

Institutional ownership data: Quantitative research results

June 2021

Research Signals

IHS Markit's Equity Point-in-Time Ownership data provides daily insights into global institutional and fund owned security positions, flow of funds and activity globally across developed and emerging markets. Ownership is sourced from 13Fs, global mutual funds, daily ETF holdings, annual reports, and major stakeholder exchange announcements for equity securities. We combine our Research Signals team's quantitative research capability with key elements of this proprietary data, specifically looking for factors that are drivers of stock price performance. In total, we introduce 17 factors capturing ownership concentration, changes in holdings, institutional and hedge fund holdings and liquidity flow ratios.

- Our research reveals varying effects of institutional ownership on stock returns across regions; for example, we find Hedge fund holdings was a positive signal across most developed and emerging markets, along with greater institutional ownership, particularly in the US and emerging Asia
- Closer inspection of rank correlations between three main ownership factors and key drivers from the Research Signals factor library suggests low commonality in general, with the exception of measures of large cap, high volume stocks with low borrowing costs in the securities lending market, demonstrating the uniqueness of the signals
- Using the ownership factors as an overlay with our Value Momentum Analyst Model, we demonstrate additional monthly alpha across developed markets in the US (9.1 bps), Europe (20.0 bps) and Pacific (5.0) regions

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Introduction and methodology

Fund holdings disclosures provides transparency to the equity markets. Many jurisdictions have regulations in place requiring the periodic filing of fund ownership by institutions, including 13-F filings in the US. IHS Markit's "best-of-breed" Ownership dataset captures global institutional and fund owned security positions, flow of funds and activity on a daily point-in-time basis. The unadulterated and extensive 15-year historical view of the data allow for the timely reconstruction of portfolios, shareholders and flows as of any point in time through history, free of retroactive corrections and amendments, which can be used to correlate daily changes of ownership to pricing movements. The dataset combines numerous market sources, public filings and our own proprietary content. It includes portfolios from an extensive breadth of fund sources including investment managers, hedge funds, pensions, insurance companies, family offices, mutual funds and sovereign wealth funds, among others. We have used the dataset to build signals that take advantage of incremental changes in underlying data.

Using the Point-in-Time Equity Ownership data, we constructed 17 factors built from holdings and trading activity. Factors introduced evaluate ownership concentration, changes in holdings, institutional and hedge fund holdings and liquidity flow ratios. The main categories and hypotheses are listed below:

Institutional and hedge fund holdings - a higher number of institutional holders and hedge funds boosts returns

- % Institutional Holdings
- % Hedge Fund Holdings (Shares)
- % Hedge Fund Holdings (Count)

Institutional concentration - a greater percent of holdings by a few institutions lowers liquidity and, in turn, lowers returns

- Top 5 Ownership Concentration
- Top 10 Ownership Concentration

Change in average ownership - an increase in share holdings by institutions and active funds offers better liquidity and returns

- Changes in Active Share Holdings
- Average % Change in Ownership

Liquidity flow ratio - more holdings by active investors provides higher liquidity and returns

- Liquidity Flow (Shares)
- Liquidity Flow (Count)

Buy-ins and sell-offs - an increase in new (closing out of) positions suggests positive (negative) outlook and forecasted returns

- % Buyins out of Bought (Shares)
- % Buyins out of Bought (Count)
- % Selloffs out of Sold (Shares)
- % Selloffs out of Sold (Count)

Buy-in/sell-off and bought/sold imbalance - higher buy-ins over sell-offs and buys over sells implies greater demand and thus higher returns

- Buyin Selloff Imbalance (Shares)

- Buyin Selloff Imbalance (Count)
- Bought Sold Imbalance (Shares)
- Bought Sold Imbalance (Count)

Factor definitions are included in the Appendix. The factors are available globally across developed and emerging markets.

As an example of the granularity of the data used, we show the following sample (Table 1) of historic data for Apple Inc to demonstrate the date logic and construction of the hedge fund holdings factors:

Table 1

Example Apple data					
Company ID	Hedge fund	Position date	Portfolio date	Point-in-time date	Shares
587620	No	30 Dec 2019	31 Dec 2020	8 Mar 2020	4200
587620	No	30 Dec 2019	31 Dec 2020	12 Mar 2020	4200
587620	No	31 Dec 2020	31 Dec 2020	12 Mar 2020	4200
587620	No	31 Jan 2020	31 Mar 2020	5 Apr 2020	4200
587620	No	31 Jan 2020	31 Mar 2020	6 May 2020	4200
587620	No	28 Feb 2020	31 Mar 2020	6 May 2020	4193
587620	No	28 Feb 2020	31 Mar 2020	14 May 2020	4193
587620	No	29 Feb 2020	31 Mar 2020	14 May 2020	4200
519122	Yes	31 Mar 2020	31 Mar 2020	15 May 2020	8750

Source: IHS Markit

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First, we pick up data entries for each company holding the stock for point-in-time dates within the last three months of the rank date. We then sort the data by portfolio date, then point-in-time date and finally position date to arrive at the most recent observation, confirming that the difference between the portfolio date and rank date is no greater than 90 days. In this example, for the companies that we identify as 587620, an institutional holder, and 519122, a hedge fund, the data from the dates in the two highlighted rows ultimately feed into the factor calculations.

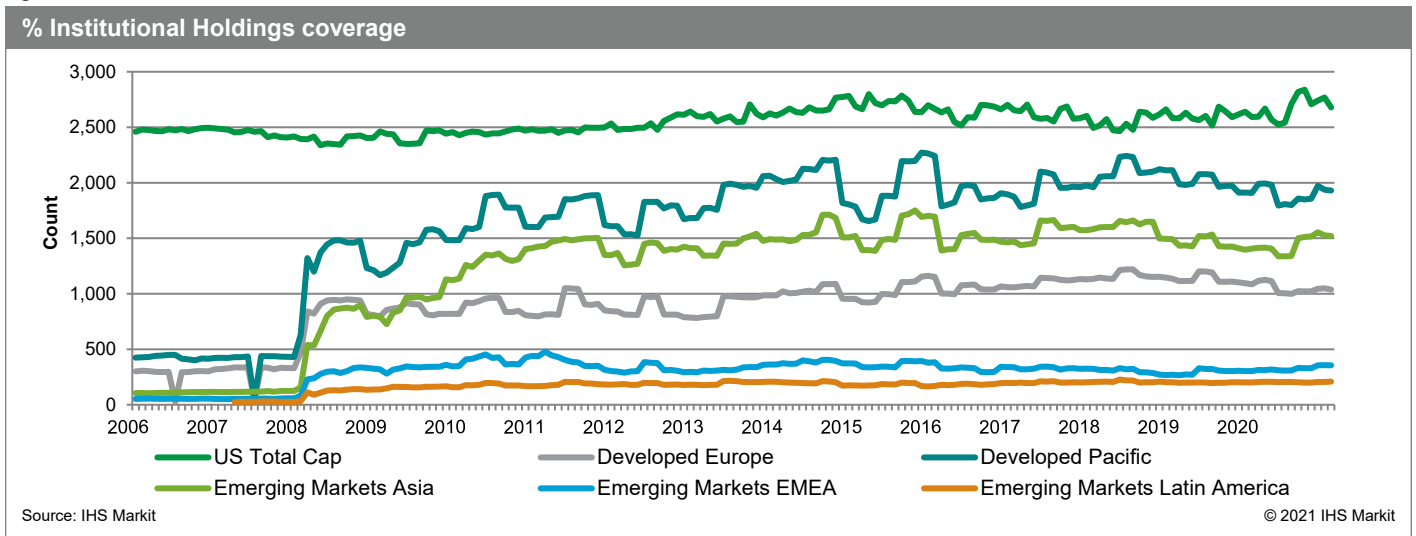
Taking this example a step further, to construct the hedge fund holdings factors, we begin with the number of hedge funds holding the stock in addition to the total number of institutional holders. These two companies are included in the total count of 3,510 institutional holders and 216 hedge funds for Apple on this rank date. To calculate % Hedge Fund Holdings (Count), the number of hedge funds is divided by the institutional holders, arriving at a raw value of 6.15%.

To compute % Hedge Fund Holdings (Shares), we first add the total shares under companies labeled as a hedge fund and the total shares under all institutional holders and then divide the two sums. In this case, 8,750 shares for company 519122 are included in the sum of 35,111,768 for hedge funds and 4,200 for company 587620 are included in the shares for institutional holders totaling 2,514,441,170, resulting in a raw value of 1.40%.

To test factor efficacy, we calculate simulated long-short decile portfolio returns using the following method. First, percentile ranks for each factor are computed across each universe by sorting according to the underlying factor interpretation. We begin with the percentile ranks at the beginning of each month and divide the universe into ten deciles, with the top ranked, or buy-rated, names assigned to decile 1 (D1) and the bottom ranked, or sell-rated, names in decile 10 (D10). At the end of each month, we then compute the equal-weighted decile return using USD total returns and report the return spread between D1 and D10, simulating a long-short portfolio. Note that we use quintiles rather than deciles for emerging markets due to smaller universe sizes.

Factors were backtested over the Research Signals standard universes. The US Total Cap universe represents 98% of the cumulative market cap, or approximately 3,000 names, while the developed and emerging markets universes represent 95% of cumulative market cap for each member country subject to minimum market caps of USD 250 million and 100 million, respectively. Coverage is fairly comprehensive across each universe, as exemplified by % Institutional Holdings (Figure 1), with availability exceeding 80% of constituents for the majority of the backtest period for each region, with the exception of Emerging Markets Latin America which was just shy of that level.

Figure 1



Results

Turning to factor performance, Table 2 summarizes average monthly quantile spreads across each region through December 2020. Note that factor availability varies within each region; however, for completeness we report each factor's full history, thus the statistics may not necessarily be comparable across regions given the potential for differing start dates (see Table A1 in the Appendix for the full list of start dates).

Overall, we find that hedge fund holdings and greater institutional ownership were strong performers on average in both the US and Pacific, along with liquidity flows especially in developed Pacific markets. Measures of buy-ins and trading imbalance were positive signals in Europe and Emerging EMEA, while institutional ownership level was a main driver for Emerging Asia and hedge fund holdings was a particularly strong indicator in Emerging Latin America.

Table 2

Regional factor average monthly quantile spreads (%), through Dec 2020						
Factor	US Total Cap	Developed Europe	Developed Pacific	Emerging Asia	Emerging EMEA	Emerging Latin America
Top 5 Ownership Concentration	0.39	0.09	0.05	0.30	-0.04	0.07
Top 10 Ownership Concentration	0.31	-0.05	0.16	0.17	-0.26	0.04
Changes in Active Share Holdings	0.30	0.03	0.34	0.11	0.01	0.25
Average % Change in Ownership	0.06	0.27	0.11	0.05	-0.01	-0.23
% Institutional Holdings	0.12	0.07	-0.03	-0.37	-0.24	-0.06
Bought Sold Imbalance (Shares)	-0.13	-0.02	-0.09	-0.34	-0.15	-0.07
Bought Sold Imbalance (Count)	-0.05	0.15	-0.06	-0.17	-0.15	-0.33
Buyin Selloff Imbalance (Shares)	-0.12	0.20	-0.03	-0.19	0.19	-0.24
Buyin Selloff Imbalance (Count)	0.07	0.38	0.03	-0.14	0.13	-0.33
% Buyins out of Bought (Shares)	-0.14	0.07	0.04	0.05	0.08	-0.21
% Buyins out of Bought (Count)	-0.05	0.25	-0.20	0.13	0.08	-0.20
% Selloffs out of Sold (Shares)	-0.04	0.22	-0.03	-0.23	-0.02	-0.17
% Selloffs out of Sold (Count)	0.06	0.24	0.08	-0.16	0.16	-0.04
% Hedge Fund Holdings (Shares)	0.23	-0.06	0.04	0.30	0.32	0.48
% Hedge Fund Holdings (Count)	0.41	-0.16	0.08	0.08	0.11	0.53
Liquidity Flow (Shares)	0.16	0.19	0.49	0.08	-0.20	0.02
Liquidity Flow (Count)	0.09	-0.10	0.60	0.25	0.08	0.38

Source: IHS Markit

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More specifically, we drill down to key factor performance in each market segment. For this analysis, we highlight the monthly time series of cumulative spreads (interpreted as the growth of a dollar) for the best performing factors regionally.

For the US Total Cap universe, the top performing factor was % Hedge Fund Holdings (Count), which saw a significant post-pandemic upward move in 2020, pushing it to a 94% cumulative spread over the full period, while a 2019 double-digit surge contributed to strong performance from Top 5 and Top 10 Ownership Concentration. The 2020 spike in performance for Buyin-Selloff Imbalance (Count) elevated it to the top spot in Developed Europe, with an 88% cumulative spread, followed by Average % Change in Ownership and % Buy ins out of Bought (Count).

The highest average monthly spreads in Developed Pacific were turned in by Liquidity Flow (Count) and Liquidity Flow (Shares), with positive spreads in 60% and 59% of months, respectively. Liquidity Flow (Count) was also a key contributor in Emerging Asia, though the top cumulative spread was recorded by Top 5 Ownership Concentration at 53%.

% Hedge Fund Holdings (Shares) led factor performance in Emerging EMEA, though with a volatile historical trend (standard deviation: 3.9), while the next top returning factors were Buyin Selloff Imbalance (Shares) and % Selloffs out of Sold (Count). Lastly, factor efficacy was especially strong in Emerging Latin America markets, especially since 2016, led by % Hedge Fund Holdings (Count), % Hedge Fund Holdings (Shares) and Liquidity Flow (Count).

Figure 2

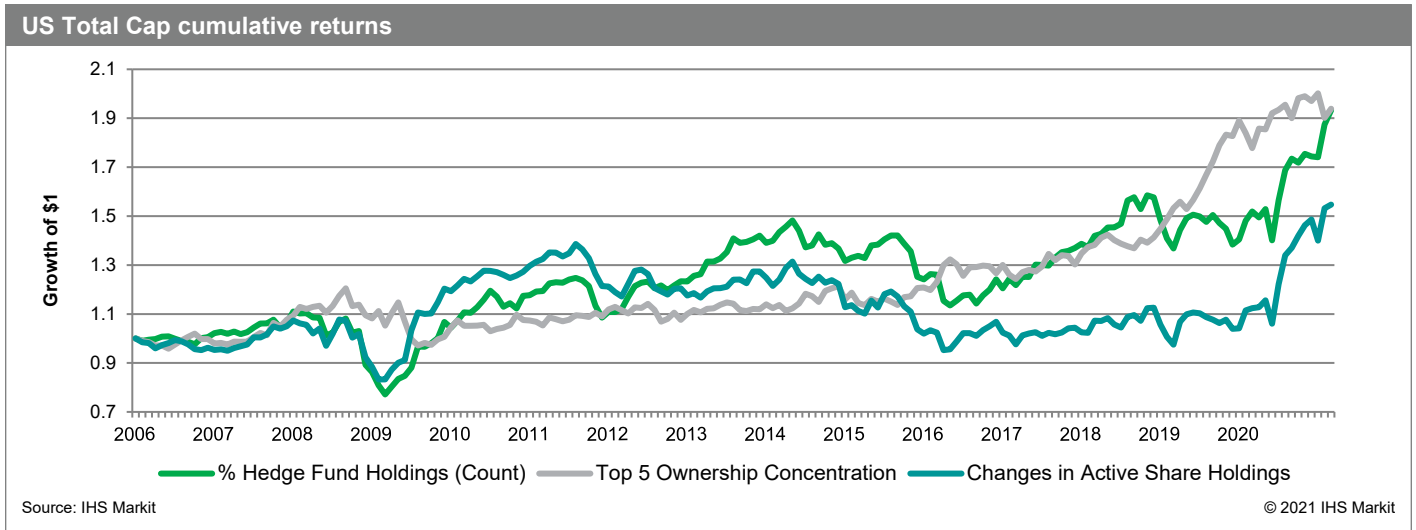


Figure 3

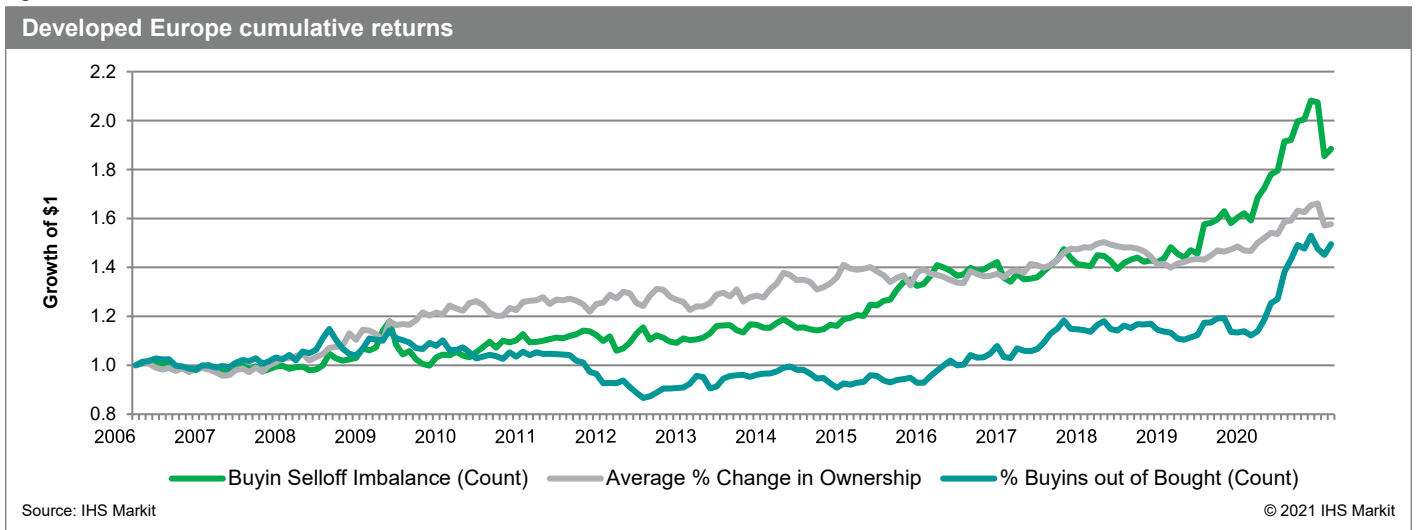


Figure 4

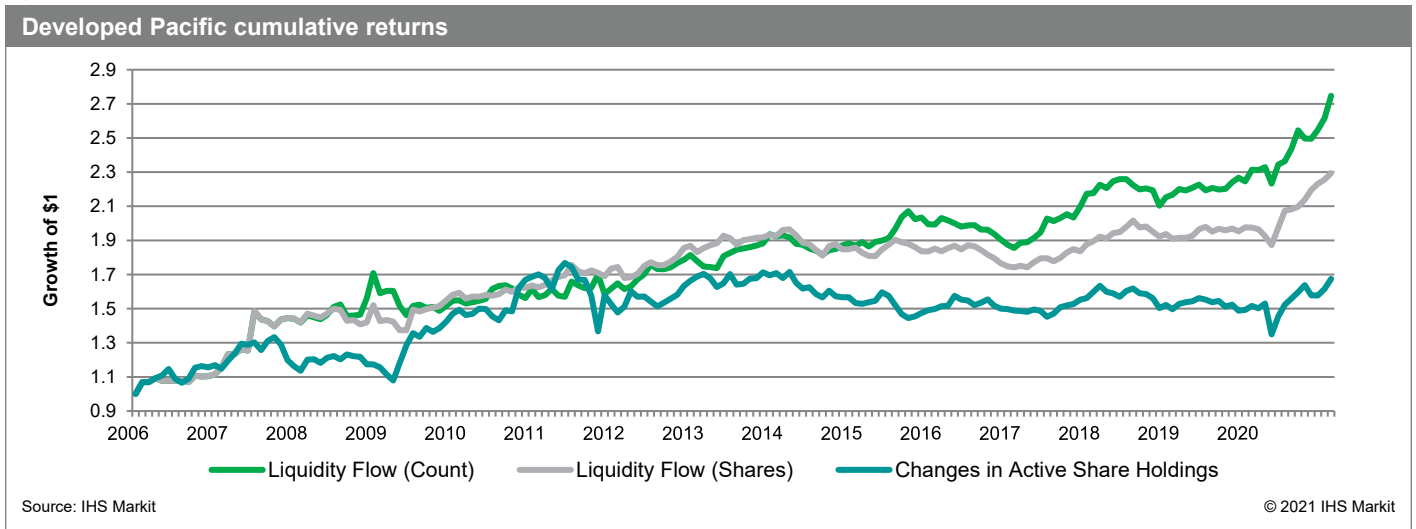


Figure 5

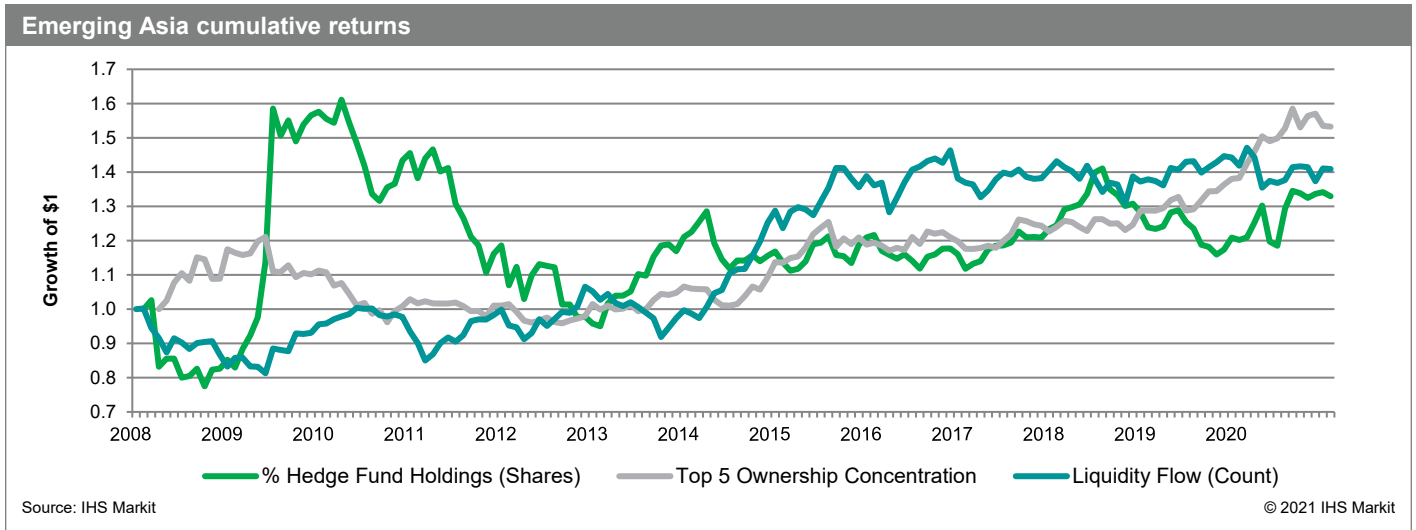


Figure 6

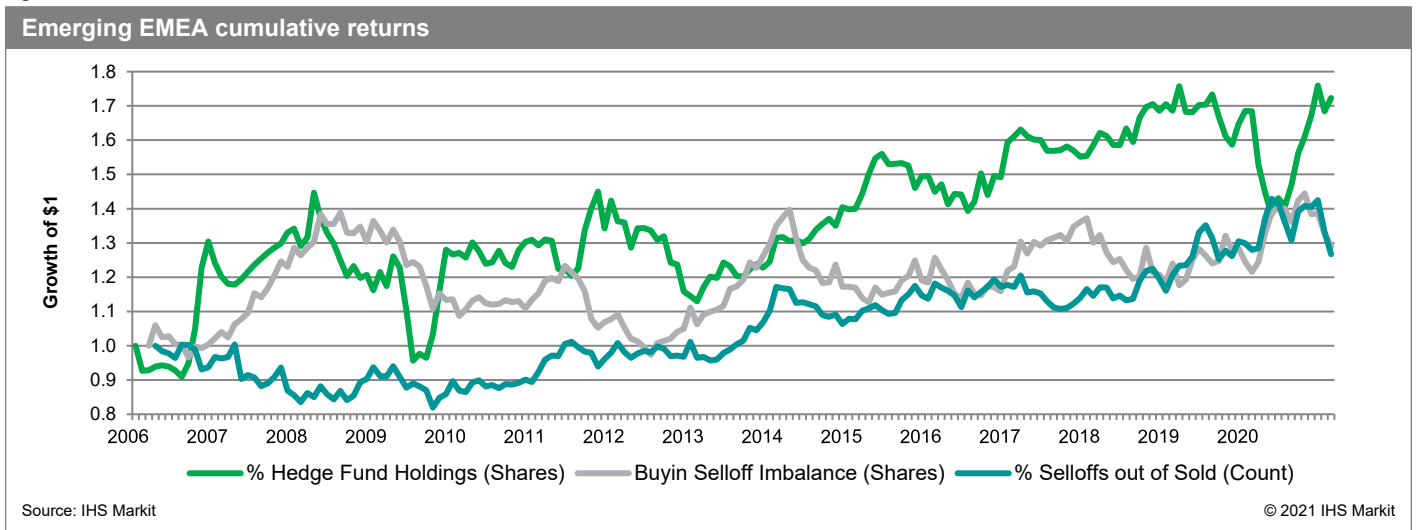
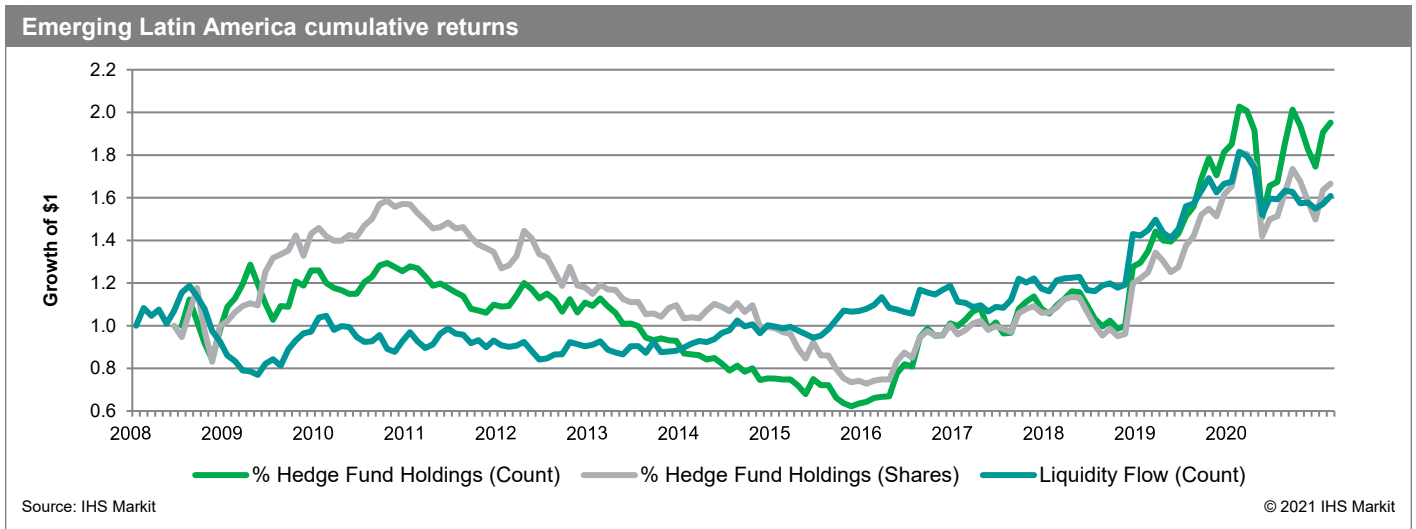


Figure 7



Correlations

Next, we review the relationship between select members of our newly introduced institutional ownership factors and key drivers from the Research Signals factor library, across a broad spectrum of value, quality, growth, risk, momentum and short sentiment measures. To begin with, in Table 3 we report the average rank correlations of Average % Change in Ownership, % Hedge Fund Holdings (Shares) and % Institutional Holdings through December 2020 for the developed universes (see Table A2 in the Appendix for emerging markets results).

Several factors tended to have high correlations in magnitude across most universes, including Natural Logarithm of Market Capitalization (negative), Average Monthly Trading Volume-to-Market Cap (positive) and Implied Loan Rate (positive), in other words, measures of large cap, high volume stocks with low borrowing costs in the securities lending market. We take a closer look below at the time series trend in rank correlations across our developed universe for Natural Logarithm of Market Capitalization (Figures 8 - 10), while the remaining two factors are included in the Appendix (see Figures A1 - A6).

Some notable observations include the relationship between % Hedge Fund Holdings (Shares) and Natural Logarithm of Market Capitalization and Implied Loan Rate in the US versus the other regions, where we find a high rank correlation with small caps and high borrow costs. We also find a decrease in the trend of % Institutional Holdings exposure to high volume stocks in both the US and Developed Pacific.

With the exception of these three metrics, the ownership factors display low correlations, in general, with factors in our factor library. The implication is that the newly introduced factors tend to provide a unique signal outside our core style measures.

We also review quantile return spread correlations across the same set of factors for developed and emerging markets (see Tables A3 and A4 in the Appendix). Variations in return patterns are seen across universes; however, some similarities are found in the ownership factors with positive co-movement with Implied Loan Rate, in addition to positive trends with large caps (negative return correlation with Natural Logarithm of Market Capitalization) in the US and Emerging Asia and EMEA. We also highlight the findings that value factors tended to move in the opposite direction, while positive co-movements were found, in general, with 1-yr Growth in TTM Free Cash Flow.

Table 3

Average monthly rank correlations, through Dec 2020

Style	Factor	US Total Cap			Developed Europe			Developed Pacific		
		Avg % Chg in Ownshp	% Hdg Fnd Hld (Shr)	% Inst Holdings	Avg % Chg in Ownshp	% Hdg Fnd Hld (Shr)	% Inst Holdings	Avg % Chg in Ownshp	% Hdg Fnd Hld (Shr)	% Inst Holdings
V a l u e	Book-to-Market	-0.09	-0.02	-0.04	-0.06	-0.10	-0.11	-0.02	0.01	0.04
	Forward 12-M EPS-to-Enterprise Value	-0.01	-0.17	0.02	-0.01	0.01	0.12	-0.04	0.00	0.00
	TTM EBITDA-to-Enterprise Value	-0.03	-0.12	0.03	-0.02	-0.01	-0.01	-0.02	0.03	0.00
	TTM Free Cash Flow-to-Enterprise Value	0.01	-0.09	0.07	0.01	0.04	0.06	0.02	0.05	-0.01
	Industry Relative Leading 4-QTRs EPS to Price	0.04	-0.02	0.10	0.00	0.03	0.09	-0.04	0.00	0.00
	Industry Relative TTM Dividend Yield	-0.03	-0.21	-0.04	0.00	-0.04	0.05	-0.07	0.04	0.06
Q u a l i t y	Fixed Assets Turnover Ratio	0.01	0.01	0.06	0.01	0.04	0.12	0.03	0.03	-0.03
	Inventory Turnover Ratio	0.00	0.02	-0.07	0.01	-0.01	0.00	0.01	-0.01	-0.05
	Net Operating Asset Turnover	0.02	-0.02	0.08	0.03	0.05	0.05	0.04	0.04	0.02
	Change in Accruals to Assets	0.00	-0.01	0.00	-0.01	-0.01	-0.01	0.00	0.00	-0.01
	Change in TTM COGS vs. Inventory Level	0.00	-0.11	0.10	0.01	0.02	0.03	0.04	0.04	0.09
	Change in TTM Sales vs. Accounts Receivable	0.01	0.01	-0.01	0.02	0.02	-0.02	0.01	0.00	-0.01
G r o	Working Capital Accruals	0.00	0.00	-0.01	-0.03	-0.01	0.02	-0.02	-0.03	0.01
	1-yr Growth in TTM Free Cash Flow	0.04	-0.08	0.07	0.03	0.03	0.05	0.02	0.03	-0.02
R i s k	Reinvestment Rate	0.05	-0.13	0.09	0.02	0.04	0.04	0.02	0.01	0.00
	Average Monthly Trading Volume-to-Market Cap	0.09	0.33	0.13	0.03	0.15	0.33	-0.06	0.06	0.01
	60-Month Beta	-0.05	-0.11	-0.13	-0.04	-0.07	-0.03	0.04	-0.07	-0.08
	Asset Quality Index	0.02	0.03	-0.01	0.02	0.01	0.00	0.02	0.00	-0.01
	Operating Leverage	-0.02	-0.04	0.00	0.00	-0.01	0.00	-0.01	0.00	0.01
	Natural Logarithm of Market Capitalization	-0.16	0.24	-0.28	-0.16	-0.13	0.03	-0.07	-0.09	-0.12
M o m e n t u m	2-Year Ahead EPS Growth	0.00	0.17	0.01	0.00	0.01	-0.02	-0.01	-0.01	0.01
	3-M Revision in FY2 EPS Forecasts	0.04	-0.02	-0.02	0.04	0.01	0.00	0.06	0.00	-0.02
	Real Earnings Surprise	0.03	0.02	0.03	0.01	0.03	0.07	0.03	0.05	0.01
	24-Month Value at Risk	-0.03	-0.26	-0.01	-0.04	-0.09	-0.02	0.03	-0.01	0.00
	5-day Industry Relative Return	0.00	0.00	-0.01	0.00	0.00	0.00	-0.01	0.00	0.00
	Industry-adjusted 12-month Relative Price Strength	0.10	-0.04	0.00	0.08	0.00	0.01	0.11	0.00	-0.01
S h a r e	Rational Decay Alpha	0.08	-0.01	-0.01	0.05	0.02	0.01	0.07	0.00	-0.02
	Demand Supply Ratio	0.00	-0.08	0.11	0.00	0.03	0.08	-0.01	0.07	0.06
	Implied Loan Rate	0.01	-0.12	0.24	0.10	0.24	0.38	0.04	0.22	0.18

Source: IHS Markit

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Figure 8

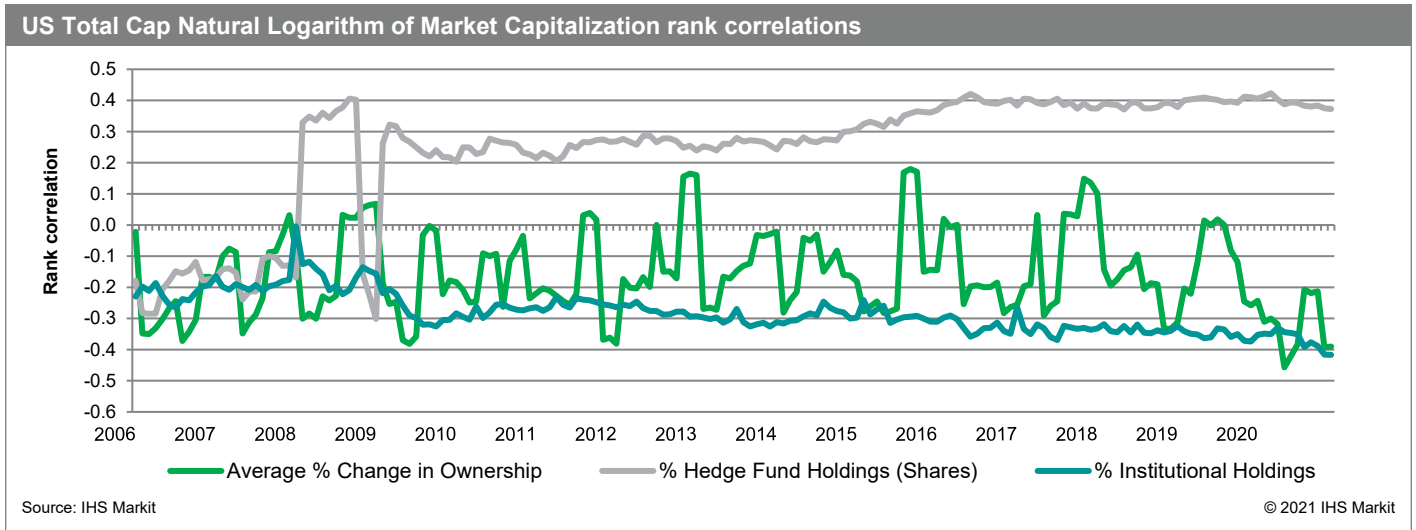


Figure 9

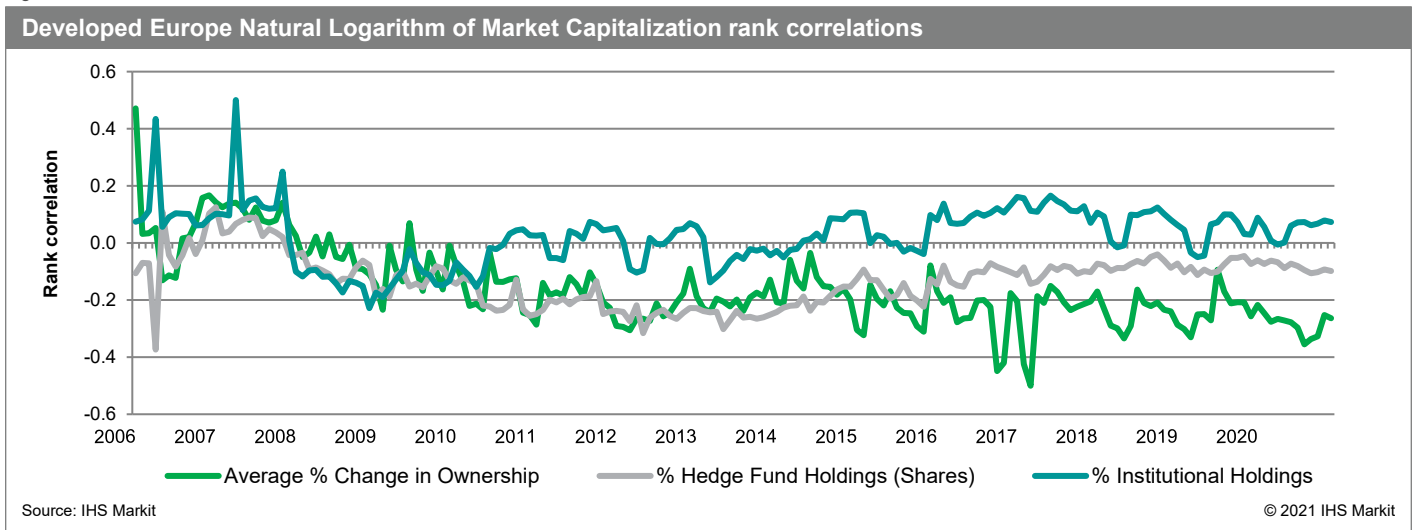
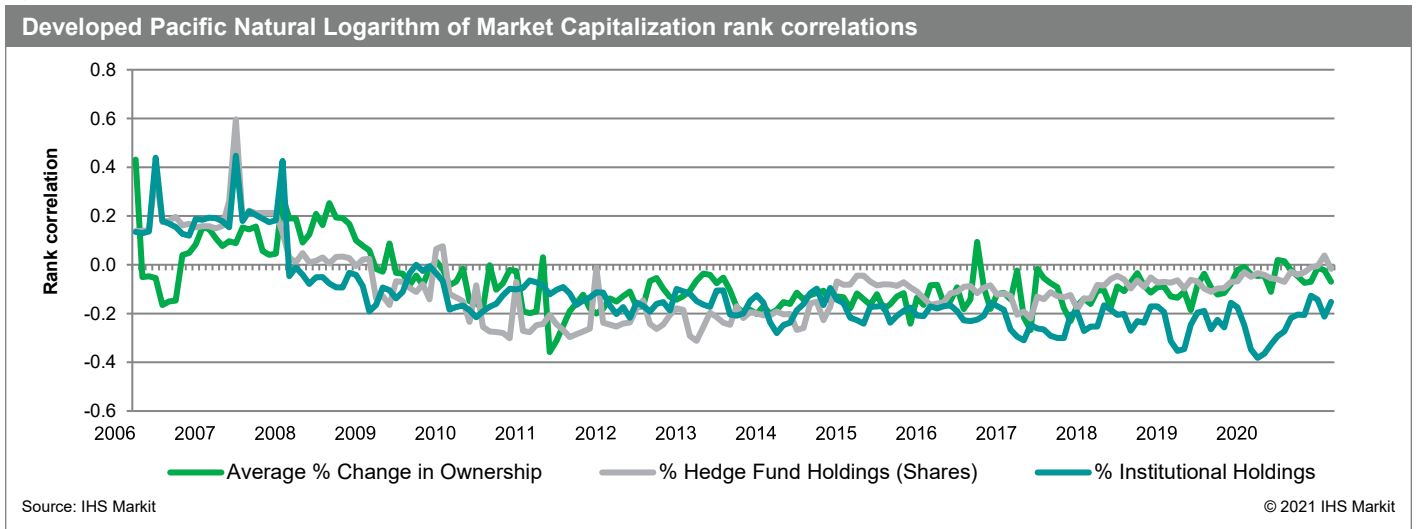


Figure 10



Application

We round out the report with an example of the use of the ownership factors as an overlay to a multifactor strategy. For this application, we begin with our well-established Value Momentum Analyst Model (VMA), built from factors spanning value, quality, price and earnings momentum signals, and combine it with 5% weights in three ownership factors - Top 10 Ownership Concentration, % Hedge Fund Holdings (Shares) and Changes in Active Shares Holdings. Results are presented over the US Total Cap (Figure 11), Developed Europe (Figure 12) and Developed Pacific universes (Figure 13).

In the US, overlaying the ownership factors on VMA resulted in steady outperformance, with an average monthly spread of 0.96%, compared with 0.87% for the base model. Over the full period, this led to a cumulative return of 309% for the overlay strategy versus 252% for VMA.

Improvement in performance was strongest in Developed Europe, where the ownership factor overlay increased the average monthly spread to 0.72% from 0.53% for the base model, or 142% cumulatively, compared with 88%. Finally, in Developed Pacific, the overlay strategy provided an average monthly spread of 0.98% (cumulative: 298%), while VMA came in at 0.93% (cumulative: 231%).

Figure 11

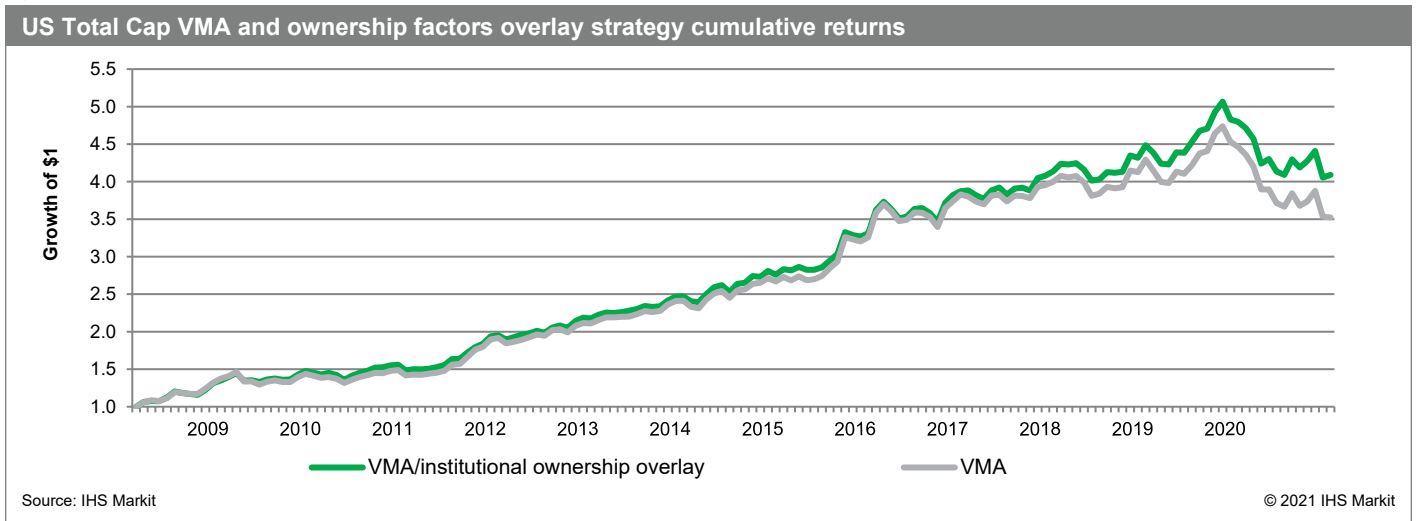


Figure 12

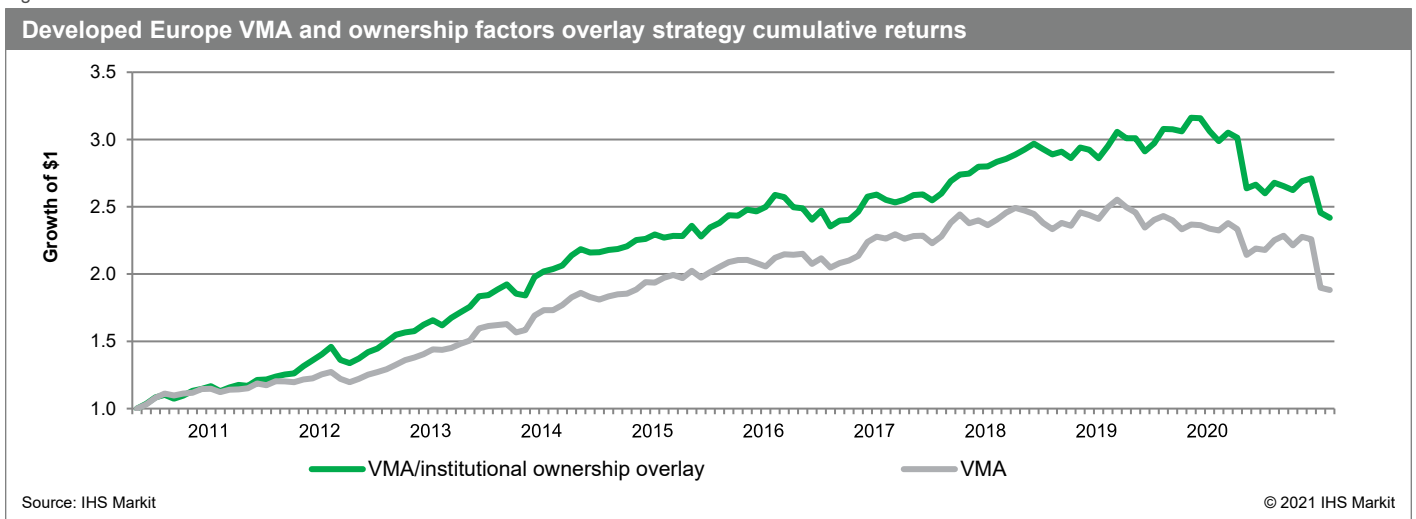
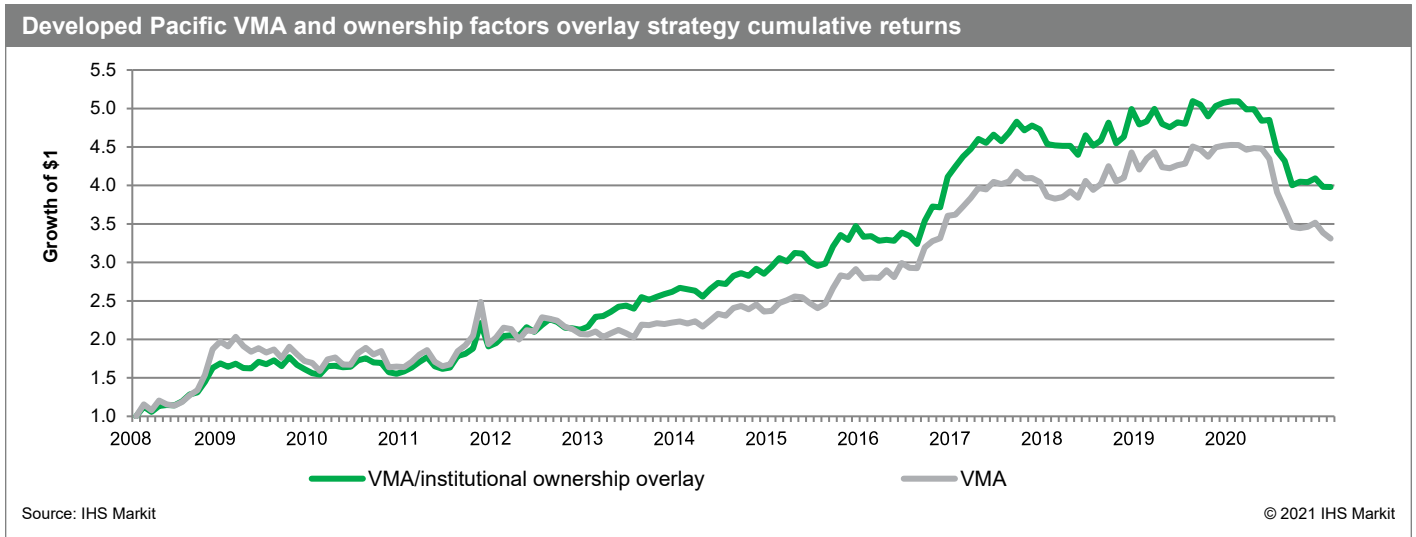


Figure 13



Conclusion

IHS Markit's Equity Point-in-Time Ownership data provides daily insights into global institutional and fund owned security positions, flow of funds and activity globally across developed and emerging markets. Using this proprietary dataset sourced from 13Fs, global mutual funds, daily ETF holdings, annual reports, and major stakeholder exchange announcements for equity securities, we introduce 17 ownership factors capturing ownership concentration, changes in holdings, institutional and hedge fund holdings and liquidity flow ratios to systematically score stocks across our global universes.

Over our backtest period, hedge fund holdings was a positive signal across most developed and emerging markets, along with greater institutional ownership, particularly in the US and emerging Asia. The top performing factor in each include % Hedge Fund Holdings (Count) in the US, Buyin-Selloff Imbalance (Count) in Developed Europe, Liquidity Flow (Count) in Developed Pacific and versions of % Hedge Fund Holdings in Emerging Asia (Shares), EMEA (Shares) and Latin America (Count).

We also examine correlations of three main ownership factors - Average % Change in Ownership, % Hedge Fund Holdings (Shares) and % Institutional Holdings - with other pertinent factors in our factor library. From a ranking perspective, some key findings include high correlations between measures of large cap, high volume stocks with low borrowing costs in the securities lending market. However, overall, correlations with ownership factors were low, demonstrating the uniqueness of the signals. Taking advantage of this feature, we wrap up with an example of the benefits from combining ownership factors with our Value Momentum Analyst Model, where we found 9.1 bps, 20.0 bps and 5.0 bps of additional monthly alpha from this overlay strategy in the US Total Cap, Developed Europe and Developed Pacific universes, respectively.

Appendix

Factor definitions

Top 5 Ownership Concentration - Sum of top 5 institutional holdings of a stock as a ratio of total institutional holdings, sorted in ascending order

Top 10 Ownership Concentration - Sum of top 10 institutional holdings of a stock as a ratio of total institutional holdings, sorted in ascending order

Change in Active Share Holdings - 3-month change in active shares as a percent of total institutional holdings, sorted in descending order

Average % Change in Ownership - Average change in institutional holdings of a stock relative to the prior 3-month institutional holdings, sorted in descending order

% Institutional Holdings - Total institutional holdings of a stock as a percent of total shares outstanding, sorted in descending order

Bought Sold Imbalance (Shares) - Total shares bought by institutions less sold relative to the total shares bought and sold by institutions, sorted in descending order

Bought Sold Imbalance (Count) - Number of institutions buying a stock less selling relative to the total number of institutions buying and selling the stock, sorted in descending order

Buyin Selloff Imbalance (Shares) - Total shares of newly opened positions by institutions less shares of closed positions relative to the total number of buyin and selloff shares by institutions, sorted in descending order

Buyin Selloff Imbalance (Count) - Number of institutions with newly opened positions less closed positions relative to the total number of buyins and selloffs, sorted in descending order

% Buyins out of Bought (Shares) - Total shares of newly opened positions by institutions as a percent of total shares bought by institutions, sorted in descending order

% Buyins out of Bought (Count) - Number of institutions with newly opened positions as a percent of number of institutions buying, sorted in descending order

% Selloffs out of Sold (Shares) - Total shares of closed positions by institutions as a percent of total shares sold by institutions, sorted in ascending order

% Selloffs out of Sold (Count) - Number of institutions with closed positions as a percent of number of institutions selling, sorted in ascending order

% Hedge Fund Holdings (Count) - Number of hedge fund investors in a stock as a percent of total number of institutional investors, sorted in descending order

% Hedge Fund Holdings (Shares) - Total shares held in hedge funds as a percent of total institutional holdings, sorted in descending order

Liquidity Flow (Shares) - Total shares held by active institutions as a ratio of total institutional holdings, sorted in descending order

Liquidity Flow (Count) - Number of active institutional investors in a stock as a ratio of total number of institutional investors in the stock, sorted in descending order

Tables and figures

Table A1

Regional factor start dates						
Factor	US Total Cap	Developed Europe	Developed Pacific	Emerging Asia	Emerging EMEA	Emerging Latin America
Top 5 Ownership Concentration	Nov 2005	Dec 2007	Jan 2008	Mar 2008	Mar 2008	Apr 2008
Top 10 Ownership Concentration	Nov 2005	Dec 2007	Jan 2008	Mar 2008	Apr 2008	May 2008
Change in Active Share Holdings	Nov 2005	Dec 2005	Dec 2005	Dec 2007	Dec 2005	Jan 2008
Average % Change in Ownership	Feb 2006	Feb 2006	Feb 2006	Feb 2006	Feb 2006	Feb 2006
% Institutional Holdings	Nov 2005	Nov 2005	Nov 2005	Nov 2005	Nov 2005	Feb 2007
Bought Sold Imbalance (Shares)	Feb 2006	Feb 2006	Feb 2006	Feb 2006	Feb 2006	Apr 2006
Bought Sold Imbalance (Count)	Feb 2006	Feb 2006	Feb 2006	Feb 2006	Feb 2006	Apr 2006
Buyin Selloff Imbalance (Shares)	Feb 2006	Feb 2006	Feb 2006	Feb 2006	Feb 2006	Feb 2007
Buyin Selloff Imbalance (Count)	Feb 2006	Feb 2006	Feb 2006	Feb 2006	Feb 2006	Feb 2007
% Buyins out of Bought (Shares)	Feb 2006	Feb 2006	Feb 2006	Feb 2006	Feb 2006	Dec 2007
% Buyins out of Bought (Count)	Feb 2006	Feb 2006	Feb 2006	Feb 2006	Feb 2006	Dec 2007
% Selloffs out of Sold (Shares)	Feb 2006	Feb 2006	Feb 2006	Mar 2006	Mar 2006	Aug 2006
% Selloffs out of Sold (Count)	Feb 2006	Feb 2006	Feb 2006	Mar 2006	Mar 2006	Aug 2006
% Hedge Fund Holdings (Shares)	Nov 2005	Dec 2005	Dec 2007	Jan 2008	Dec 2005	May 2008
% Hedge Fund Holdings (Count)	Nov 2005	Dec 2005	Dec 2007	Jan 2008	Dec 2005	May 2008
Liquidity Flow (Shares)	Nov 2005	Dec 2005	Dec 2005	Dec 2007	Dec 2005	Dec 2007
Liquidity Flow (Count)	Nov 2005	Dec 2005	Dec 2005	Dec 2007	Dec 2005	Dec 2007

Source: IHS Markit

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Table A2

Average monthly rank correlations, through Dec 2020

Style	Factor	Emerging Asia			Emerging EMEA			Emerging Latin America		
		Avg % Chg in Ownshp	% Hdg Fnd Hld (Shr)	% Inst Holdings	Avg % Chg in Ownshp	% Hdg Fnd Hld (Shr)	% Inst Holdings	Avg % Chg in Ownshp	% Hdg Fnd Hld (Shr)	% Inst Holdings
V a l u e	Book-to-Market	-0.08	-0.05	-0.10	-0.04	0.01	-0.02	-0.05	-0.01	-0.06
	Forward 12-M EPS-to-Enterprise Value	-0.03	0.01	0.02	-0.01	0.08	-0.01	-0.05	0.01	-0.01
	TTM EBITDA-to-Enterprise Value	-0.06	0.00	0.01	-0.05	0.04	0.00	-0.05	0.00	-0.07
	TTM Free Cash Flow-to-Enterprise Value	0.00	0.04	0.01	-0.01	0.02	0.00	0.02	0.01	-0.01
	Industry Relative Leading 4-QTRs EPS to Price	-0.02	0.02	0.01	-0.02	0.04	0.07	-0.03	0.05	0.04
	Industry Relative TTM Dividend Yield	-0.06	-0.04	-0.01	-0.04	0.03	0.03	0.03	0.06	0.03
Q u a l i t y	Fixed Assets Turnover Ratio	0.01	0.07	0.06	0.01	0.01	0.14	0.07	0.11	0.14
	Inventory Turnover Ratio	0.05	0.07	0.06	0.05	0.05	0.13	0.00	-0.04	-0.05
	Net Operating Asset Turnover	-0.03	0.02	0.04	0.02	0.02	0.09	-0.03	-0.04	-0.03
	Change in Accruals to Assets	0.00	-0.02	-0.01	0.00	-0.02	0.01	0.00	-0.04	-0.04
	Change in TTM COGS vs. Inventory Level	-0.02	-0.03	0.00	0.00	0.04	0.06	-0.04	-0.06	-0.05
	Change in TTM Sales vs. Accounts Receivable	-0.01	0.00	0.01	0.02	0.02	-0.03	0.02	0.02	0.02
G r o	Working Capital Accruals	-0.01	-0.03	0.00	-0.05	-0.02	-0.01	0.03	0.10	0.11
	1-yr Growth in TTM Free Cash Flow	0.04	0.05	0.04	0.03	0.04	0.04	0.04	-0.02	0.01
R i s k	Reinvestment Rate	0.09	0.07	0.09	0.01	0.02	0.06	0.03	-0.04	-0.04
	Average Monthly Trading Volume-to-Market Cap	0.02	0.08	-0.06	-0.03	-0.02	0.08	0.12	0.34	0.38
	60-Month Beta	0.02	-0.07	-0.01	0.01	-0.02	-0.04	-0.03	-0.18	-0.09
	Asset Quality Index	0.00	-0.01	0.00	0.00	-0.03	-0.03	0.00	0.00	-0.03
	Operating Leverage	0.01	0.01	0.01	-0.01	0.00	-0.02	0.00	0.00	0.00
	Natural Logarithm of Market Capitalization	-0.07	-0.01	-0.14	-0.01	-0.18	-0.11	0.03	0.28	0.17
M o m e n t u m	2-Year Ahead EPS Growth	0.00	0.02	0.05	-0.03	-0.03	0.05	-0.01	0.09	0.04
	3-M Revision in FY2 EPS Forecasts	0.06	-0.02	-0.06	0.05	-0.01	-0.03	0.10	0.24	0.16
	Real Earnings Surprise	0.07	0.04	0.02	0.05	0.02	0.01	0.01	0.00	-0.04
	24-Month Value at Risk	0.04	-0.05	0.02	0.04	-0.01	0.08	0.01	-0.12	-0.07
	5-day Industry Relative Return	0.00	0.00	0.00	-0.01	0.02	-0.01	0.00	-0.01	0.00
	Industry-adjusted 12-month Relative Price Strength	0.15	0.00	0.03	0.09	0.01	0.00	0.10	0.06	0.03
S h S t	Rational Decay Alpha	0.10	0.01	0.02	0.07	0.00	-0.02	0.08	0.04	0.03
	Demand Supply Ratio	0.12	0.05	0.19	0.05	0.07	0.12	-0.05	-0.15	0.04
	Implied Loan Rate	0.11	0.27	0.12	0.11	0.29	0.33	-0.01	-0.05	0.05

Source: IHS Markit

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Table A3

Average monthly quantile return spread correlations, through Dec 2020

Style	Factor	US Total Cap			Developed Europe			Developed Pacific		
		Avg % Chg in Ownshp	% Hdg Fnd Hld (Shr)	% Inst Holdings	Avg % Chg in Ownshp	% Hdg Fnd Hld (Shr)	% Inst Holdings	Avg % Chg in Ownshp	% Hdg Fnd Hld (Shr)	% Inst Holdings
V a l u e	Book-to-Market	-0.26	-0.30	0.05	-0.06	-0.13	0.15	-0.14	-0.05	0.06
	Forward 12-M EPS-to-Enterprise Value	-0.07	-0.10	0.01	-0.10	0.16	0.23	-0.39	-0.02	0.11
	TTM EBITDA-to-Enterprise Value	-0.18	-0.33	0.04	-0.23	-0.10	0.09	0.02	-0.12	0.10
	TTM Free Cash Flow-to-Enterprise Value	0.24	0.08	0.48	0.10	-0.02	0.22	0.33	-0.13	-0.13
	Industry Relative Leading 4-QTRs EPS to Price	-0.08	-0.18	0.22	-0.16	0.05	0.37	-0.50	0.00	0.14
	Industry Relative TTM Dividend Yield	-0.07	-0.36	0.17	-0.13	-0.14	0.26	-0.25	-0.11	0.23
Q u a l i t y	Fixed Assets Turnover Ratio	0.28	0.18	0.44	0.10	0.10	0.35	0.14	-0.30	-0.07
	Inventory Turnover Ratio	-0.04	-0.06	-0.08	-0.01	0.13	0.09	0.29	-0.17	0.02
	Net Operating Asset Turnover	0.34	0.14	0.41	0.02	0.11	0.12	0.35	-0.14	-0.07
	Change in Accruals to Assets	-0.12	-0.14	-0.12	-0.03	0.02	0.09	0.00	0.07	-0.11
	Change in TTM COGS vs. Inventory Level	0.24	-0.07	0.40	0.15	-0.11	0.16	0.37	-0.14	-0.05
	Change in TTM Sales vs. Accounts Receivable	-0.29	0.05	-0.47	0.04	0.03	-0.02	-0.24	0.11	0.22
G r o	Working Capital Accruals	-0.08	-0.01	0.05	-0.16	-0.07	0.05	-0.39	0.07	0.20
	1-yr Growth in TTM Free Cash Flow	0.25	0.26	0.37	0.15	0.09	0.09	0.36	0.03	-0.10
R i s k	Reinvestment Rate	0.10	0.04	0.00	-0.16	0.14	-0.01	-0.26	-0.09	0.16
	Average Monthly Trading Volume-to-Market Cap	-0.01	0.25	0.04	-0.01	-0.03	0.46	-0.33	0.27	0.09
	60-Month Beta	-0.02	-0.28	-0.10	-0.06	-0.08	-0.26	0.45	-0.15	-0.31
	Asset Quality Index	-0.21	-0.16	-0.40	0.00	0.21	0.00	0.30	0.12	-0.17
	Operating Leverage	-0.01	-0.18	0.01	0.07	0.14	0.03	-0.11	-0.07	-0.08
	Natural Logarithm of Market Capitalization	-0.35	-0.06	-0.40	-0.34	0.17	0.24	-0.25	0.24	0.04
M o m e n t u m	2-Year Ahead EPS Growth	-0.19	0.04	-0.21	-0.03	0.04	0.14	-0.27	0.18	0.06
	3-M Revision in FY2 EPS Forecasts	0.06	0.23	-0.17	0.04	0.18	-0.15	0.32	-0.21	-0.14
	Real Earnings Surprise	0.12	0.13	0.16	-0.18	-0.01	0.03	0.00	0.00	0.11
	24-Month Value at Risk	0.05	-0.19	-0.02	-0.03	-0.02	-0.22	0.46	-0.08	-0.29
	5-day Industry Relative Return	0.07	0.10	0.02	-0.13	-0.05	0.21	0.05	0.18	0.02
	Industry-adjusted 12-month Relative Price Strength	0.23	0.05	-0.06	0.20	0.22	-0.10	0.22	0.08	-0.01
S h e e t	Rational Decay Alpha	0.37	0.35	0.01	0.24	0.21	-0.09	0.05	0.08	0.01
	Demand Supply Ratio	0.03	-0.02	-0.04	-0.11	0.16	-0.04	0.06	0.18	-0.11
	Implied Loan Rate	0.19	0.03	0.50	0.02	0.26	0.61	0.38	0.09	0.07

Source: IHS Markit

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Table A4

Average monthly quantile return spread correlations, through Dec 2020

Style	Factor	Emerging Asia			Emerging EMEA			Emerging Latin America		
		Avg % Chg in Ownshp	% Hdg Fnd Hld (Shr)	% Inst Holdings	Avg % Chg in Ownshp	% Hdg Fnd Hld (Shr)	% Inst Holdings	Avg % Chg in Ownshp	% Hdg Fnd Hld (Shr)	% Inst Holdings
V a l u e	Book-to-Market	-0.52	0.09	0.03	-0.22	-0.07	-0.04	-0.12	0.14	-0.04
	Forward 12-M EPS-to-Enterprise Value	-0.20	-0.01	-0.22	0.05	0.10	0.10	-0.14	-0.08	-0.15
	TTM EBITDA-to-Enterprise Value	-0.29	-0.15	-0.17	-0.08	0.05	0.15	-0.06	0.13	-0.12
	TTM Free Cash Flow-to-Enterprise Value	0.08	-0.33	-0.21	0.10	0.05	0.08	0.20	-0.03	-0.08
	Industry Relative Leading 4-QTRs EPS to Price	-0.21	0.17	-0.05	-0.19	-0.12	0.32	-0.02	0.22	0.21
	Industry Relative TTM Dividend Yield	-0.14	-0.33	-0.29	-0.10	0.13	0.00	-0.02	0.17	0.10
Q u a l i t y	Fixed Assets Turnover Ratio	-0.03	0.09	0.20	-0.03	-0.17	0.38	0.26	0.41	0.46
	Inventory Turnover Ratio	0.35	-0.35	0.08	0.06	0.10	0.32	0.26	0.16	-0.04
	Net Operating Asset Turnover	-0.02	-0.29	-0.09	0.22	0.09	0.18	-0.02	0.12	0.15
	Change in Accruals to Assets	-0.05	-0.07	-0.10	0.11	-0.02	-0.01	-0.21	-0.12	0.01
	Change in TTM COGS vs. Inventory Level	-0.14	-0.39	0.02	-0.15	0.05	0.14	-0.02	-0.36	-0.20
	Change in TTM Sales vs. Accounts Receivable	0.02	-0.18	-0.09	0.01	0.00	-0.03	0.15	0.05	0.12
	Working Capital Accruals	-0.11	0.35	0.12	-0.09	-0.14	-0.02	0.01	0.36	0.27
G r o	1-yr Growth in TTM Free Cash Flow	0.19	-0.10	-0.01	0.16	0.09	0.16	0.10	-0.19	-0.06
	Reinvestment Rate	0.40	0.15	0.17	-0.02	-0.05	0.19	0.05	-0.19	-0.17
R i s k	Average Monthly Trading Volume-to-Market Cap	-0.19	-0.01	-0.22	-0.13	-0.15	0.18	0.23	0.61	0.61
	60-Month Beta	0.13	-0.43	-0.03	0.07	0.18	-0.11	-0.23	-0.41	-0.27
	Asset Quality Index	-0.03	-0.15	-0.09	-0.12	-0.05	-0.01	0.01	-0.23	-0.15
	Operating Leverage	0.08	0.01	0.07	-0.01	0.18	-0.02	-0.13	-0.02	-0.12
	Natural Logarithm of Market Capitalization	-0.24	-0.07	-0.17	-0.11	-0.21	-0.18	0.14	0.49	0.35
M o m e n t u m	2-Year Ahead EPS Growth	0.07	0.09	0.23	-0.14	-0.15	0.09	0.06	0.42	0.31
	3-M Revision in FY2 EPS Forecasts	0.19	-0.15	-0.21	0.23	0.23	-0.16	0.15	0.16	0.22
	Real Earnings Surprise	0.35	0.27	-0.07	-0.12	-0.08	-0.01	0.12	-0.07	-0.27
	24-Month Value at Risk	0.17	-0.37	-0.06	0.07	0.10	0.11	-0.12	-0.47	-0.32
	5-day Industry Relative Return	-0.09	0.13	0.08	-0.15	-0.03	0.01	0.16	0.24	0.19
	Industry-adjusted 12-month Relative Price Strength	0.49	-0.06	0.08	0.05	0.02	-0.13	0.21	-0.08	0.01
	Rational Decay Alpha	0.28	-0.40	0.00	0.05	-0.04	-0.10	0.01	-0.10	-0.01
S h o r t	Demand Supply Ratio	0.12	-0.11	0.24	0.30	0.26	-0.12	-0.31	-0.49	-0.24
	Implied Loan Rate	0.36	0.10	0.07	0.17	0.38	0.21	-0.06	-0.32	-0.31

Source: IHS Markit

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Figure A1

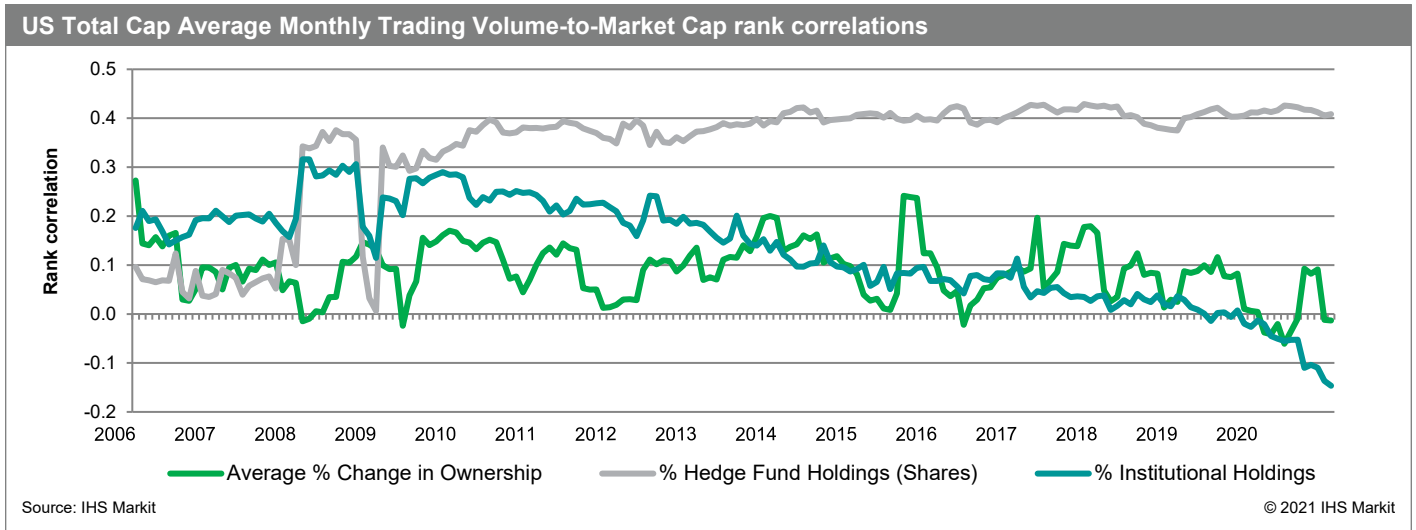


Figure A2

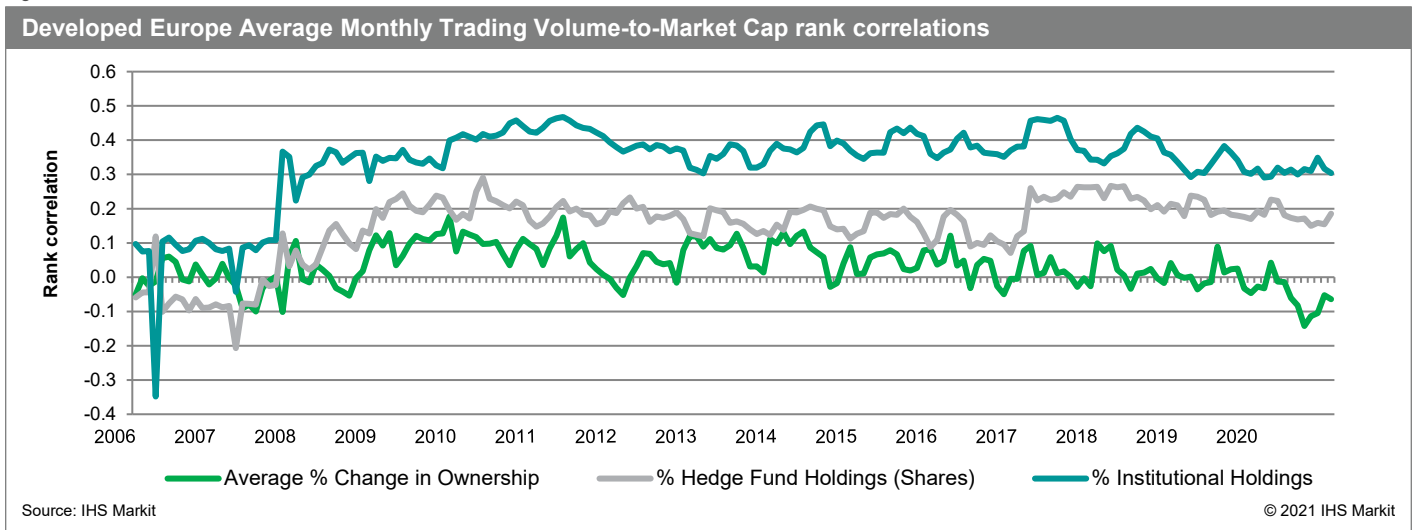


Figure A3

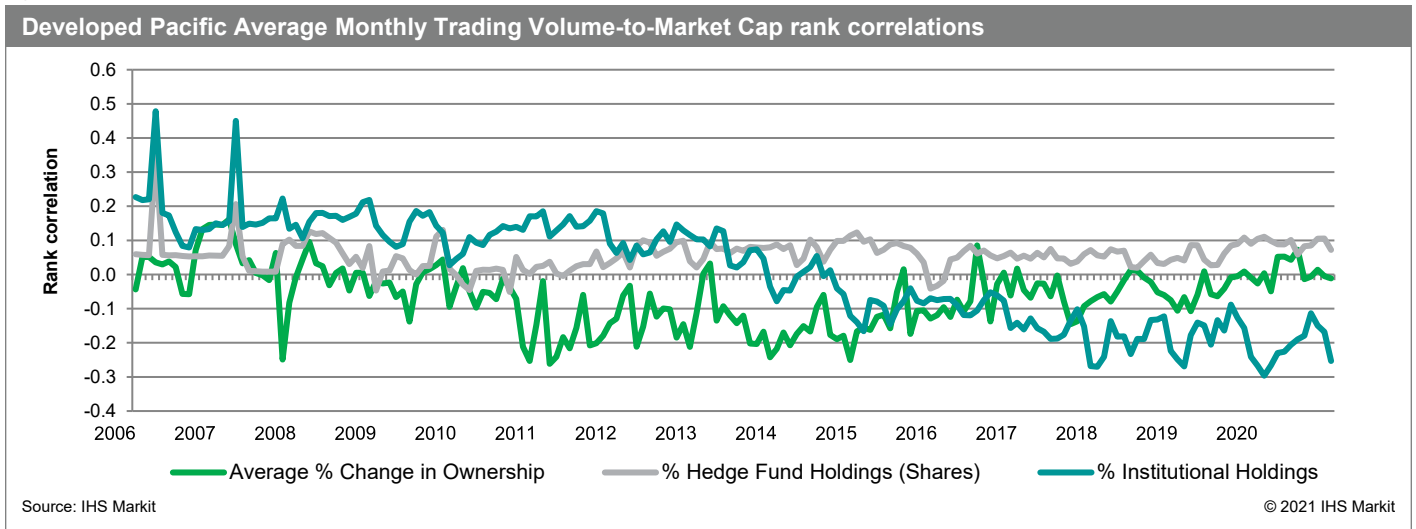


Figure A4

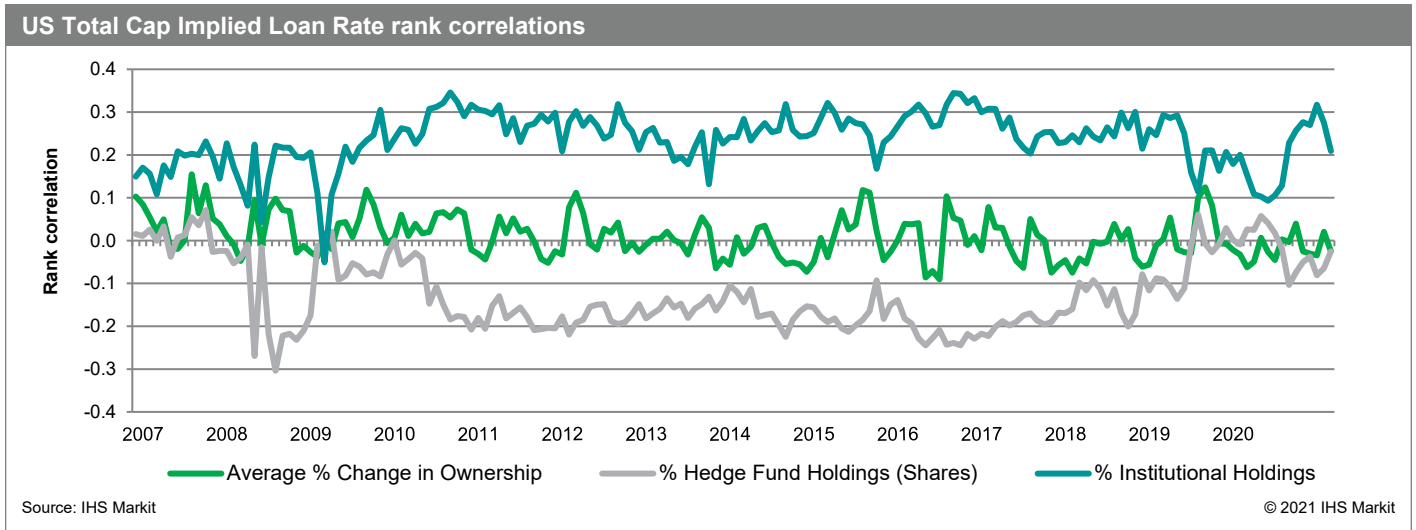


Figure A5

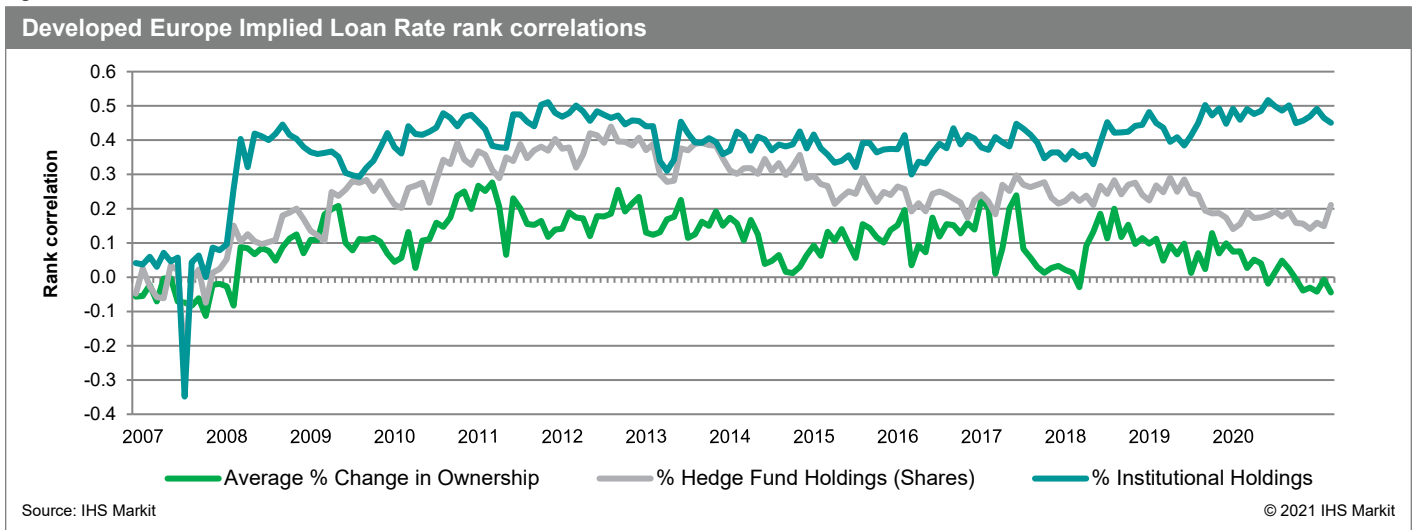
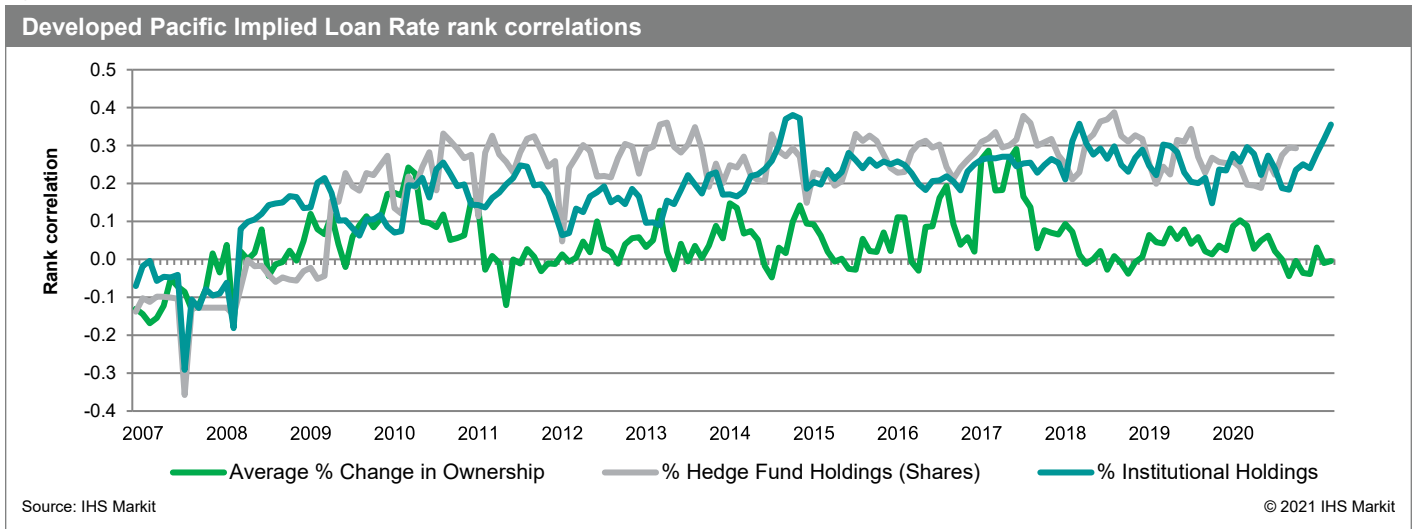


Figure A6



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