92%	3.38%
<b>Ann. Vol.</b>	16.47%	15.97%	15.11%	10.49%
<b>IR</b>	-0.24	-0.1	0.13	0.32

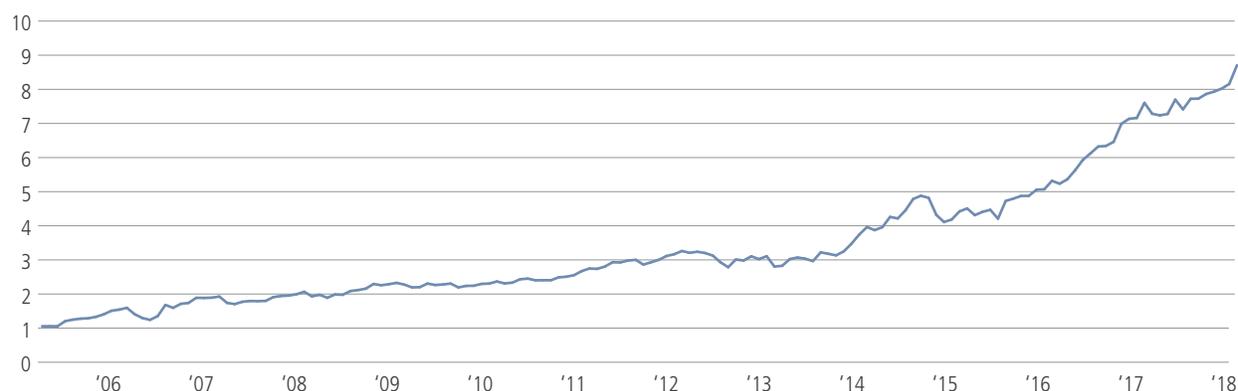
Source: Juyuan, Kenneth R. French (<http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html>), Neuberger Berman. Data as of December 31, 2018. The momentum factor is created by going long the stocks with the best 12-month returns, excluding the most recent month, and short those with the worst returns. Annualized return and volatility data are calculated based on historical returns of respective portfolios from 2006 to 2018, using monthly returns. The China market includes substantially all A shares, excluding only those with the lowest liquidity. The U.S. market includes all of the stocks in the Center for Research in Security Prices (CRSP) database. All portfolios are hypothetical long-short portfolios gross of transaction costs. For illustrative and discussion purposes only. While these data series are not reflective of actual investment returns, they are factors constructed using a disciplined methodology and, in our view, can be used as proxies for Alternative Risk Premia. The performance shown does not represent the performance of any Neuberger Berman product or strategy and does not reflect the fees and expenses associated with managing a portfolio. Investing entails risks, including possible loss of principal. **Past performance is no guarantee of future results.** See Hypothetical Backtested Performance Disclosures for more information on Fama/French Factors.

We believe that there is another rewarded factor, particular to the A-shares market, which may also reflect the returns left on the table by what appear to be poorly informed, trigger-happy retail investors—the “turnover factor.” We go long the stocks with the lowest turnover ratios (measured as the average of the daily ratios of shares traded to shares outstanding over the preceding 20 days), and short the stocks with the highest ratios.

Academic research has failed to find a return to the turnover factor in developed markets: it is not among the large number of factors reported in Kenneth R. French’s online data library, for example.<sup>3</sup> Figure 4 shows that it has been very successful indeed in the China A-shares market, however, probably because it captures the profits left behind by the overactive trading of retail investors.

#### FIGURE 4. THE “TURNOVER FACTOR” EXHIBITS UNIQUELY STRONG PERFORMANCE IN CHINA

Cumulative and annualized returns and risk for the turnover factor in China A shares, 2006 – 2018



	Shares Turnover
<b>Ann. Ret.</b>	18.11%
<b>Ann. Vol.</b>	15.60%
<b>IR</b>	1.16

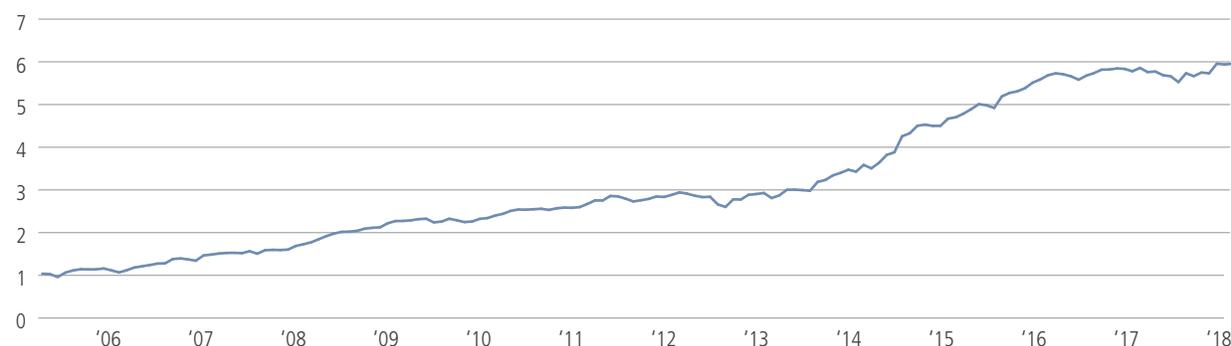
Source: Juyuan, Neuberger Berman. Data as of December 31, 2018. Annualized return and volatility data are calculated based on historical returns of respective portfolios from 2006 to 2018, using monthly returns. The turnover factor is replicated by a hypothetical portfolio that is long the stocks with the lowest turnover ratios and short the stocks with the highest ratios, gross of transaction costs. The China market includes substantially all A shares, excluding only those with the lowest liquidity.

The prior analysis shows that some simple factors performed strongly in A shares despite not working at all in the U.S. over the same period. When these simple factors are combined, the composite strategy delivered much higher risk-adjusted returns than any individual factor (figure 5). To avoid any data mining, we simply average the four factors that worked in China A shares: size, value, reversal and turnover. The simple composite strategy delivered a 14.71% annualized return with only 9.15% annualized volatility between 2006 and 2018, which resulted in an impressive information ratio of 1.61, gross of transaction costs.

<sup>3</sup> See <http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html>

## FIGURE 5. A COMPOSITE OF THE SIZE, VALUE, REVERSAL AND TURNOVER FACTORS IN A SHARES

Cumulative and annualized returns and risk for the four-factor composite in China A shares, 2006 – 2018



	Four-Factor Composite
Ann. Ret.	14.71%
Ann. Vol.	9.15%
IR	1.61

Source: Juyuan, Neuberger Berman. Data as of December 31, 2018. Gross of transaction costs. The China market includes substantially all A shares, excluding only those with the lowest liquidity.

Testing these simple factors is only the beginning of the rich story of quantitative investing in China, and certainly not the basis of a fully developed systematic A-shares strategy. The tests do teach us some very important things, however. They indicate that the nature and the extent of the A-shares opportunity is closely related to the knowledge gaps and biases of the investors who currently dominate this market, and that rewards to factor investing in China A shares could be substantial. Moreover, they tell us that factors that generate returns elsewhere do not necessarily generate returns in China; and, vice versa, there appear to be factors rewarded in China that are not rewarded in other markets. And that, in turn, teaches us perhaps the most important lesson: successful quantitative investing in China is not a matter of simply transporting U.S. or European equity factor models to this new market.

### Conclusion: A Rich Excess Return Opportunity for Quantitative Investors

In summary, we believe the China A-shares market is too big to ignore, diversifying enough to be considered a distinct asset class in its own right, and rich in potential excess risk-adjusted returns to both traditional and China-specific systematic factors. This creates a good opportunity set for quantitative investment approaches. The simple analysis on some traditional and unique factors in China A shares indicates that the magnitude of the excess returns available to systematic investors is highly significant. In many ways, the China A-shares opportunity set is as rich as that of the developed markets 20 years ago in the heyday of quant investing.

Two decades of reform and the recent inclusion of A shares in benchmark MSCI indices are likely to unlock considerable foreign institutional investor flows into this market. That evolution may change the market over time and erode some of the factor premia we have described, but the process is likely to take a long time. Today, mutual fund data from CITIC Group suggest that less than 1% of China mutual fund assets under management are in quantitative equity funds. In our view, quantitative strategies are far from crowded in China and we expect them to continue to have a rich excess return opportunity set for the foreseeable future.

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China is considered an emerging market. Emerging markets are more likely than more developed markets to experience periods of extreme volatility. It is impossible to predict with certainty how rebalancing the MSCI China Index to include China A shares will ultimately impact the performance of securities reflected on the Index or the China equity market as a whole. Moreover, investors in emerging markets often face heightened risks (some of which could be significant) and special considerations not typically associated with investing in other more established economies or securities markets. Such risks may include, but are not limited to: (a) greater social, economic and political uncertainty including war; (b) higher dependence on exports and the corresponding importance of international trade; (c) greater risk of inflation; (d) increased likelihood of governmental involvement in and control over the economies; (e) governmental decisions to cease support of economic reform programs or to impose centrally planned economies; and (f) certain considerations regarding the maintenance of foreign investors' invested securities and cash with brokers and securities depositories outside their country of domicile. Separately, bid and offer spreads of the price of securities may be significant and accordingly, such investors may incur significant trading costs.

#### HYPOTHETICAL BACKTESTED PERFORMANCE DISCLOSURES

The hypothetical performance results included in this material are for backtested model portfolios and are shown for illustrative purposes only. Neuberger Berman calculated the hypothetical results by running a model portfolio on a backtested basis using the methodology described herein. The results do not represent the performance of any Neuberger Berman managed account or product and do not reflect the fees and expenses associated with managing a portfolio. If such fees and expense were reflected, returns referenced would be lower.

##### Model Portfolios

Models Presented: Individual size, value and momentum factor portfolios in both U.S. and China equities, based on the Fama-French factors; individual reversal and turnover factor portfolios in both U.S. and China equities, constructed using the methodology described herein; a blended portfolio of the size, value, reversal and turnover factors in China equities, constructed using the methodology described herein.

Period: January 2006 to December 2018.

Data Sources: Juyuan, Kenneth R. French, Neuberger Berman.

\*Eugene Fama and Kenneth French posited their "three-factor" model of returns to stocks by adding the value and size factors to the single market factor used in the Capital Asset Pricing Model (CAPM). See Fama, E.F. and French, K.R., "Common Risk Factors in the Returns on Stocks and Bonds", *Journal of Financial Economics* 33.1 (February 1993). In 1997 Mark Carhart described a fourth factor, monthly momentum, in his paper, "On Persistence in Mutual Fund Performance", *The Journal of Finance* 52.1 (March 1997). This factor was later adopted by Fama and French. While these data series are not reflective of actual investment returns, they are simply factors constructed using a disciplined methodology and, in our view, can be used as proxies for Alternative Risk Premia. The performance shown does not represent the performance of any Neuberger Berman product or strategy and does not reflect the fees and expenses associated with managing a portfolio.

##### Hypothetical Backtest Methodology for Model Portfolios:

For individual factors in the portfolios constructed and backtested, positions were weighted equally and recalibrated and rebalanced monthly. For the blended portfolio of the size, value, reversal and turnover factors, the factors were weighted equally and the portfolio was rebalanced monthly. All portfolios are hypothetical long-short portfolios gross of transaction costs. The U.S. market includes all of the stocks in the Center for Research in Security Prices (CRSP) database. The China market includes substantially all A shares, excluding only those with the lowest liquidity, which includes all of those introduced via initial public offerings (IPOs) in the previous 12 months and all of those classified as ST or ST\* companies (listed companies with Special Treatment because their profitability is so poor that they may be de-listed).

The model portfolio may not be appropriate for any investor. There may be material differences between the hypothetical backtested performance results and actual results achieved by actual accounts. Backtested model performance is hypothetical and does not represent the performance of actual accounts. Hypothetical performance has certain inherent limitations. Unlike actual investment performance, hypothetical results do not represent actual trading and accordingly the performance results may have under- or over-compensated for the impact, if any, that certain economic or other market factors, such as lack of liquidity or price fluctuations, might have had on the investment decision-making process or results if assets were actually being managed. Hypothetical performance may also not accurately reflect the impact, if any, of other material economic and market factors, or the impact of financial risk and the ability to withstand losses. Hypothetical performance results are also subject to the fact that they are generally designed with the benefit of hindsight. As a result, the backtested models theoretically may be changed from time to time to obtain more favorable performance results. In addition, the results are based, in part, on hypothetical assumptions. Certain of the assumptions have been made for modeling purposes and may not have been realized in the actual management of accounts. No representation or warranty is made as to the reasonableness of the assumptions made or that all assumptions used in achieving the hypothetical results have been stated or fully considered. Changes in the model assumptions may have a material impact on the hypothetical returns presented. There are frequently material differences between hypothetical performance results and actual results achieved by any investment strategy. Neuberger Berman did not manage any accounts in this manner reflected in the models during the backtested time periods shown.

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