Stock-Level Liquidity – Alpha or Risk?

Stocks with Rising Liquidity Outperform Globally

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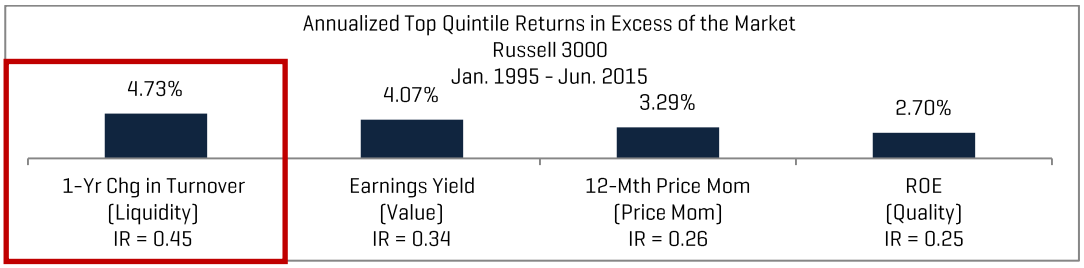
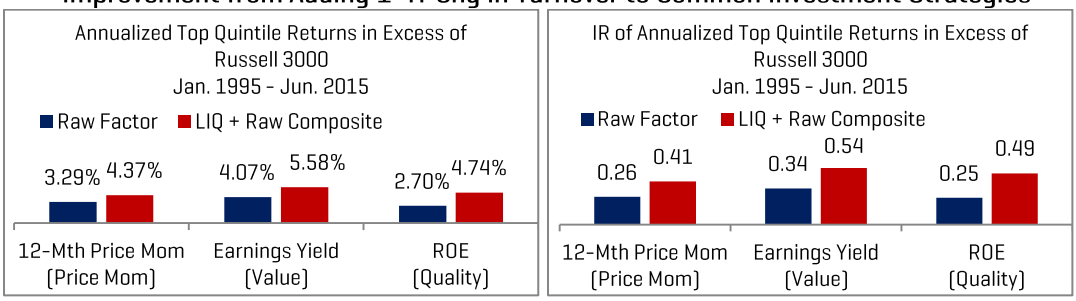
Most investors do not associate stock-level liquidity as a stock selection signal but as a measure of how easily a trade can be executed without incurring a large transaction cost or adverse price impact. Inspired by recent literature, such as Bali, Peng, Shen and Tang (2012), we show globally that a strategy of buying stocks with the highest one-year change in stock-level turnover has historically outperformed the market and has outperformed strategies of buying stocks with strong price momentum, attractive valuation, or high quality (see top chart). One-year change in stock-level turnover has a low correlation (i.e., <0.15) with commonly used stock selection signals. When it is combined with these signals, the composites have yielded higher excess returns and information ratios (IR) than the standalone raw signals (see bottom chart).

Change in Stock-Level Liquidity as an Investment Strategy



Improvement from Adding 1-Yr Chg in Turnover to Common Investment Strategies



1) Signals are cap- and GICS industry-neutral 2) IR = Annualized Information Ratio

Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.Backtested returns do not represent the actual trading results and were constructed with the benefit of hindsight. Inclusion of fees and expenses would lower performance. Past performance is not a guarantee of future results.

Our findings in our study covering the period January 1995 to June 2015 show:

- In the U.S., a strategy of buying stocks with the highest one-year change in turnover outperformed the market and outperformed strategies of buying stocks with attractive valuation, strong price momentum, or high quality by 4.73%, 0.66%, 1.44% and 2.03% per year, respectively.[1] (Top chart)
- One-year change in stock-level liquidity has low correlations (<0.15) with commonly used investment strategies. When it is added to the mix, the composites have produced higher excess returns and IRs. (Exhibit 7)
- Our results indicate change in turnover works due to investors' underreaction (Section 3.5)
- One-year change in turnover has produced excess returns after controlling for market, size, value, and price momentum and is not driven by variations in liquidity beta (Exhibit 3 and 4)

[1] 0.66%: the difference in returns between 1-Yr Chg in Turnover (4.73%) and Earnings Yield (4.07%); 1.44%: the difference in returns between 1-Yr Chg in Turnover (4.73%) and 12-Mth Price Mom (3.29%); 2.03%: the difference in returns between 1-Yr Chg in Turnover (4.73%) and ROE (2.70%)

1. Introduction

A majority of literature that have explored the relationship between stock-level liquidity and returns, such as Amihud and Mendelson (1986) or Amihud (2002), have found liquidity to be a risk factor with an associated risk premium (i.e., illiquid stocks outperform liquid ones to compensate investors for bearing liquidity risk). We do not find enough evidence to support the liquidity risk premium conclusion using our liquidity level proxies. Conversely, inspired by recent literature, such as Bali, Peng, Shen and Tang (2012), we find that change in stock-level liquidity is a useful predictor of future stock returns. One of the key takeaways from our results is that stocks with rising (declining) liquidity outperform (underperform) and returns are not driven by market, size, value, price momentum and liquidity beta.

2. Defining Liquidity and Change in Liquidity

Since there is no one well-defined measure of liquidity, we will use proxies for liquidity that are derived from daily market data such as volume, price, and shares outstanding. We explore four liquidity proxies: turnover and the Amihud[2] measure (a measure of price impact) as proxies for liquidity level and their 12-month changes as proxies for changes in liquidity level. We select turnover because it is a familiar measure to equity investors. We select the Amihud measure as it has empirically been shown to be one of the best measures of capturing price impact that does not involve using high frequency data (i.e., stock tick data)[3].

2.1 Defining Stock-Level Liquidity using Turnover as a Proxy

We define a stock's daily turnover as its daily volume traded divided by its shares outstanding.[4] Since we show monthly results throughout the paper, a stock's monthly turnover is the average of its daily turnover in a month. Intuitively, turnover is a proxy for liquidity in that, all else equal, a company that has more of its shares traded is more liquid.

$$Turnover_{i,t} = \frac{AvgDailyVolume_{i,t}}{ShrsOut_{i,t}}$$

where i denotes the i^{th} stock and t denotes calendar month t

2.2 Defining Stock-Level Liquidity using Amihud as a Proxy

A stock's daily Amihud measure is defined as the absolute value of its daily return divided by its daily dollar volume. Since we show monthly results throughout the paper, a stock's monthly Amihud measure is the average of its daily Amihud during that month. The Amihud ratio effectively measures the price impact of a stock for $1 traded. The intuition is that a more (less) liquid stock should experience a smaller (larger) price impact when a certain dollar amount is traded. By implication, a larger (smaller) Amihud ratio means that a stock is less (more) liquid. We take the

[2] Amihud, Y. "Illiquidity and Stock Returns: Cross-Section and Time-Series Effects." *Journal of Financial Markets*, 5 (2002), 31–56.

[3] Goyenko, R., Holden, C., and Trzcinka, C. "Do Liquidity Measures Measure Liquidity?" Journal of Financial Economics, 92 (2009), 153-181; Hasbrouck (2009)

[4] We also consider a variant definition of turnover using shares floated. Throughout the paper, we show results for turnover using shares outstanding because global historical coverage for shares outstanding is better. Inferences do not change regardless of whether we use shares outstanding or shares floated. See appendix A.1.

inverse of Amihud to make it a measure of liquidity instead of illiquidity, in order to make the interpretation of the results consistent with turnover (i.e., a larger (smaller) number means higher (lower) liquidity). We denote the new measure as Amihud_LIQ.

$$Amihud_{i,t} = (Avg(\frac{|DailyReturn|}{DailyDollarVolume}))_{i,t}$$

$$Amihud\_LIQ_{i,t} = \frac{1}{Amihud_{i,t}}$$

where i denotes the i^{th} stock and t denotes calendar month t

2.3 Defining Change in Stock-Level Liquidity using Change in Turnover as a Proxy

To calculate a 12-month change in stock-level turnover[5], we take a stock's turnover at month t and subtract its prior 12-month average in turnover (i.e., demeaning).[6] Then we divide the difference by its 12-month volatility in its monthly turnovers (see below).[7] Effectively, we are calculating a z-score based on the turnover measure for each stock relative to its own history. We denote this as z12m_Turnover.[8]

$$z12m\_Turnover_{i,t} = \frac{Turnover_{i,t} - Avg[TurnoverPast12Mths]_{i,t}}{Stdev[TurnoverPast12Mths]_{i,t}}$$

where i denotes the i^{th} stock and t denotes end of month t

2.4 Defining Change in Stock-Level Liquidity using Change in Amihud as a Proxy

We calculate a stock's 12-month change in its Amihud measure in the same manner as we calculated a stock's 12-month change in turnover (i.e., a z-score). Then, we multiply a stock's 12-month change in its Amihud measure by negative one (i.e., -1) to make it a measure of liquidity in lieu of a measure of illiquidity, so that the interpretation of the results is consistent with turnover's (i.e., a larger (smaller) number means higher (lower) liquidity). We denote the new measure as z12m_Amihud_LIQ.

$$z12m\_Amihud\_LIQ_{i,t} = -1 * \frac{Amihud_{i,t} - Avg[Amihud\_Past\_12Mths]_{i,t}}{Stdev[Amihud\_Past\_12Mths]_{i,t}}$$

where i denotes the i^{th} stock and t denotes end of month t

[5] We use 1-Yr Chg in Turnover and 12-Mth Chg in Turnover interchangeably.
[6] The intuition behind the demeaning is to make the liquidity measures more comparable across firms in the cross-section since certain firms are consistently more (less) liquid than others.
[7] The division by volatility is intended to make a stock's liquidity measure more comparable across time since a stock's liquidity is time-varying.
[8] We also explore a variant signal definition of 12-month change in turnover using shares floated. Due to better global historical coverage, we show results for the signal construction based on shares outstanding throughout the paper. Inferences do not change whether we use shares outstanding or shares floated. See appendix A.1.

3. Stock-Level Liquidity

In their seminal publication on liquidity, Amihud and Mendelson (1986) found that investors demand a premium for holding more illiquid stocks such that they command higher-than-average future returns. Since then, there has been continual interest among practitioners and academics alike in better understanding the relationship between stock-level liquidity and future stock returns. In this section, we explore this relationship using our liquidity proxies utilizing portfolio sort methodology. We use the time-series average of quintile return spreads to assess economic significance and use IRs to quantify risk-adjusted performance.

3.1 Is There A Stock-Level Liquidity Premium?

Our results indicate that globally more liquid stocks outperform their less illiquid counterparts using our liquidity proxies. These results have meaningful economic and statistical significance and are consistent with findings from recent literature documenting that stocks with rising liquidity outperform (Bali, Peng, Shen and Tang (2012)). The mispricing appears to be more pronounced for change in liquidity (instead of stock-level liquidity); it is also more pronounced outside the United States. One plausible explanation is that markets outside of the U.S. are less efficient. From January 1995 to June 2015, the annualized average quintile return spreads using 12-month change in turnover and 12-month change in Amihud_LIQ as the sorting signals have yielded 729 and 520 basis points (bps) per annum, respectively, with significance at the 1% level (Exhibit 1). See appendix A.1 for results based on shares floated in the turnover construction.

Exhibit 1: Annualized Capitalization-Neutral Quintile Return Spreads
Jan. 1995 – Jun. 2015

	Turnover	z12m_Turnover	Amihud_LIQ	z12m Amihud_LIQ
Russell 3000	1.57%	7.29% ***	3.51% **	5.20% ***
S&P BMI Europe DM[9]	6.51% ***	7.26% ***	4.52% ***	6.59% ***
S&P BMI Asia DM ex-Japan[10]	2.56%	11.30% ***	1.71%	7.09% ***
S&P BMI Japan	1.03%	6.32% ***	2.57% *	4.29% ***

1) Signals are cap- and GICS industry-neutral 2) monthly rebalancing at month end 3) ***, **, * denote 1%, 5%, 10% significance levels respectively

Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.Backtested returns do not represent the results of actual trading and were constructed with the benefit of hindsight. Returns do not include payment of any sales charges or fees. Inclusion of fees and expenses would lower performance. Past performance is not a guarantee of future results.

To ensure that the excess returns are not mainly driven by the short side (there are more impediments and costs to shorting[11]), we decompose the long-short returns to see how much of the contribution comes from the long-side. For the 12-month change in turnover strategy, the long-side makes economically and statistically significant contribution to the long-short returns. For instance, the long-side (i.e., top quintile containing stocks with the highest positive 12-month change in turnover) of the 12-month change in turnover outperforms the market by 473bps per

[9] S&P BMI Europe Developed Markets
[10] S&P BMI Asia Developed Markets ex-Japan
[11] Some impediments and costs to shorting are: 1) one must locate and borrow the stock from a current owner 2) the stock lender charges a fee to the short seller 3) there is a risk that the short position will involuntarily need to be closed 4) legal and institutional constraints prohibit investors from selling short; See additional details in Jones C.M., O.A. Lamont, "Short-sale constraints and stock returns" Journal of Financial Economics, 66 (2002), 207-239.

annum, which is approximately 65% of the annualized average long-short spread, with significance at the 5% level. As for the 12-month change in Amihud_LIQ, the short-side does mainly drive the long-short return spreads. This result indicates that stocks that have the lowest 12-month change in Amihud_LIQ significantly underperform the market benchmark. Investors may want to monitor these stocks if their liquidity is deteriorating and they are on the long-side of the portfolio. These results are shown in the appendix A.2.

To obtain a better understanding of how the four liquidity proxies[12] relate to each other, we show their average pairwise rank and return correlations in Exhibit 2. Our results indicate that the average pairwise signal rank correlations are positively correlated ranging from 0.15 to 0.48 with significance at the 5% level, but they are not highly positively correlated[13]. One plausible explanation for the relatively low average correlations among the different liquidity proxies is that there are different definitions to liquidity and the four proxies are capturing different aspects of liquidity. Another observation from the result is that correlations are stronger between proxies of stock-level liquidity or proxies of changes in stock level liquidity[14] whereas correlations between liquidity level and change are weaker. This suggests that liquidity level and change in liquidity level are quite different. When considering stock-level liquidity, investors should pay attention to both. Similarly, correlations among quintile return spreads of the liquidity proxies are generally positive (with the exception of the correlation between turnover and z12m_Amihud_LIQ) ranging from -0.21 to 0.41.

Exhibit 2: Correlations among Liquidity Proxies
Russell 3000
Jan. 1995 – Jun. 2015

	Avg Rank Correlations			Returns Correlations		
	Z12m_ Turnover	Amihud_ LIQ	Z12m_ Amihud_LIQ	Z12m_ Turnover	Amihud_ LIQ	Z12m_ Amihud_LIQ
Turnover	0.34 ***	0.48 ***	0.19 ***	0.25 ***	0.41 ***	-0.21 ***
Z12m_Turnover	-	0.15 **	0.48 ***	-	0.30 ***	0.28 ***
Amihud_LIQ	-	-	0.24 ***	-	-	0.16 **

1) Signals are cap- and GICS industry-neutral 2) ***, **, * denote 1%, 5%, 10% significance levels respectively
Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.

3.2 Is the Liquidity Premium Driven by Risk Characteristics?

In the previous section, our results showed that there is a global liquidity mispricing and that the mispricing is most pronounced for change in stock-level liquidity. The next logical question is that whether the mispricing is driven by non-liquidity related characteristics of liquidity portfolios. We consider CAPM[15] beta, market-capitalization, book-to-market, 12-month price momentum[16] (effectively the Fama-French-Carhart factors) and liquidity beta based on work from Pastor and Stambaugh (2003)[17].

[12] turnover, 12-month change in turnover, Amihud_LIQ, 12-month change in Amihud_LIQ
[13] which we define as correlation >= 0.50
[14] proxies of stock-level liquidity: turnover and Amihud; proxies of changes in stock level liquidity: 12-month change in turnover and 12-month change in Amihud_LIQ
[15] Capital Asset Pricing Model – Treynor, Sharpe, Lintner and Mossin
[16] Throughout the paper, 12-month price momentum means 12-month price momentum excluding the most recent month
[17] Pastor, L., and R.F. Stambaugh. "Liquidity Risk and Expected Stock Returns." Journal of Political Economy, 111 (2003), 642-685.

Our results indicate that the portfolio of stocks with the largest increase (decrease) in liquidity tend to have higher (lower) price momentum. The variations of CAPM beta, market-cap, price-to-book and liquidity beta are virtually indistinguishable among the sorted portfolios on change in stock-level liquidity (i.e., no or low correlations with potential diversification benefits). See Exhibit 3. In the following section, we will control the returns for price momentum as well as other risk characteristics[18] to see whether they are the underlying drivers of the returns to the 12-month change in turnover strategy. As an added robustness check, we will also explicitly control for price momentum via a two-way dependent sort methodology.

Exhibit 3: Median Characteristics of Liquidity Portfolios
Russell 3000 Jan. 1995 – Jun. 2015
Liquidity Change Using Turnover as 1-Yr Chg in Turnover as Proxy

	Most Liquid	Bin 2	Bin 3	Bin 4	Least Liquid
60-Month CAPM Beta	0.99	0.99	1.00	1.01	1.01
Market-Cap (USD $MM)	902	913	852	828	832
Book-to-Market	0.43	0.45	0.46	0.47	0.48
Price Momentum	10.55%	8.61%	6.47%	4.78%	4.60%
60-Month Liquidity Beta[19]	0.123	0.122	0.118	0.118	0.128

1) Signals are cap- and GICS industry-neutral
Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.

In Exhibit 4, we show quintile return spreads after controlling for market beta, size, value, and price momentum. Our results indicate that the global liquidity mispricing is not driven by market, size, value, and price momentum. The results are especially strong using changes to liquidity and outside of U.S. For instance, the annualized average quintile return spreads for 12-month change in turnover after adjustments range from 651bps to 1247bps per annum globally with significance at the 1% level. In appendix A.3, we show the exposures of Fama-French-Carhart characteristics for z12m_Turnover. Our results indicate that the quintile return spreads of z12m_Turnover have very limited exposures to Fama-French-Carhart characteristics.[20] This suggests that there are diversification benefits to be had of adding change in liquidity to size, value and price momentum.

To ensure the results in the above exhibit are not mainly driven by the short-side of the quintile return spreads, we decompose the long-short returns and show the adjusted returns from the long-side (top quintile) in appendix A.5. Our results indicate that the adjusted returns to the long-side make economically and statistically significant contribution to the long-short adjusted returns ranging from 265bps to 1028bps per annum globally with significance (at least) at the 10% level. In the interest of not cluttering up the main body of the paper, we only show results for change in stock-level liquidity in Exhibits 4. Results for stock-level liquidity for all four proxies of liquidity are available in appendix A.4 and A.5.

[18] We still control for size and value risk dimensions because they still could drive some of the returns from change in stock-level strategies despite the fact that they don't show much variations among the liquidity portfolios at the signal level. Returns could still be correlated while the signals are not.
[19] Data is between Jan. 1995 and Dec. 2014 because Pastor and Stambaugh update their data up until Dec. 2014. The betas are calculated from a rolling 60-month time-series regression (along with the Fama-French three factors) with a minimum data availability of 36-month.
[20] Throughout the paper, we form portfolios based on signals that are cap- and GICS-industry neutral. The exposures globally virtually do not change when we remove these controls outside of the U.S. In the U.S. the exposures to market size, value and price momentum become -0.07, -0.09, 0.04, and 0.12, respectively.

Exhibit 4: Annualized Capitalization-Neutral Quintile Return Spreads
after Controlling for the Underlying Characteristics of the Liquidity Portfolios
Jan. 1995 – Jun. 2015

	Long-Short		Long in Excess of Market Returns	
	Z12m Turnover	Z12m_Amihud_LIQ	Z12m Turnover	Z12m_Amihud_LIQ
Russell 3000	7.11% ***	5.45% ***	3.36% ***	0.32%
S&P BMI Europe DM	7.47% ***	4.99% ***	10.28% ***	7.71% ***
S&P BMI Asia DM ex-Japan	12.47%***	5.35% **	7.09% ***	1.38%
S&P BMI Japan	6.51% ***	3.72% ***	2.65% *	0.75%

1] Signals are cap- and GICS industry-neutral 2] monthly rebalancing at month end 3] ***, **, * denote 1%, 5%, 10% significance levels respectively based on Newey-West t-statistic 4] Fama-French-Carhart adjusted-returns
Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.Backtested returns do not represent the results of actual trading and were constructed with the benefit of hindsight. Returns do not include payment of any sales charges or fees. Inclusion of fees and expenses would lower performance. Past performance is not a guarantee of future results.

As an added robustness check, we employ a two-way dependent sort to ascertain whether the outperformance for the 12-month change in stock-level turnover is driven by the 12-month price momentum strategy. First, we sort stocks into quintile bins using the 12-month price momentum signal. Then within each of the quintile bins, we sort by the 12-month change in stock-level turnover signal. In Exhibit 5, we show the quintile return spreads after conditioning on the 12-month price momentum strategy. In each of the bins, the quintile return spreads using 12-month change in stock-level turnover as the sorting signal are economically and statistically significant at the 5% significance level. This indicates that returns from the 12-month change in stock-level turnover strategy are not driven by the exhibited variation in price momentum among the liquidity portfolios.

Exhibit 5: Annualized Quintile Return Spread of 12-Month Change in Stock-Level Turnover
Conditioned on 12-Month Price Momentum via Two-Way Dependent Sort
Russell 3000 Jan. 1995 – Jun. 2015

	12-Month Price Momentum				
	Highest	Bin 2	Bin 3	Bin 4	Lowest
12-Mth Change in Turnover LS Spread	4.91% ***	5.85% ***	6.73% ***	6.24% ***	8.75% ***

1] Signals are cap- and GICS industry-neutral 2] monthly rebalancing at month end 3] ***, **, * denote 1%, 5%, 10% significance levels respectively
Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.Backtested returns do not represent the results of actual trading and were constructed with the benefit of hindsight. Returns do not include payment of any sales charges or fees. Inclusion of fees and expenses would lower performance. Past performance is not a guarantee of future results.

3.3 How Does Liquidity Stack Up Against Other Stock Selection Signals?

Based on our results from the last two sections, there appears to be a liquidity mispricing globally for 12-month change in turnover and Amihud_LIQ. The next logical question is how well does liquidity measure up to other commonly used stock selection signals such as price momentum, value and quality. We use 12-month change in turnover as the representative for liquidity; 12-month price momentum excluding the most recent month for momentum; earnings yield for value; and return on equity (ROE) for quality.

Our results indicate that in the past twenty years the annualized average quintile return spread to the 12-month change in turnover has been the best or second best performing stock selection

signal globally, with the exception of Europe (where it still yielded 726bps per annum with significance at the 1% level). Even in Japan where most commonly used stock selection signals do not work (except for value), the 12-month change in turnover yields the highest quintile return spread yielding 632bps per annum with significance at the 1% level. Using IR as a proxy for risk-adjusted returns, the historical performance of 12-month change in turnover has been even stronger. It has the best or the second best IRs in each of the four regions. This suggests not only that the 12-month change in turnover strategy is highly profitable globally, but also that the strategy is relatively stable without large oscillations in performance. See Exhibit 6.

Exhibit 6: Economic Significance and IRs of Historical Annualized Quintile Spread EW Returns of Long-Short Cap-Neutral Returns Jan. 1995 – Jun. 2015

	1-Yr Chg in Turnover (Liquidity)	Pmom12m1m (Price Mom)	Earnings Yield (Value)	ROE (Quality)
Russell 3000	7.29% ***	5.41% *	7.34% ***	6.16% ***
S&P BMI Europe DM	7.26% ***	12.43% ***	10.59% ***	10.89% ***
S&P BMI Asia DM ex-Japan	11.30% ***	12.90% ***	9.09% ***	7.79% ***
S&P BMI Japan	6.32% ***	0.29%	5.53% ***	1.13%

1) Signals are cap- and GICS industry-neutral 2) monthly rebalancing at month end 3) ***, **, * denote 1%, 5%, 10% significance levels respectively

Risk-Reward Tradeoff – Historical Annualized Information Ratio

	1-Yr Chg in Turnover (Liquidity)	Pmom12m1m (Price Mom)	Earnings Yield (Value)	ROE (Quality)
Russell 3000	1.78	0.37	0.69	0.64
S&P BMI Europe DM	1.71	0.99	1.81	1.61
S&P BMI Asia DM ex-Japan	1.26	0.84	0.81	0.75
S&P BMI Japan	1.18	0.02	0.79	0.14

1) Signals are cap- and GICS industry-neutral 2) monthly rebalancing at month end

Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.Backtested returns do not represent the results of actual trading and were constructed with the benefit of hindsight. Returns do not include payment of any sales charges or fees. Inclusion of fees and expenses would lower performance. Past performance is not a guarantee of future results.

Similar to the previous two sections, we separate out and show the market-adjusted top quintile returns and their respective IRs from the long-short strategies. The 12-month change in turnover shows equally impressive results here. Market-adjusted top quintile returns and IRs for 12-month change in turnover are among the best or second best in terms of performance among the four examined signals. For instance in the U.S. market, the top quintile portfolio of stocks has outperformed the market by 473bps per annum with significance at the 5% level with an annualized IR of 0.45 whereas the top quintile portfolio of stocks for earnings yield, the second best performing signal, outperformed the market by 407bps per annum with a lower annualized IR of 0.34. See Exhibit A.6 in the appendix.

To get a better understanding of how the 12-month change in turnover interacts with the other three commonly used stock selection signals, we show average rank and return correlations of the four signals in Exhibit 7. At the signal level, our results indicate that the 12-month change in turnover is uncorrelated with price momentum, earnings yield and ROE globally. As for return correlations, the 12-month change in turnover has low correlations of 0.15, 0.07, and 0.13 with price momentum, earnings yield, and ROE, respectively. Outside of the U.S., the correlations are

muted. The main takeaway from the correlation analysis is that the 12-month change in turnover has virtually no or very low (<0.2) correlations with other alpha signals both at the signal and return levels. This implies that a composite of the 12-month change in turnover signal with any one of the examined signals should deliver a superior risk-adjusted performance.

Exhibit 7: Correlations of 1-Yr Chg in Turnover with Common Stock Selection Signals
Jan. 1995 – Jun. 2015

	Avg Rank Correlations			Returns Correlations		
	Price Momentum	Earnings Yield	ROE	Price Momentum	Earnings Yield	ROE
Russell 3000	0.09	0.01	0.03	0.15 **	0.07	0.13 **
S&P BMI Europe DM	-0.03	0.03	0.03	-0.19 ***	0.07	-0.04
S&P BMI Asia DM ex-Japan	0.02	-0.01	0.03	0.08	-0.05	-0.06
S&P BMI Japan	0.00	-0.02	-0.01	0.02	-0.09	-0.09

1) Signals are cap- and GICS industry-neutral 2) ***, **, * denote 1%, 5%, 10% significance levels respectively
Source: S&P Capital IQ Quantamental Research. Results are as of 06/30/2015.Backtested returns do not represent the results of actual trading and were constructed with the benefit of hindsight. Returns do not include payment of any sales charges or fees. Inclusion of fees and expenses would lower performance. Past performance is not a guarantee of future results.

In Exhibit 8, we equally blend 12-month change in turnover and value, price momentum, and quality factors at the signal level to form a liquidity composite signal. Our results show that every composite signal globally shows improved returns and IRs versus the standalone factor signals. The value-add is especially pronounced for value and quality. For instance, in the U.S. the market-adjusted top quintile return of a composite strategy of 12-month change in turnover and earnings yield improved to 558bps per annum, from 407bps per annum for earnings yield alone, and the IR improves to 0.54 from 0.34. The improvement in IR of the composite is larger than the improvement in returns. This suggests that by adding 12-month change in turnover to earnings yield, the composite strategy has both higher returns and less risk than the standalone earnings yield. In fact, we see this improvement in stability for all the composites globally. See Exhibit 8.

Exhibit 8: Performance of Adding 1-Yr Change in Turnover to Common Stock Selection Signals
Market-Adjusted Top Quintile Returns and Information Ratios
Jan. 1995 – Jun. 2015

	Raw Factor Returns			Raw + Liquidity Composite Returns		
	Price Mom	Earnings Yield	ROE	Price Mom + LIQ	Earnings Yield + LIQ	ROE + LIQ
Russell 3000	3.29%	4.07%	2.70%	4.37%*	5.58%**	4.74%**
S&P BMI Europe DM	4.95%***	3.13%**	3.54%***	5.85%***	5.29%***	5.07%***
S&P BMI Asia DM ex-Japan	3.68%**	2.62%	1.40%	6.30%***	5.88%***	5.62%***
S&P BMI Japan	-1.21%	3.28%*	-0.48%	1.29%	4.15%**	1.95%

	Raw Factor IR			IR of Composite: Raw + Liquidity		
	Price Mom	Earnings Yield	ROE	Price Mom + LIQ	Earnings Yield + LIQ	ROE + LIQ
Russell 3000	0.26	0.34	0.25	0.41	0.54	0.49
S&P BMI Europe DM	0.72	0.45	0.61	1.01	0.81	0.94
S&P BMI Asia DM ex-Japan	0.44	0.24	0.21	0.91	0.69	0.85
S&P BMI Japan	-0.17	0.38	-0.07	0.20	0.54	0.29

1) Signals are cap- and GICS industry-neutral 2) monthly rebalancing at month end 3) ***, **, * denote 1%, 5%, 10% significance levels respectively

Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.Backtested returns do not represent the results of actual trading and were constructed with the benefit of hindsight. Returns do not include payment of any sales charges or fees. Inclusion of fees and expenses would lower performance. Past performance is not a guarantee of future results.

3.4 A Liquidity Enhanced Short-Term Reversal Signal

Lo and MacKinlay (1998) shows that stock returns could either have positive or negative autocorrelations. Empirical research suggests that stock returns have positive autocorrelations (i.e. price momentum) at the monthly frequency (Jegadeesh and Titman 1993) and have negative autocorrelations at the daily frequency (i.e., short-term reversal) (Jegadeesh 1991). According to Llorente, Saar, and Wang (2002), information asymmetry may play a role in explaining positive and negative return autocorrelations. In their study, they argue that investors fall into either speculators or hedgers. Returns from hedging activities tend to revert while returns from speculating activities tend to trend.

In the previous section, our results indicate that composites from equal-weighted blends of 12-month change in turnover and commonly used stock selection factors at the signal level improve both excess returns and IRs globally. This occurs because 12-month change in turnover has low correlations with commonly used stock selection factors. In this section, we show how to improve short-term reversal by conditioning on changes in liquidity using 12-month change in turnover as the proxy.

In Exhibit 9, we show Fama-Macbeth estimates of 1-month price reversal for all stocks, 1-month price reversal among stocks with positive 12-month change in turnover, and short-term reversal for stocks with negative 12-month change in turnover for the U.S. market. Our results indicate that short-term reversal on average has yielded 4.10% per annum in Russell 3000 in the past twenty years. However, short-term reversal is most pronounced among stocks with negative liquidity change yielding 5.28% per annum, 2.37% higher than short-term reversal among stocks with positive liquidity change.

Exhibit 9: Short-Term Reversal and Liquidity Change
Fama-Macbeth Estimates in Russell 3000 Jan. 1995 – Jun. 2015

	All Stocks	Stocks with Negative 12-month Change in Turnover Only	Stocks with Positive 12-month Change in Turnover Only
Annualized Return	4.10% ***	5.28% ***	2.91%***
Annualized IR	1.08	1.30	0.73

1) Signals are cap- and GICS industry-neutral 2) monthly rebalancing at month end 3) ***, **, * denote 1%, 5%, 10% significance levels respectively

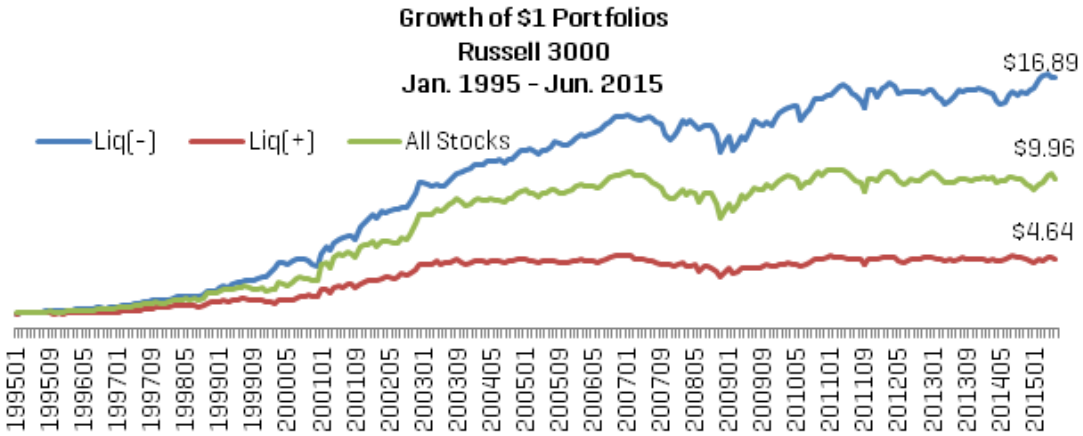
Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.Backtested returns do not represent the results of actual trading and were constructed with the benefit of hindsight. Returns do not include payment of any sales charges or fees. Inclusion of fees and expenses would lower performance. Past performance is not a guarantee of future results.

Based on the results in Exhibit 9, we see that the short-term reversal effect is most pronounced among stocks with deteriorating liquidity. Hence, we propose a way to improve upon the traditional short-term reversal strategy by creating a liquidity enhanced short-term reversal strategy by conditioning short-term reversal on liquidity change. The methodology that we use is a two-way

dependent sort. First, we sort stocks into tertile bins using 12-month change in turnover. We denote the top tertile that has stocks with the most improvement in liquidity as LIQ[+] and the bottom tertile that has stocks with the most deterioration in liquidity as LIQ[-]. Then, we form our one-month price reversal long-short quintile return spread strategies within LIQ[+] and LIQ[-], respectively.

There are on average about 400 stocks for each of the two long-short strategies. We compare the historical performance of these two strategies to the regular one-month price reversal strategy that is formed by taking the decile return spread where the strategy has about 600 stocks on average. We show their historical performance in the U.S. in Exhibit 13. Our results indicate that the performance of the 1-month price reversal strategy for stocks that have experienced the most deterioration in liquidity has historically outperformed the reversal strategy for stocks that have experienced the most improvement in liquidity and has outperformed the unconditioned one-month price reversal strategy by 603bps and 215bps per annum[21], respectively. Moreover, the volatility of the price reversal strategy among stocks with the most deterioration in liquidity has the lowest annualized volatility among all three strategies. See the annualized IRs for all three strategies in Exhibit 10.

Exhibit 10: One-Month Price Reversal Factor Conditioned on 12-Month Change in Turnover



	Short-Term Reversal		
	Liq[-]	Liq[+]	All Stocks
Annualized Avg Monthly Return	14.40% ***	8.37% ***	12.25%***
Annualized Stdev (Monthly Returns)	11.18%	13.36%	14.48%
Annualized IR	1.29	0.63	0.85

1) Signals are cap- and GICS industry-neutral 2) monthly rebalancing at month end 3) ***, **, * denote 1%, 5%, 10% significance levels respectively

Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.Backtested returns do not represent the results of actual trading and were constructed with the benefit of hindsight. Returns do not include payment of any sales charges or fees. Inclusion of fees and expenses would lower performance. Past performance is not a guarantee of future results.

[21] 603bps = difference in annualized returns between Liq[-] and Liq[+] in Exhibit 10; 215 bps = difference in annualized returns between Liq[-] and All Stocks in Exhibit 10

3.5. Why Change in Stock-Level Liquidity Works?

According to Bali, Peng, Shen and Tang (2012), one plausible explanation of why change in stock-level liquidity has historically worked and may continue to work in the future is investors' underreaction due to limited investors' attention and slow adjustment in stock price due to illiquidity. They argue that change in stock-level liquidity is positively correlated and since investors demand a premium for holding less liquid stocks, stocks with rising (declining) liquidity should lead to a lower risk premium with an instantaneous price increase (decrease) and, therefore, lower (higher) future expected returns. However, this market reaction is not priced in immediately and future stock returns drift in the same direction as past change in stock-level liquidity. See Exhibit 11 for forward returns from month 0 to 6 after forming our quintile portfolios based on change in stock-level liquidity in month 0. Our results indicate that the drift continues for three months with meaningful economic and statistical significance in our sample period.

Exhibit 11: T Month Ahead Annualized Quintile Return Spreads
for Change in Stock-Level Liquidity
Russell 3000
Jan. 1995 – Jun. 2015

	Forward Months						
	Month 0	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6
z12m_Turnover	16.61% ***	7.11% ***	1.82%**	2.11%***	-0.39%	-0.65%	0.00%

1) Signals are cap- and GICS industry-neutral 2) monthly rebalancing at month end 3) ***, **, * denote 1%, 5%, 10% significance levels respectively based on Newey-West t-statistic 4) Returns are Fama-French-Carhart adjusted

Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.Backtested returns do not represent the results of actual trading and were constructed with the benefit of hindsight. Returns do not include payment of any sales charges or fees. Inclusion of fees and expenses would lower performance. Past performance is not a guarantee of future results.

They provide two possible reasons for the underreaction: limited investors' attention and slow adjusting price due to illiquidity. For the limited investors' attention reasoning, they cite the work from Kahneman's (1973) theory of attention. The application to financial economics is that investors have limited bandwidth to process information and since change in stock-level liquidity is not well-defined and less tangible, average investors have a hard time interpreting the pricing implications. Therefore, they go on to argue that the price impact is spilled over to the future months. They substantiate the attention-based underreaction hypothesis by predicting the returns due to change in stock-level liquidity should be the largest among stocks that investors pay the least attention to. They use stock size, analyst coverage and institutional ownership as proxies for investor attention. Their results from doing a two-way dependent quintile sort by conditioning change in stock-level liquidity on one of the three proxies for investor attention show that return spreads due to change in liquidity monotonically increase from the quintile with the largest market-capitalization, the highest analyst coverage or the highest institutional ownership to the quintile with the smallest market-capitalization, the fewest analyst coverage or the lowest institutional ownership. We confirm their results for institutional ownership in Exhibit 12. Our results suggest that indeed the returns to change in stock-level liquidity strategy are the largest for stocks that have the lowest institutional ownership.

Exhibit 12: Quintile Return Spread of Two-Way Dependent Sort
of Change in Stock-Level Liquidity Conditioned on Institutional Ownership as a % of Shares Floated
Russell 3000 Jan. 2004 – Jun. 2015

	Institutional Ownership as a % of Shares Floated				
	Highest	Bin 2	Bin 3	Bin 4	Lowest
z12m_Turnover	-1.20%	1.63%	1.51%	3.79% **	4.82% *

1) ***, **, * denote 1%, 5%, 10% significance levels respectively based on Newey-West t-statistic 2) Returns are Fama-French-Carhart adjusted

Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.Backtested returns do not represent the results of actual trading and were constructed with the benefit of hindsight. Returns do not include payment of any sales charges or fees. Inclusion of fees and expenses would lower performance. Past performance is not a guarantee of future results.

As for investors' underreaction due to slow adjustment in price due to illiquidity, they argue that information is revealed via trading. Since more illiquid stocks are harder to trade, the permeation of material information via movement in prices for these stocks is slower. Informed investors trade less (more) aggressively when liquidity is low (high) and when transaction costs are high (low). Hence, the price adjustments that are associated with change in stock-level liquidity are not priced in immediately and therefore drift. Bali, Peng, Shen and Tang (2012) test the illiquidity reasoning by doing a two-way quintile dependent sort by conditioning change in stock-level liquidity on illiquidity using Amihud measure as a proxy. We confirm their results in Exhibit 13. Our results suggest that indeed the returns to change in stock-level liquidity strategy are the largest for stocks that have the lowest stock-level liquidity. The average difference in quintile return spreads for 12-month change in stock-level turnover is in the mid-teens. See Exhibit 13.

Exhibit 13: Quintile Return Spread of Two-Way Dependent Sort
of Change in Stock-Level Liquidity Conditioned on Stock-Level Liquidity Level
Russell 3000 Jan. 1995 – Jun. 2015

	Stock-Level Liquidity (using Inverse of Amihud Measure as Proxy)				
	Highest	Bin 2	Bin 3	Bin 4	Lowest
z12m_Turnover	-1.99%	1.03%	5.29% ***	9.43% ***	16.28% ***

1) ***, **, * denote 1%, 5%, 10% significance levels respectively based on Newey-West t-statistic 2) Returns are Fama-French-Carhart adjusted

Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.Backtested returns do not represent the results of actual trading and were constructed with the benefit of hindsight. Returns do not include payment of any sales charges or fees. Inclusion of fees and expenses would lower performance. Past performance is not a guarantee of future results.

3.6 Robustness

To ensure that our results for 12-month change in stock-level turnover are robust, in appendix A.7, we show quintile return spreads for 6-, 18-, 24- and 36-month change in stock level turnover. Our results here indicate both economic and statistical significance at the 5% significance level ranging from 434bps to 711bps (see appendix A.7).

We also show subsample results specifically the U.S. results starting May 2001 post-decimalization where the U.S. stocks moved to penny increments from one-sixteenth of a dollar increments in appendix A.8.[22] Our post-decimalization quintile return spreads also show economic and statistical significance at the 5% significance level ranging from 337bps to 581bps (see appendix A.8).

3.7 Section Summary

Our results suggest that there is a global liquidity mispricing, with the mispricing most pronounced using changes in liquidity and outside of the U.S. market. The mispricing is not driven by market, size, value, or price momentum. Liquidity has historically offered an attractive risk-reward tradeoff and economically significant returns while being virtually uncorrelated to commonly used stock selection signals such as price momentum, earnings yield, and ROE. When change in liquidity is added to one of commonly used signals, the composite's excess return and IR are better than those of the standalone raw factor's. Two possible causes of why change in stock-level liquidity has historically worked and may continue to work in the future are limited investor attention and slow adjustment in price due to illiquidity.

4. Market-Wide Liquidity

Up to this point, the study has explored stock-level liquidity and changes in liquidity. In this section, we explore market-wide liquidity using the four previously defined stock-level liquidity proxies. The market-wide liquidity proxies are aggregated from their respective stock-level proxies by cap-weighting.

A Brief Note on the Evolution of Liquidity in Equity Markets

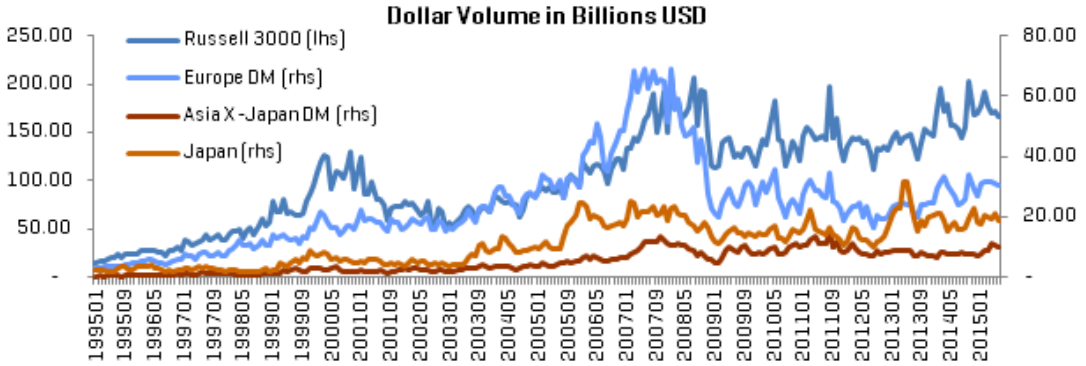
Evolution in global equity markets due to regulatory changes has had a meaningful impact on both market-wide and stock-level liquidity. In Exhibit 11, we plot monthly dollar volumes traded globally since January 1995. We see that there has been a gradual increase in dollar volume over time where the U.S. has the highest dollar volume and Asia Developed Markets ex-Japan the lowest. Japan's market-wide dollar volume has improved recently and we attribute this mainly to Abenomics[23].

The market-wide dollar volume trend for Europe Developed Markets is approximately 50% off of its historical highs that were reached in 2007. We attribute the substantial reduction in dollar volume in Europe Developed Markets to the region's lack of growth since the Global Financial Crisis. In general, there is an upward trend in the global nominal dollar volume. The upward trend is not surprising as the world's economy grows larger over time due to positive inflation, productivity

[22] U.S. stock prices starting in April 2001 are quoted in a decimal format rather than fractions.
[23] Abenomics is the name given to a suite of measures introduced by Japanese prime minister Shinzo Abe to revive the sluggish Japanese economy with "three arrows": a massive fiscal stimulus, more aggressive monetary easing from the Bank of Japan, and structural reforms to boost Japan's competitiveness.

improvement, technological advancement and liquidity-adding regulatory changes such as Regulation ATS[24] in 1998, decimalization[25] in 2001 and Regulation NMS[26] in 2005.

Exhibit 14: Nominal Dollar Volume
Jan. 1995 – Jun. 2015

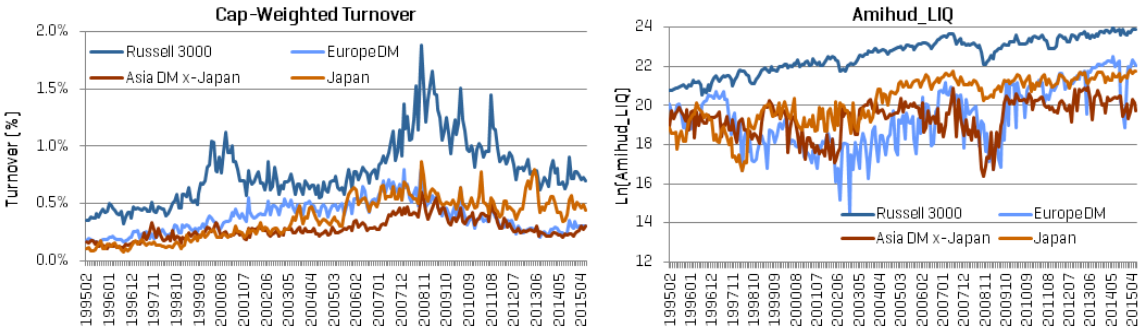


Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.

4.1 Market-Wide Liquidity

In this section, we show historical market-wide liquidity trends using turnover and Amihud_LIQ as proxies for liquidity (see Exhibit 12). The takeaways from market-wide liquidity plots are that unsurprisingly the U.S. market is the most liquid market, as measured by turnover, and has the lowest price impact, as measured by Amihud_LIQ. In contrast, Asia DM ex-Japan is the least liquid and has the highest price impact. Market-wide liquidity as measured by both proxies indicates that over time turnover is increasing and price impact is getting smaller in global equity markets.

Exhibit 15: Global Turnover and Amihud_LIQ Trends
Jan. 1995 – Jun. 2015



1) Market-wide liquidity measures are aggregated from stock-level measures using cap-weighting 2) The scale of y-axis is the natural log of Amihud_LIQ and the usage of the natural log is purely for scaling purpose (i.e., the y-axis scale is not too meaningful in absolute terms but is more meaningful in relative terms).

Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.

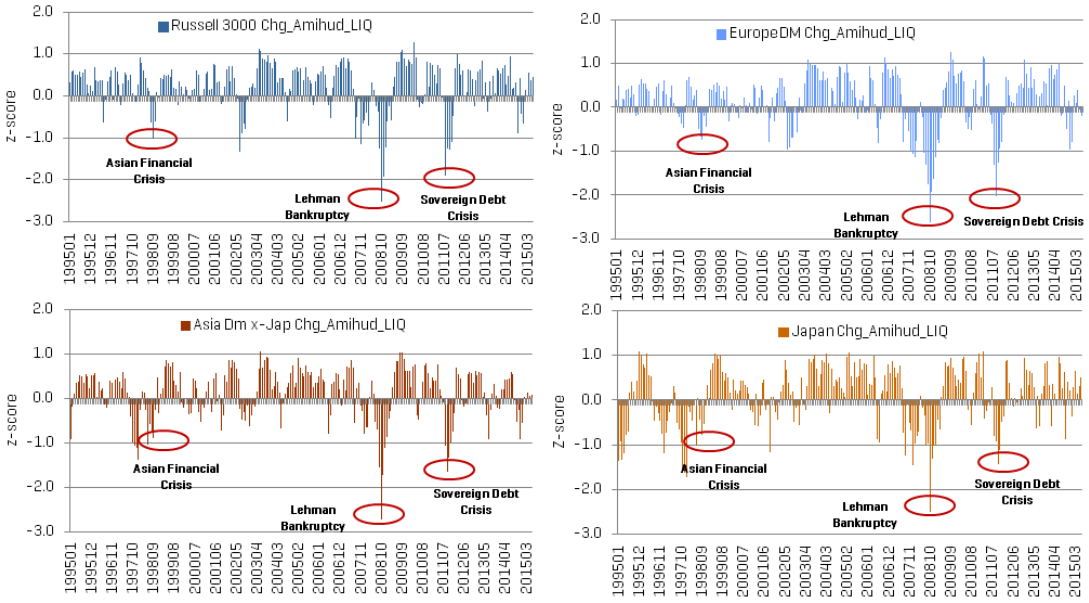
[24] Regulation ATS, was introduced by the Securities and Exchange Commission (SEC) to allow alternative trading systems to choose whether to register as national securities exchanges, or to register as broker-dealers and comply with additional requirements under Regulation ATS, depending on their activities and trading volume.
[25] U.S. stock prices starting in April 2001 are quoted in a decimal format rather than fractions.
[26] Regulation NMS, is a series of rules designed to modernize and strengthen the national market system ("NMS") to improve transparency in pricing and execution.

4.2 Changes to Market-Wide Liquidity

As we have seen, market-wide liquidity, as measured by Amihud_LIQ, has trended upward globally with occasional liquidity drawdown (i.e., liquidity dry-spells). Market-wide liquidity drawdowns seem to coincide with major financial market or geopolitical events where equity investors may be less willing to trade. These episodes of dry-spells or liquidity shocks could potentially be captured by changes in market-wide liquidity. In this section, we examine the market-wide 12-month change in Amihud, z12m_Amihud_LIQ, as our proxy. See Exhibit 13.

Interestingly, our results indicate an asymmetry, both in the number and magnitude, between states of positive and negative liquidity spikes or shocks. There are 50% fewer episodes of strong negative changes in market-wide liquidity (i.e., illiquidity shocks), than there are positive spikes. On average globally, there are about twice as many months with positive liquidity changes (164 months) than there are months with negative liquidity changes (82 months), but the negative liquidity changes have more extreme episodes. This is consistent with what we observe empirically in equity markets where there are occasional liquidity dry-spells due to sudden shocks caused by macroeconomic or geopolitical events.

Exhibit 16: Changes in Market-Wide Liquidity – z12m_Amihud_LIQ
Jan. 1995 – Jun. 2015



Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.

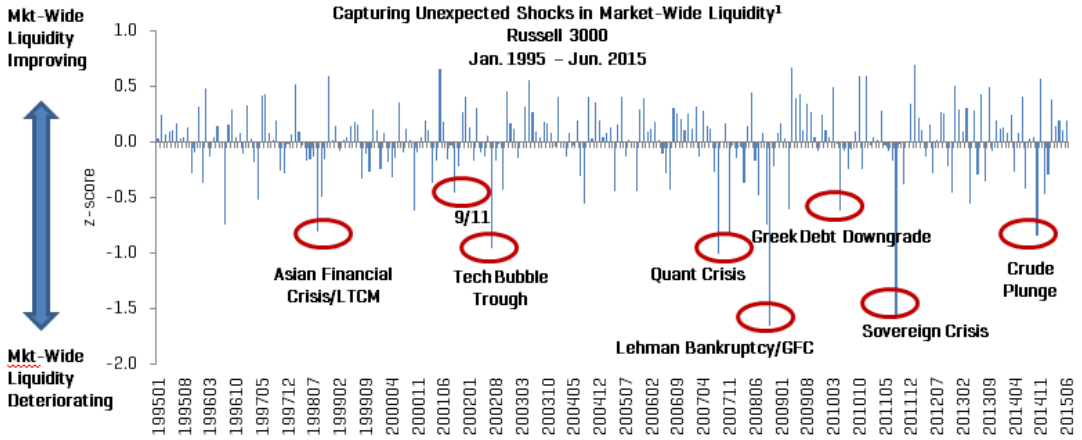
In the above plots, we notice that one of the issues with changes to market-wide liquidity using 12-month change in Amihud_LIQ as a proxy is positive autocorrelation (i.e., a positive value in one period is followed by another positive value in the subsequent period). Since unexpected changes to market-wide liquidity are more informative as market participants have not anticipated them, we remove the positive autocorrelation to see whether we could infer additional insights.

We adjust for the serial correlation in z12m_Amihud_LIQ (change in market-wide liquidity) by using an autoregressive model with a lag of 1 – AR(1). This simple model sufficiently removes the

correlations (i.e., the residuals are no longer correlated). In Exhibit 17, we plot the residuals from this adjusted time-series where the residuals are interpreted economically as unexpected liquidity changes or shocks.

Our results suggest that the AR(1) model does a good job of capturing unexpected market-wide negative liquidity shocks that were associated with major historical events in the US market in the past 20 years. The largest unexpected negative liquidity shock or dry-spell since January 1995 (unsurprisingly) occurred during the Global Financial Crisis in the aftermath of Lehman bankruptcy. Other large unexpected negative liquidity shocks are the Asian Financial Crisis/LTCM, 9/11, the Tech bubble, the quant crisis, and most recently the crude oil plunge during the late summer of 2014. Usually, a big negative shock in liquidity is followed by a positive shock in liquidity, albeit on a smaller scale.

Exhibit 17: Capturing Unexpected Market-Wide Liquidity Shocks in the U.S. Equity Market
Russell 3000 Jan. 1995 – Jun. 2015



Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.

5. Universe and Data

The study covers both the U.S. and the international markets. The Russell 3000 index is used as a representative of the U.S. market. S&P BMI Developed Markets Europe, which contains developed European countries, is used as a proxy for the European market. The countries in this index include Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and United Kingdom. S&P BMI Developed Markets Asia Pacific ex-Japan, which contains developed Asian countries, represents the Asian markets excluding Japan. The countries in this index include Australia, Hong Kong, New Zealand, Singapore, and South Korea. S&P BMI Japan is used as a proxy for Japan. The sample data time period goes from January 1995 to June 2015. The financial data utilizes S&P Global Market Intelligence's Point-In-Time global data. The total returns data are from S&P Global Market Intelligence's market data package. Financial and market data are trimmed and then winsorized at the 0.5% and 99.5% percentile.

6. Conclusion

Our results suggest that there is a global liquidity mispricing where the mispricing is most pronounced using changes in liquidity and outside of the U.S. market. The mispricing is not driven by market, size, value, or price momentum. Liquidity has historically offered an attractive risk-reward tradeoff and economically significant returns while being virtually uncorrelated to commonly used stock selection signals such as price momentum, earnings yield or ROE. When change in liquidity is added to one of commonly used stock selection signals, a composite's excess return and IR are higher than the standalone raw factor's.

Our results also show that at the market-wide level liquidity trends have historically increased over time with the U.S. market being the most liquid with the smallest price impact and the Asia DM ex-Japan market the least liquid with the highest price impact. Changes to liquidity seem to have been more adept at capturing major financial events in history. A simple AR(1) model sufficiently removes the serial correlation in the market-wide liquidity changes and captures unexpected negative liquidity shocks from major historical market events.

Appendix

Exhibit A.1: Annualized Fama-French Adjusted Long-Short Cap-Neutral Quintile Return Spreads using Shares Floated in the Construction of Turnover
Russell 3000: Jul. 1998 – Jun. 2015; International: Dec. 2005 – Jun. 2015

	Using Shares Outstanding		Using Shares Floated	
	Turnover	z12m_Turnover	Turnover	z12m_Turnover
Russell 3000	-0.59%	7.21% ***	0.17%	6.63% ***
S&P BMI Europe DM	0.97%	5.62% ***	1.39%	5.61% ***
S&P BMI Asia DM ex-Japan	-3.55%	12.44% ***	-1.20%	11.17% ***
S&P BMI Japan	-3.53%	3.13% ***	-3.85%	2.85% ***

1) Signals are cap- and GICS industry-neutral 2) monthly rebalancing at month end 3) ***, **, * denote 1%, 5%, 10% significance levels respectively 4) Fama-French-Carhart adjusted-returns

Exhibit A.2: Annualized Capitalization-Neutral Market-Adjusted Top Quintile Returns
Jan. 1995 – Jun. 2015

	Turnover	z12m_Turnover	Amihud_LIQ	z12m Amihud_LIQ
Russell 3000	0.02%	4.73% **	1.47%	1.58%
S&P BMI Europe DM	0.42%	3.16% **	0.63%	1.40%
S&P BMI Asia DM ex-Japan	-1.80%	4.99% ***	-2.55%	1.15%
S&P BMI Japan	-1.04%	2.68%	0.42%	1.08%

1) Signals are cap- and GICS industry-neutral 2) monthly rebalancing at month end 3) ***, **, * denote 1%, 5%, 10% significance levels respectively

Exhibit A.3: Fama-French-Carhart Alpha and Exposures of Quintile Return Spread of z12m_Turnover
Jan. 1995 – Jun. 2015

	Annualized Avg Mthly Alpha	Avg Mthly Alpha	Market Beta	Size Beta	Value Beta	Momentum Beta
Russell 3000	7.11% ***	0.59% ***	0.03 *	-0.04	-0.01	0.01
S&P BMI Europe DM	7.47% ***	0.62% ***	-0.02 *	-0.01	0.06 **	-0.05 **
S&P BMI Asia DM ex-Japan	12.46% ***	1.04% ***	-0.00	-0.00	-0.04	-0.08 **
S&P BMI Japan	6.49% ***	0.54% ***	0.05 **	0.00	-0.02	-0.03

1) Signals are cap- and GICS industry-neutral 2) monthly rebalancing at month end 3) ***, **, * denote 1%, 5%, 10% significance levels respectively

Exhibit A.4: Annualized Long-Short Capitalization-Neutral Quintile Return Spreads after Controlling for the Underlying Characteristics of the Liquidity Portfolios
Jan. 1995 – Jun. 2015

	Turnover	Z12m Turnover	Amihud_LIQ	Z12m_Amihud_LIQ
Russell 3000	-1.45%	7.11% ***	2.97% **	5.45% ***
S&P BMI Europe DM	6.75% ***	7.47% ***	4.54% ***	4.99% ***
S&P BMI Asia DM ex-Japan	1.28%	12.47% ***	0.00%	5.35% **
S&P BMI Japan	2.03%	6.51% ***	3.11% ***	3.72% ***

1) Signals are cap- and GICS industry-neutral 2) monthly rebalancing at month end 3) ***, **, * denote 1%, 5%, 10% significance levels respectively based on Newey-West t-statistic 4) Fama-French-Carhart adjusted-returns

Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.Backtested returns do not represent the results of actual trading and were constructed with the benefit of hindsight. Returns do not include payment of any sales charges or fees. Inclusion of fees and expenses would lower performance. Past performance is not a guarantee of future results.

Exhibit A.5: Annualized Fama-French Adjusted Long-Only Cap-Neutral Excess Returns
Jan. 1995 – Jun. 2015

	Turnover	Z12m Turnover	Amihud_LIQ	Z12m_Amihud_LIQ
Russell 3000	-5.11% **	3.36% ***	0.10%	0.32%
S&P BMI Europe DM	7.66% ***	10.28% ***	7.64% ***	7.71% ***
S&P BMI Asia DM ex-Japan	-1.22%	7.09% ***	-2.20%	1.38%
S&P BMI Japan	-0.42%	2.65% *	0.60%	0.75%

1) Signals are cap- and GICS industry-neutral 2) monthly rebalancing at month end 3) ***, **, * denote 1%, 5%, 10% significance levels respectively based on Newey-West t-statistic 4) Fama-French-Carhart adjusted-returns

Exhibit A.6: Economic Significance and Risk-Reward Tradeoff of
Market-Adjusted Top Quintile Cap-Neutral Returns Jan. 1995 – Jun. 2015
Economic Significance – Historical Annualized Market-Adjusted Top Quintile Returns

	1-Yr Chg in Turnover (Liquidity)	Pmom12m1m (Price Mom)	Earnings Yield (Value)	ROE (Quality)
Russell 3000	4.73% **	3.29%	4.07%	2.70%
S&P BMI Europe DM	3.16% **	4.95% ***	3.13% **	3.54% ***
S&P BMI Asia DM ex-Japan	4.99% ***	3.68% **	2.62%	1.40%
S&P BMI Japan	2.68%	-1.21%	3.28% *	-0.48%

1) Signals are cap- and GICS industry-neutral 2) monthly rebalancing at month end 3) ***, **, * denote 1%, 5%, 10% significance levels respectively

Risk-Reward Tradeoff – Historical Annualized Information Ratio

	1-Yr Chg in Turnover (Liquidity)	Pmom12m1m (Price Mom)	Earnings Yield (Value)	ROE (Quality)
Russell 3000	0.45	0.26	0.34	0.25
S&P BMI Europe DM	0.51	0.72	0.45	0.61
S&P BMI Asia DM ex-Japan	0.63	0.44	0.24	0.21
S&P BMI Japan	0.32	-0.17	0.38	-0.07

1) Signals are cap- and GICS industry-neutral 2) monthly rebalancing at month end

Exhibit A.7: Change in Turnover with Variant Look-Back Length
Russell 3000 Jan. 1995 – Jun. 2015

	z6mTurnover	z12mTurnover	z18mTurnover	z24mTurnover	z36mTurnover
FF-Adjusted Quintile Return Spread	6.83% ***	7.11% ***	6.12% ***	5.41% ***	4.34% ***

1) Signals are cap- and GICS industry-neutral 2) monthly rebalancing at month end 3) ***, **, * denote 1%, 5%, 10% significance levels respectively

Exhibit A.8: Change in Turnover with Variant Look-Back Length Post-Decimalization
Russell 3000 May 2001 – Jun. 2015

	z6mTurnover	z12mTurnover	z18mTurnover	z24mTurnover	z36mTurnover
FF-Adjusted Quintile Return Spread	5.59% ***	5.81 ***	4.89% ***	4.48% ***	3.37% ***

1) Signals are cap- and GICS industry-neutral 2) monthly rebalancing at month end 3) ***, **, * denote 1%, 5%, 10% significance levels respectively

Source: S&P Global Market Intelligence - Quantamental Research. Results are as of 06/30/2015.Backtested returns do not represent the results of actual trading and were constructed with the benefit of hindsight. Returns do not include payment of any sales charges or fees. Inclusion of fees and expenses would lower performance. Past performance is not a guarantee of future results.

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Our Recent Research

February 2016: U.S. Stock Selection Model Performance Review – The most effective investment strategies in 2015

Since the launch of the four S&P Capital IQ® U.S. stock selection models in January 2011, **the performance of all four models (Growth Benchmark Model, Value Benchmark Model, Quality Model, and Price Momentum Model) has been positive each year**. The models' key differentiators – a distinct formulation for large cap versus small cap stocks, incorporation of industry specific information for the financial sector, sector neutrality to target stock specific alpha, and factor diversity – enabled the models to outperform across disparate market environments. In this report, we assess the underlying drivers of each model's performance in 2015 and since inception (2011), and provide full model performance history from January 1987.

January 2016: What Does Earnings Guidance Tell Us? – Listen When Management Announces Good News

This study examines stock price movements surrounding earnings per share (EPS) guidance announcements for U.S. companies between January 2003 and February 2015 using S&P Capital IQ's Estimates database. Companies that experienced positive guidance news, i.e. those that announced optimistic guidance (guidance that is higher than consensus estimates) or revised their guidance upward, yielded positive excess returns. We focus on guidance that is not issued concurrent with earnings releases in order to have a clear understanding of the market impact of guidance disclosures. We also explore practical ways in which investors may benefit from annual and quarterly guidance information.

December 2015: Equity Market Pulse – Quarterly Equity Market Insights Issue 6

With commodity prices plunging, global economic trends diverging, and market volatility rising, analyst estimates for 2016 have been revised sharply lower. Yet estimates remain strong in particular regions and sectors, and valuations have moderated. This issue of Equity Market Pulse uses bottom-up trends in estimates and global risk-return and investment strategy performance metrics to address these questions:

- Which global regions and economic sectors have the strongest 2016 growth expectations?
- Where have 12-month estimate revision trends held up the best and worst?
- With investors focusing on the new year, which regions offer the most value?

November 2015: Late to File - The Costs of Delayed 10-Q and 10-K Company Filings

The U.S Securities & Exchange Commission ("SEC") requires companies to submit quarterly (10-Q) and annual (10-K) financial statements in a timely manner. Companies that cannot file within the statutory period are required to file form 12b-25 with the SEC. In this report we examine the relationship between late filings (form 12b-25s) and subsequent market returns, as well as whether late filings signal deeper fundamental problems within the company. Our results, within the Russell 3000 universe (February 1994 – June 2015), indicate that abnormal returns of late filers is negative prior to and post form 12b-25 filing. Late filers are also typically companies with poor fundamental characteristics relative to peers; investors may want to consider avoiding or short-selling these firms. This report is a continuation of our work in the area of event driven investing, a class of strategies that originate from company specific events.

October 2015: Global Country Allocation Strategies

In this report, we investigate the efficacy of fundamental, macroeconomic and sentiment-based strategies for country selection across global equity markets. Using point-in-time fundamental and macroeconomic data, we constructed signals at the country level, grouped into five themes: valuation, quality, sentiment, volatility and macro. We examined their performance between January 1999 and November 2014 for the developed and emerging markets in the S&P Global Broad Market Indices Our major findings include:

- Valuation is a common driver of performance in both developed and emerging markets.
- In addition to valuation, we found macro and sentiment based indicators to be effective country selection signals in developed markets.
- We found currency depreciation to be important when emerging market countries were separated into exporting and importing nations.

September 2015: Equity Market Pulse – Quarterly Equity Market Insights Issue 5

The Q3 issue of Equity Market Pulse spotlights potential opportunities in Asia, attractive growth and valuations in developed Europe and Japan, and risks associated with rising volatility and elevated 2016 global EPS estimate levels.

September 2015: Research Brief: Building Smart Beta Portfolios

Why is smart beta important? We believe that smart beta is continuing to gain momentum among a variety of constituencies, including ETF providers, asset managers and asset owners. Many asset managers are making smart beta

part of their investment processes. European and Canadian public pension funds have been increasingly relying on internalized smart beta, with the largest U.S. pension funds and endowments also adopting the approach. The purpose of this brief is to aid asset managers and owners in building their own "internal" smart beta processes with a focus on portfolio construction and optimization, including how to manage liquidity and turnover constraints and avoid unintended factor bets.

September 2015: Research Brief – Airline Industry Factors

This brief examines S&P Capital IQ's industry-specific factors for the global airline industry. The seven airline industry factors contained in S&P Capital IQ's Alpha Factor Library consist of ratios widely used by airline industry analysts. The factors address airline profitability in terms of growth, capacity utilization, and operating efficiency. By applying the factors to regime analysis, we find:

- During periods of low fuel price increases industry growth factors are most effective.
- During periods of high fuel price growth, efficiency factors stand out.
- During periods of high revenue passenger growth our studies show that both growth and fuel efficiency factors performed well.

August 2015: Point-In-Time vs. Lagged Fundamentals – This time i[t']s different?

The common starting point for alpha discovery and risk analysis is the backtesting of historical company financials using a research database. Whether internally constructed or licensed, research databases can be distinguished by two primary formats – Point in Time and Non-Point in Time. This paper focuses on the major practical differences between Point in Time (PIT) and Non-Point in Time (Non PIT) data for both backtesting and historical research. PIT data is defined by its ability to answer two questions: When was the information known? and What information was known at the time?.

August 2015: Introducing S&P Capital IQ Stock Selection Model for the Japanese Market

Since the launch S&P Capital IQ's four U.S. stock selection models ["US Stock Selection Models Introduction"] in January 2011, we released a suite of global stock selection models targeting both developed ["Introducing S&P Capital IQ Global Stock Selection Models for Developed Markets"] and emerging markets ["Obtaining an Edge in Emerging Markets"]. In this report, we introduce a stock selection model for the Japanese equity market that completes our global model offering.

July 2015: Research Brief – Liquidity Fragility

As liquidity in the bond market becomes increasingly constrained, there has been a growing chorus of concerns raised by Mohamed A. El-Erian, John Paulson, Jamie Dimon, Larry Summers and recently the Federal Reserve. As we learned in the Global Financial Crisis, when liquidity seizes in one market, margin calls are met by raising cash in one of the most liquid markets in the world: the US equity market. How should equity investors be thinking about liquidity in their market?

June 2015: Equity Market Pulse – Quarterly Equity Market Insights Issue 4

The Q2 issue of Equity Market Pulse features a spotlight on developed Europe, which has the highest estimated growth rates and most attractive valuations among developed markets.

May 2015: Investing in a World with Increasing Investor Activism

Investor activism has gained mainstream acceptance as activists with larger-than-life personas have waged a string of successful campaigns. Activist hedge funds' assets under management (AUM) have swelled to $120 billion, an increase of $30 billion in 2014 alone. It was among the best performing hedge fund strategies in 2014 as well as over the last three- and five-year periods. In this report, we explore an investment strategy that looks to ride the momentum surrounding the announcement of investor activism. We further explore what, if any, changes to targeted companies activists are able to influence.

April 2015: Drilling for Alpha in the Oil and Gas Industry – Insights from Industry Specific Data & Company Financials

During the recent slide in oil prices, clients frequently asked us which strategies have historically been effective in selecting stocks in declining energy markets. This report answers this question, along with its corollary: which strategies work in rising energy markets? We also explore the value of oil & gas reserve data used by fundamental analysts/investors, but not used in a majority of systematic investment strategies. The analysis in this report should help both fundamental and quantitatively-oriented investors determine how to best use industry-specific and generic1 investment metrics when selecting securities from a pool of global oil & gas companies.

March 2015: Equity Market Pulse – Quarterly Equity Market Insights Issue 3

Driven by proprietary data and analytics from S&P Capital IQ™, Equity Market Pulse provides professional investors with insights into global equity market fundamentals and performance at a glance. Spanning developed and emerging markets in the Americas, Europe, and Asia, it provides perspective on fundamentals, valuations and investment strategy effectiveness.

February 2015: U.S. Stock Selection Model Performance Review – The most effective investment strategies in 2014

Since the launch of the four S&P Capital IQ™ U.S. stock selection models in January 2011, the performance of all four models (Growth Benchmark Model, Value Benchmark Model, Quality Model, and Price Momentum Model) has been positive and 2014 was no exception. Our models' key differentiators - distinct formulation for large cap and small cap stocks, special treatment for the financial sector, sector neutrality to target stock specific alpha, and factor diversity - enabled the models to outperform across various market environments. In this report, we review the underlying drivers of each model's performance over the 12 months ended December 31, 2014, document performance from January 2011 when the models went live, and provide full model performance history from January 1987.

January 2015: Research Brief: Global Pension Plans – Are Fully Funded Plans a Relic of the Past?

With strong equity and bond market performances over the past few years, one might assume that pension shortfalls have declined sharply. Since our last research brief (September 2013), funding statuses have indeed improved in the U.S. and Asia, though not in Europe (Exhibit 1). However, while the S&P 500 Index has been making higher highs (Exhibit 2, red line), the number of S&P 500 plans with a funding status of 90% or higher has been in a sharp decline (blue bars).

January 2015: Profitability: Growth-Like Strategy, Value-Like Returns – Profiting from Companies with Large Economic Moats Value-based strategies have been the favorite weapons in many investors' arsenals, historically yielding large returns and consistently outperforming. Most value investors focus on the price side of the equation – i.e., buying assets that are priced below their intrinsic values. Yet, there's another dimension to the value equation that has been complementary to value and just as critical in generating excess returns. Enter profitability. Profitability has historically worked as an investment strategy because instead of focusing on the cheapness of an asset it focuses on the productiveness of an asset - i.e., its ability to generate earnings for the investor. Our results from January 1996 to August 2014 show:The S&P 500® continues to be the preeminent regional performer in terms of both financial results and price appreciation Risk and Return: Tracks the dynamics of equity market returns and volatility.

November 2014: Equity Market Pulse – Quarterly Equity Market Insights Issue 2

Driven by S&P Capital IQ's™ proprietary data and analytics, **Equity Market Pulse** provides professional investors with insights into global equity market fundamentals and performance at a glance. Spanning developed and emerging markets in the Americas, Europe, and Asia, it provides perspective on valuations, operating efficiency, and investment strategy effectiveness.

- The **S&P 500® continues to be the preeminent regional performer** in terms of both financial results and price appreciation Risk and Return: Tracks the dynamics of equity market returns and volatility.
- **Investor preference for developed markets continues**, as developed markets show rising P/E multiples versus the emerging markets on much stronger financial performance.
- **Emerging markets appear cheap** on a valuation-to-projected-growth basis, with forward P/E to earnings growth (PEG) ratios of less than half those of the developed market average.

October 2014: Lenders Lead, Owners Follow – The Relationship between Credit Indicators and Equity Returns

August 2014: Equity Market Pulse – Quarterly Equity Market Insights Issue 1

July 2014: Factor Insight: Reducing the Downside of a Trend Following Strategy

May 2014: Introducing S&P Capital IQ's Fundamental China A-Share Equity Risk Model

April 2014: Riding the Coattails of Activist Investors Yields Short and Long Term Outperformance

March 2014: Insights from Academic Literature: Corporate Character, Trading Insights, & New Data Sources

February 2014: Obtaining an Edge in Emerging Markets

February 2014: U.S Stock Selection Model Performance Review

January 2014: Buying Outperformance: Do share repurchase announcements lead to higher returns?