Quantitative Monographs
Irrational asset management

Equities

Global
Quantitative

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The disposition to break even

Human emotion is a remarkably dominant factor when making investment decisions. Avoiding regret and seeking pride are both at the heart of the disposition effect; the tendency for investors to sell their winners too soon and hold their losers too long. This irrational behaviour has been confirmed through countless studies and has profound implications for mispricing opportunities.

Demonstrably irrational behaviour

For the first time, we measure the interaction of trading patterns and unrealised returns using a global database of active institutional fund ownership. We clearly observe the disposition effect in practice; this is consistent over time and value managers naturally exhibit this behaviour most prominently. We find stocks sold at a gain actually continue to outperform afterwards—investors actively sell their winners to fund their losers.

Why is this useful?

This irrational trading behaviour induces under-reaction to news events and gives rise to consistent mispricing patterns; perhaps the precursor to momentum. We exploit this to generate a trading strategy, which is uncorrelated to, and has outperformed, many standard quant factors. We introduce a modern technique for regressing mixed-frequency signals, to ameliorate the reporting lags in the fund holdings by combining them with pricing data.

What are the current pain and gain trades?

We screen on the global pain and gain trades by aggregating stocks being carried at the largest unrealised losses and gains. Based on this screen, Noble Group, Sembcorp Marine and Unione di Banche Italiane would appear to be currently the largest pain trades in developed markets; Adidas, Aristocrat and Agnico Eagle Mines currently the largest gain trades. Please see inside for a full list.

Introduction

In 1999, two Stanford university PhD students tried in vain to sell their search engine to the then-tech giants, looking to focus on their academic studies instead. Excite, AltaVista and Yahoo each declined their offers—one as low as US$750,000. Those rejected students, Sergey Brin and Larry Page, instead kept their technology and built Google into the US$500bn company it is today.

We can only imagine the cognitive contortions and tortured rationale by which the involved parties justified their decision during the subsequent two decades of Google's meteoric rise, but we should be mindful of our *schadenfreude*; we are all human and fall prey to the same emotional and cognitive shortcomings ourselves.

Avoiding regret and the quest for pride are at the heart of the disposition effect; the behaviour in which investors tend to sell their winners too soon and hold their losers too long. This wholly irrational behaviour has been confirmed over countless independent studies and has significant implications for asset pricing.

In this report we explore this behavioural bias as exhibited by active fund managers, using a global database of institutional ownership. We show how these biases can be measured over time and across manager style, how they induce mispricings and price momentum, and how they can be exploited to produce alpha.

We would like to thank Cathy Fang, our support service professional, for her assistance in preparing this research report.

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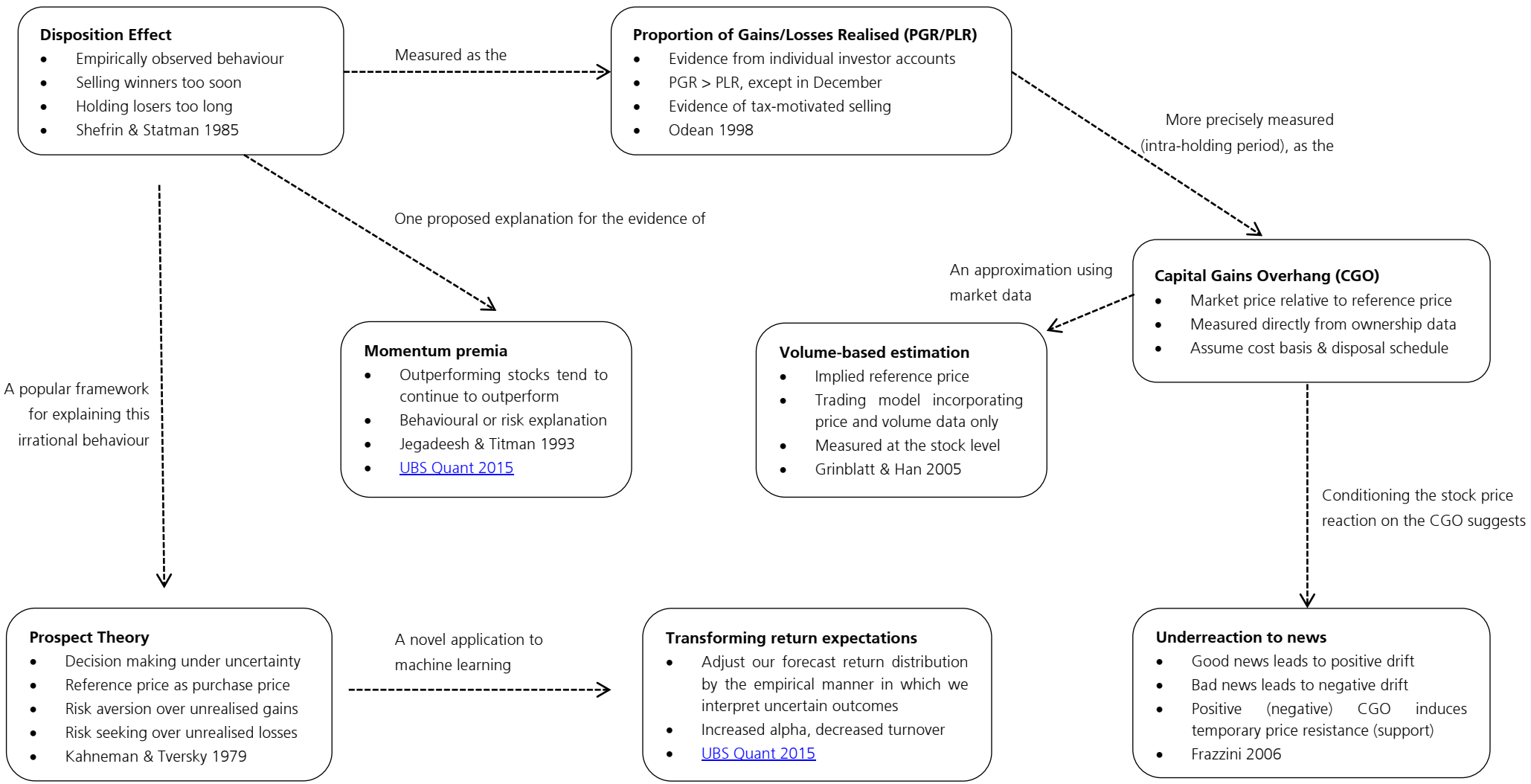
Figure 1: A high-level roadmap to this report



Source: UBS Quant

What is the disposition effect?

Selling winners too soon; holdings losers too long

The disposition effect is the observation that investors tend to sell their winners too soon and hold their losers too long, first identified by Shefrin and Statman (1985). However perverse yet preventable this behaviour might seem, this finding has been verified in countless studies of investor behaviour; across countries, cultures, asset classes, investor expertise, and over time.

Avoiding regret and the quest for pride are at the heart of this

Avoiding regret and the quest for pride are at the heart of the disposition effect; complex human emotions that manifest themselves in predictable manners within our decision-making process. Accordingly, there have been many attempts to explain this effect and account for it within decision-making frameworks.

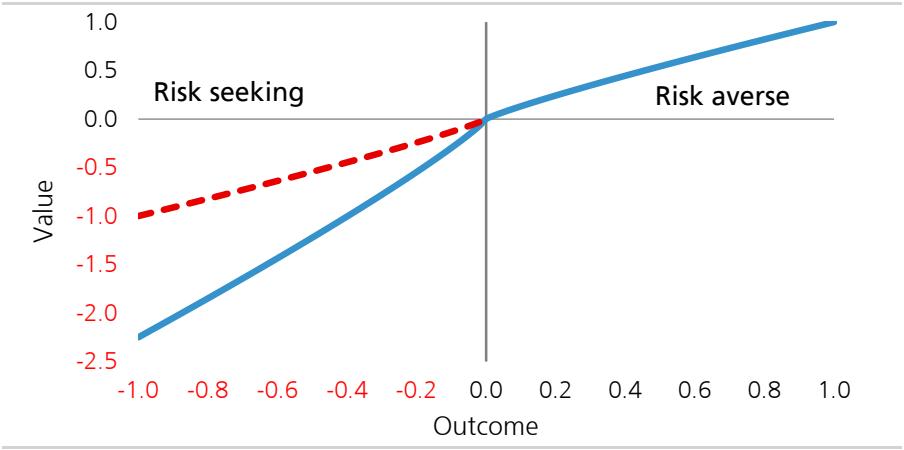
Prospect Theory is a prominent decision-making framework

Perhaps the most popular explanation is afforded by Prospect Theory, the Nobel-prize winning model introduced by Kahneman and Tversky (1979). This theory describes some of the salient features of our decision-making process: we are loss-averse and overweight low probability events—expressed in their model via the value function and probability function respectively.

We recognise decreasing marginal utility in outcomes

Intuitively we can appreciate that the difference between an outcome of $10 and $15 has more psychological impact than the difference between $1,000 and $1,005; we recognise decreasing marginal utility in outcomes. Formally, this means their proposed value function is S-shaped—concave for gains and convex for losses.

Figure 2: The prospect theory value function



Source: Kahneman & Tversky, 1979

Providing a popular explanation for this behavioural pattern

The basic premise of the disposition effect in this context is that if an investor has experienced an unrealised (paper) gain, they are in the concave (risk averse) part of the value function, thus experiencing diminishing returns on their investment and becoming more likely to sell accordingly.

Although this is not without its critics

Barberis and Xiong (2009) argue the conventional wisdom is misleading and the relationship between the disposition effect and prospect theory is less clear-cut. Alternative theories on the true nature of the disposition effect abound; we spare our readers the needless armchair psychology and posturing.

Regardless, the effect is robust and economically significant

Suffice to say this is a robust, empirically observed and economically significant effect. In this report, rather we discuss the implications and applications of this irrational behaviour to asset management—quantitatively, no less.

How do we calculate it?

How do we quantify these effects to move from theory to practice?

Behavioural finance is nothing if not interesting; often the challenge is rather how to quantify these effects so we can move from theory to practice—from anecdotes to application. The disposition effect was originally measured as the proportion of gains *realised* (relative to the number of total unrealised gains); being significantly larger than the corresponding proportion of losses realised (Odean 1998).

Capital gains overhang = unrealised stock return

Another measurement is the "*capital gains overhang*"; the market price relative to a reference price (the cost basis), that reflects an investor's position. *We define this simply as the unrealised return on a fund's investment*[1].

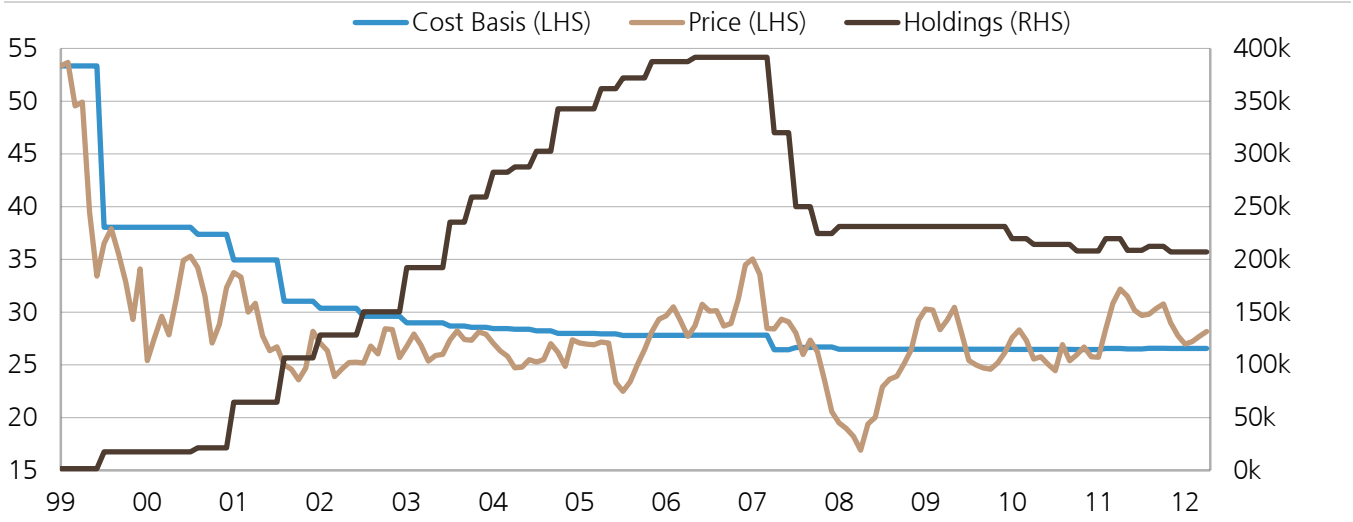
$$CGO = \frac{\text{Market Price}}{\text{Reference Price}} - 1$$

This is a deceptively simple concept; while this is straightforward in a scenario in which an investor enters a position in a single transaction and disposes of it in another, this does not resemble trading behaviour from submitted fund holdings.

We observe individual fund holdings to estimate behavioural effects directly

Figure 3 shows a single open-ended growth fund's Microsoft holdings. This fund enters this position at the peak of the dot-com bubble, and then consistently increases its stake over the subsequent eight years, despite the stagnant stock price, before halving its position during the GFC—perhaps due to redemptions.

Figure 3: A single fund's stake in Microsoft over time (in USD)



Source: FactSet, UBS Quant

Prior to reducing its position the reference price can be calculated as the trade-weighted average of the purchase prices. Since the market price was below the reference price until mid-2006, the fund's investment was underwater during this entire period, until the final stage of the 2000's bull market (2006-07). While a small example, the disposition effect certainly seemed to play a role in this instance.

When positions are reduced, the cost basis becomes ambiguous

The calculation becomes problematic in March 2008 when the fund first reduced its holdings at an average price of $28. We do not know whether the fund sold the lot purchased at $25 at a 12% gain, or the lot purchased at $36, at a 22% loss; the fund holdings data does not specify. We adopt the FIFO disposal schedule as in Frazzini (2006), which assumes holdings are disposed on a first-in, first-out basis.

[1] This definition varies slightly from the measure introduced by Grinblatt and Han (2005), but the results are unaffected. See Appendix for further details.

What is it saying?

Given our estimation of the cost-basis for individual fund holdings, we can observe the disposition effect in practice. This should simply manifest itself through the return distribution of reduced and disposed positions in the database; there should be a positive central tendency, i.e. more stocks are sold at a gain than a loss.

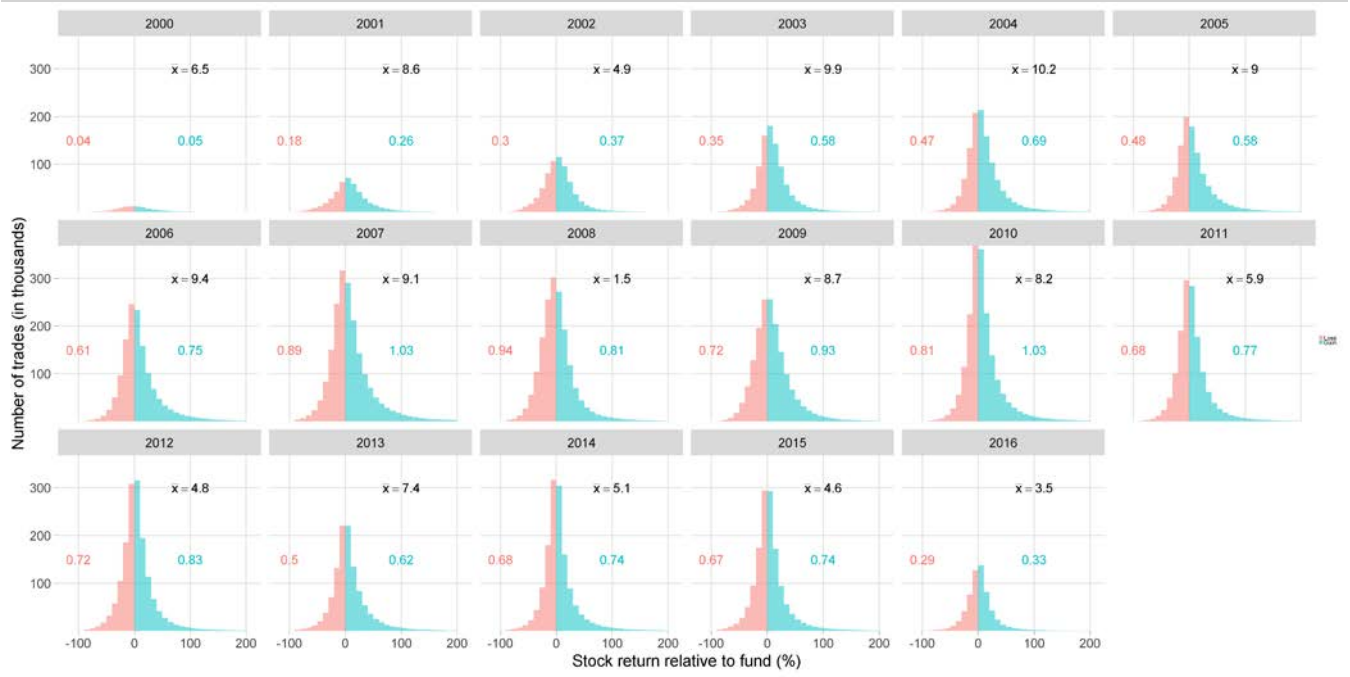
We expect capital gains will be realised ahead of capital losses

From the stock-level positions we first net out the value-weighted average return, to ensure a meaningful comparison between funds. We see the average return on decreased positions was positive, consistent with the disposition effect (Figure 4).

So the fund-relative return of sold positions would be positive

Naturally the distribution of returns is bounded on the downside and unbounded on the upside, however the simple counts of negative and positive returns (shown in millions of trades), concur with this finding also; with the exception of 2008 in which more stocks were understandably sold at a loss than a gain.

Figure 4: The return distribution of reduced holdings

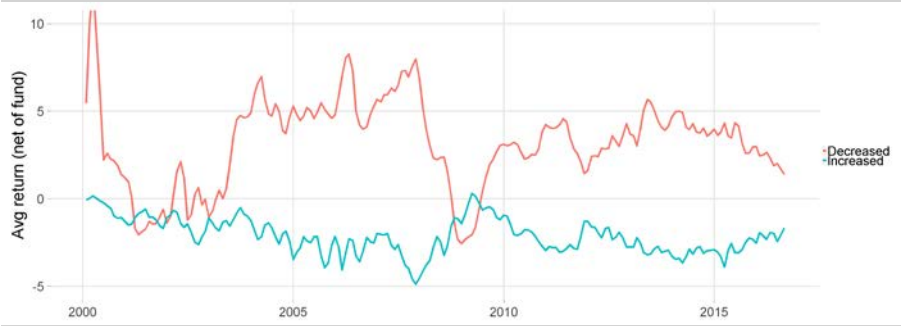


Source: FactSet, UBS Quant

Given the huge sample size (there are over 21 million trades in Figure 4 above); it seems the disposition effect is alive and well. In Figure 5, we show the value-weighted average return of decreased and increased holdings as a time series.

The disposition effect is evidently present in the holdings database

Figure 5: Average return of decreased/increased holdings



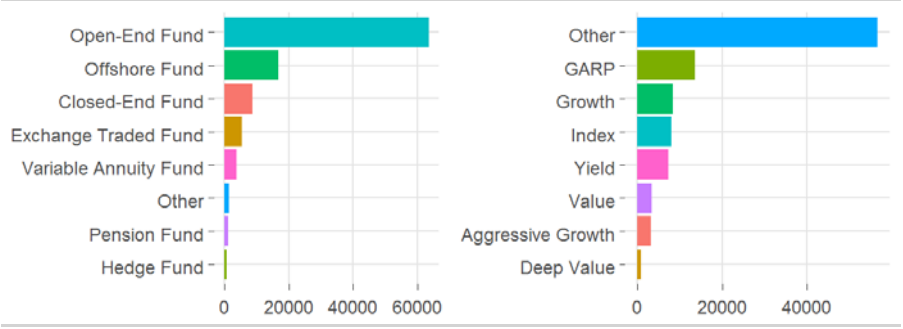
Source: FactSet, UBS Quant

From Figure 5 we can observe that active managers tend to sell their winners over their losers consistently through time, with the exception of the tech-wreck and the GFC, in which they tended to write off their losers and increase stakes in their winners. Otherwise the perverse tendency to "double-down" by selling winners to fund losers seems commonplace.

The disposition effect appears consistent over time with the exception of the GFC

The FactSet ownership database also makes an effort to classify the style and type of institutional investor captured. While the coverage is not complete and the fund categorization is understandably coarse, we can examine the extent of this effect conditioned on these fund characteristics, as in Figure 6.

Figure 6: Breakdown of fund classifications



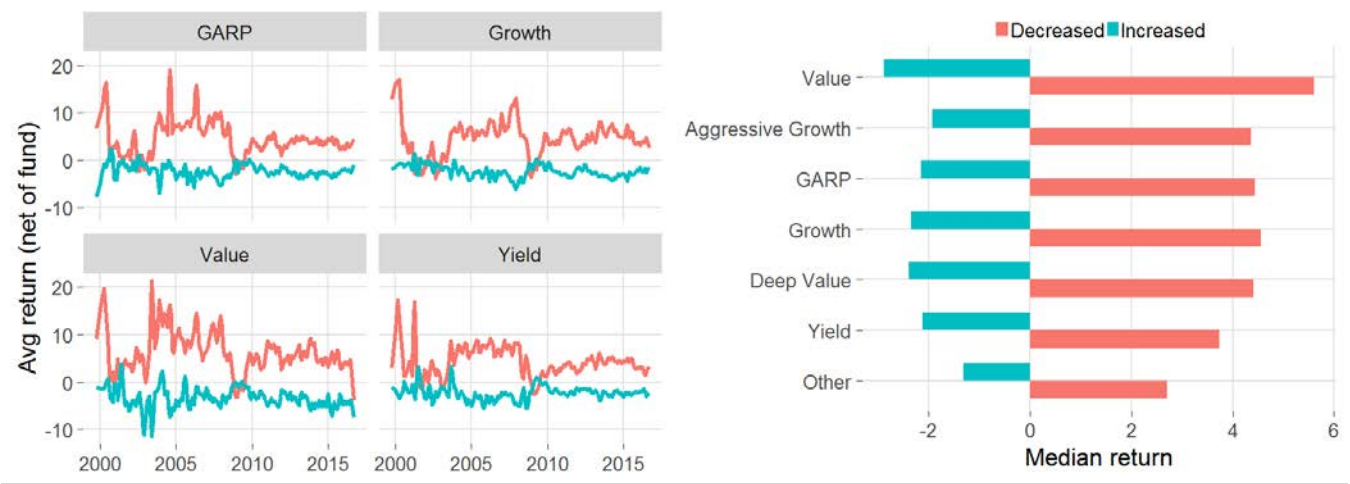
Source: FactSet, UBS Quant

Figure 7 shows that value managers exhibit the disposition effect most significantly. The right hand chart shows the median return of their reduced positions over time; they tend to reduce their holdings at the highest gain and conversely increase their positions at the highest losses.

Value managers exhibit the disposition effect most prominently

Of course, this is not surprising considering that stocks that have experienced price appreciation are likely no longer considered to be inexpensive. Indeed it becomes difficult to disentangle pure price action from the capital gains overhang; they both have market price in their numerator. We explore this further in the subsequent sections.

Figure 7: The disposition characteristics of investment styles



Source: FactSet, UBS Quant

What are the implications?

The more interesting question is what becomes of the stocks which are disposed at a gain and loss—how can this be used to make better investment decisions? While the literature is clear on the robustness and pervasiveness of the disposition effect; the implications of this effect on asset mispricing are still subject to active debate.

The capital gains overhang affects stock reactions

Frazzini (2006) explores the interaction of the disposition effect and the reaction to news events. Their findings suggest that when a stock experiences good news and its share price appreciates; investors with a high capital gains overhang will tend to sell, temporarily depressing the stock price. From that lower base, the subsequent returns tend to be higher.

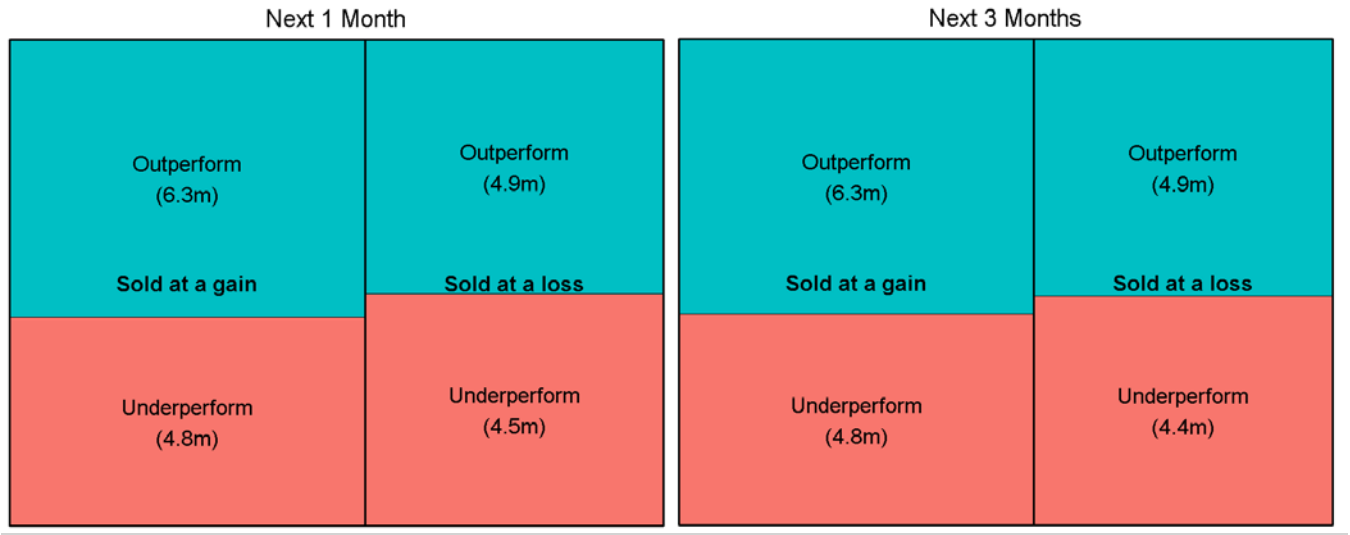
There is no commonly accepted belief for momentum style premia

A related contentious finding of significance is that of the momentum style premia; why should outperforming stocks continue to outperform? Explanations typically take the form of an appeal to a behavioural or risk-based phenomenon, however the economic significance of the empirical findings are undeniable[2].

One theory ties momentum to the disposition effect

We believe one of the most compelling arguments for the existence of this return premia is the under-reaction that this disposition effect induces. That is, a positive capital gains overhang induces temporary price support via the disposition effect, and vice-versa for a negative capital gains overhang.

Figure 8: The subsequent returns of sold positions



Source: FactSet, UBS Quant

Gains that are realised typically continue to outperform; investors truly sell their winners too early

In Figure 8 we now show the subsequent performance for those reduced positions, conditioned on whether or not a gain or loss was realised. The x-axis in each chart represents the proportion of gains versus losses realised (shown in brackets is the number of trades); the y-axis represents the proportion of stocks that subsequently outperformed or underperformed (in absolute terms).

Again we clearly observe the disposition effect, in that more gains are realised than losses. However, *the gains that are realised then typically continue to outperform*; this proportion of outperformers to underperformers is more pronounced for gains than losses; investors sell their *current and future* winners ahead of their losers.

[2] For an exposé of this debate, refer to Asness (2014), or our Academic Research Monitor "Momentum Investing", Jan 2015.

How does it perform?

Assuming for the moment that we knew fund holdings at the time, we now run backtests of this aggregated stock-level capital gains overhang. This is aggregated to the stock level with the value-weighted capital gains overhang across all active funds in the holdings database.

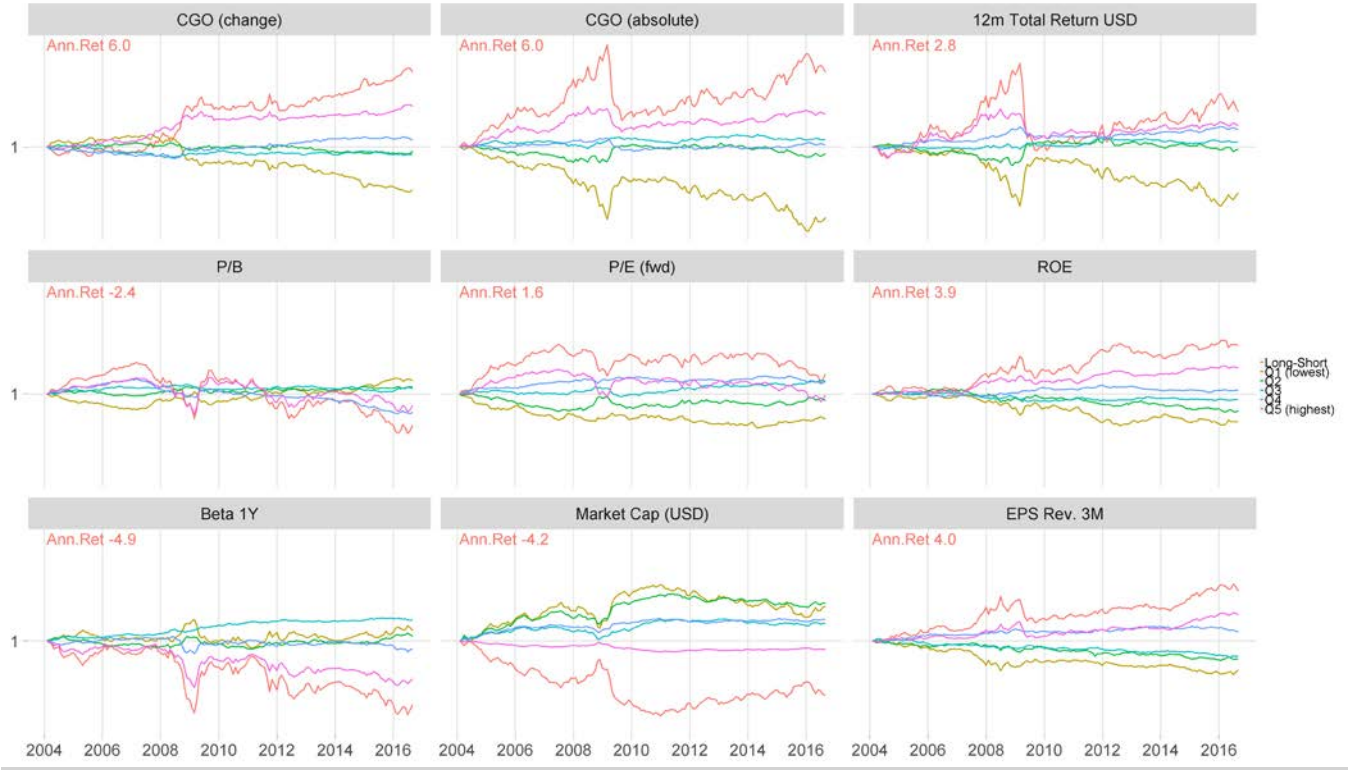
Figure 9 shows the backtested performance of this strategy in the MSCI AC World[3]; we include some common factors for comparison. The absolute capital gains overhang factor looks remarkably similar to momentum; both strongly outperform during market rallies and suffer massive drawdowns during corrections.

The capital gains overhang looks very similar to price momentum

Figure 10 overleaf shows the average rank correlation of these factors during the full backtest period; we can see that the capital gains overhang is indeed highly correlated to momentum, and it seems we have not added much value. However, at face value we do not know whether there was active positioning and volume behind momentum, or whether it was an artefact of thin trading.

Momentum gives no indication as to the active positioning and volume behind it…

Figure 9: Factor performance in MSCI ACWI



Source: FactSet, MSCI, UBS Quant

A more interesting factor seems to be the change in the capital gains overhang, which is also stationary for time series analysis. Perhaps the first derivative performs better because the assumptions embedded in the cost basis drift from reality over time, but the change still bears some accuracy.

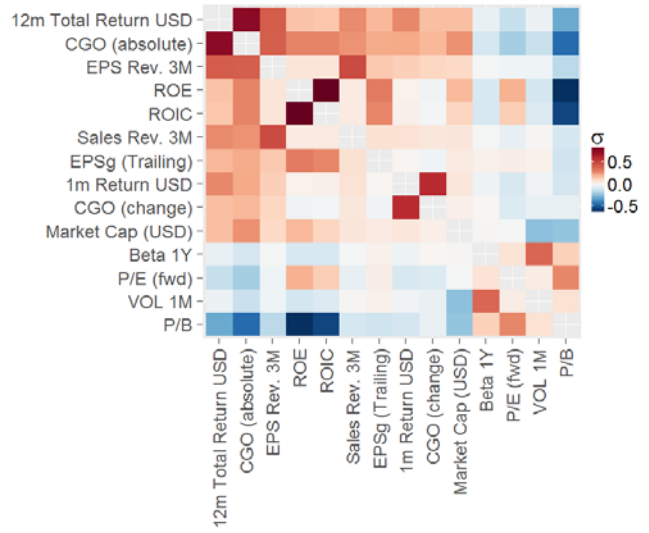
…or whether it is an artefact of thin trading

[3] Monthly rebalanced, free-float adjusted market cap weighted quintiles, cumulative excess total returns in US dollars.

This change in the capital gains overhang (CGO) is also uncorrelated with many of the standard quant factors, which yields an interesting (performant) orthogonal factor. The median rank correlations of the cross-sectional factors are shown in Figure 10; the highest correlated factor to the absolute CGO is 12-month momentum, and the highest correlated factor to the CGO change is one-month momentum.

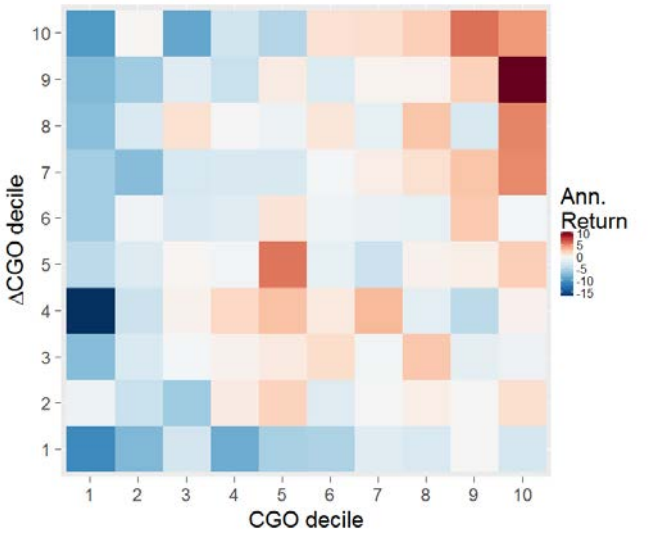
The interaction between the absolute level and the change in the capital gains overhang is also of interest. Figure 11 shows the annual return of the intersection of the deciles of these factors. From bottom-left to top-right we observe increasing performance of the portfolio with an increase in the absolute level and the change of capital gains overhang.

Figure 10: Uncorrelated to many other factors



Source: FactSet, MSCI, UBS Quant

Figure 11: CGO versus ΔCGO performance



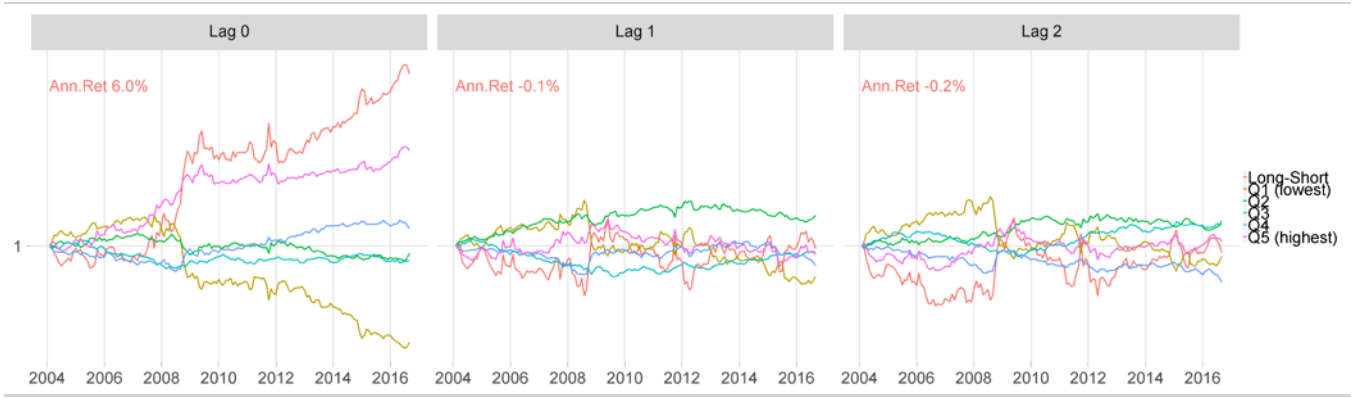
Source: FactSet, MSCI, UBS Quant

Aren't the holdings lagged?

Up to this point we have run the analysis without introducing the lags present in the real data set. This was done to better understand the relationship between holdings and prices, if only retrospectively. In reality, the performance of the CGO strategy in Figure 9 is unachievable due to reporting delays in the holdings data.

While the fund-specific reporting delays are not provided in the data feed, the vast majority of the funds report their holdings several months after their positions have been engaged. Below we show the effect of lagging this data gradually; the outperformance of this strategy completely disappears.

Figure 12: The effect of lagging the holdings data (on the CGO change)



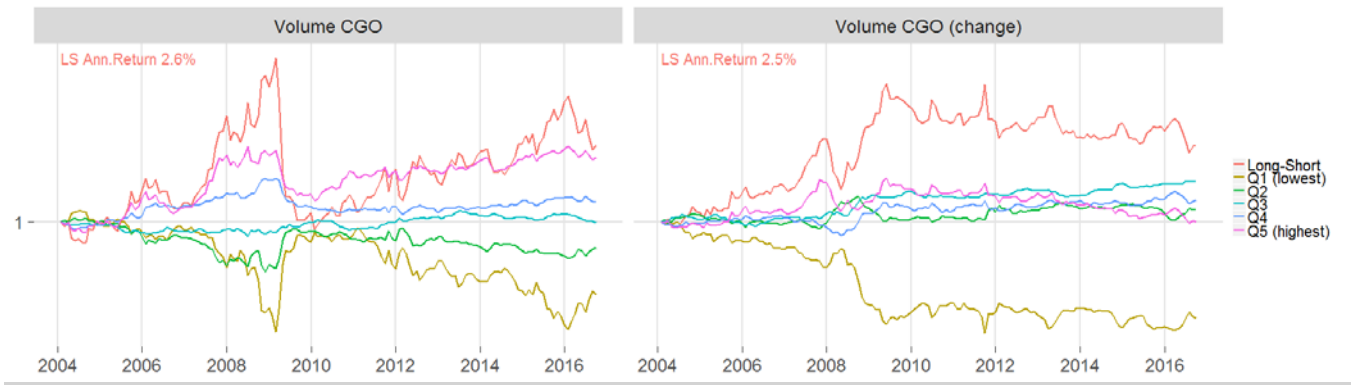
Source: FactSet, MSCI, UBS Quant

A paper from Grinblatt and Han (2005) introduced a technique for approximating the capital gains overhang based on market data instead. In simple terms their approach estimates the cost basis using the fraction of shares purchased as of one date and still held by their original purchasers as of another date.

As a means to this end, they assume a simple model of trading behaviour which solely incorporates stock price and volume data. The calculation is computationally laborious but yields a high frequency approximation of the capital gains overhang in the absence of fund holdings data.

Again this seems highly correlated to momentum, which is perhaps not surprising given its functional form. Unfortunately this rough approximation does not yield competitive results with the holdings-based capital gains overhang (Figure 13).

Figure 13: Performance of the volume-implied capital gains overhang (and MoM change)



Source: FactSet, MSCI, UBS Quant

Can we ameliorate the lag?

"Nowcasting" problems are well-studied in econometrics

Fortunately there are modern techniques available to address problems like these. Such challenges arise often in econometric modelling, in which forecasts (a similar setting is that of "nowcasting") of an infrequent variable are sought using more frequent indicators as predictors.

For example, these situations arise when getting early read on GDP

For example, GDP might only be available on an annual basis and with a significant lag beyond the fiscal year-end. Several studies have introduced models predicting GDP ahead of its official release, using coincident or leading indicators available on a monthly basis; eg, retail sales, non-farm payrolls, industrial production, and so on.

We combine the high frequency volume-implied CGO with the lagged holdings-based CGO

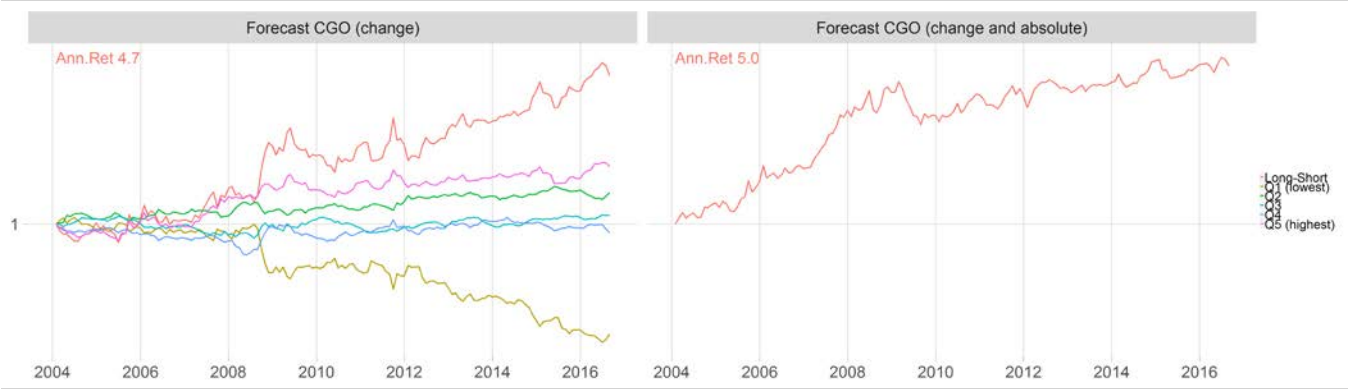
Mixed data sampling (MIDAS) models have become popular as a means to this end. Introduced by Ghysels (2004), they provide an effective framework for performing regressions incorporating data sampled at different frequencies. We adopt this technique to compensate for the information decay suffered by the three-month lagged holdings, essentially augmenting it with the daily volume-implied CGO signal.

Figure 14: Part of the capital gains overhang time series for Microsoft

Source: FactSet, UBS Quant

These predictions are modelled for each stock individually, using an expanding window to estimate the model parameters. The resulting forecasts are completely out-of-sample, only incorporating market data available as of the rebalance date alongside the lagged holdings. Please refer to the Appendix for technical details.

Figure 15: The capital gains overhang "nowcasting" model (MSCI ACWI)

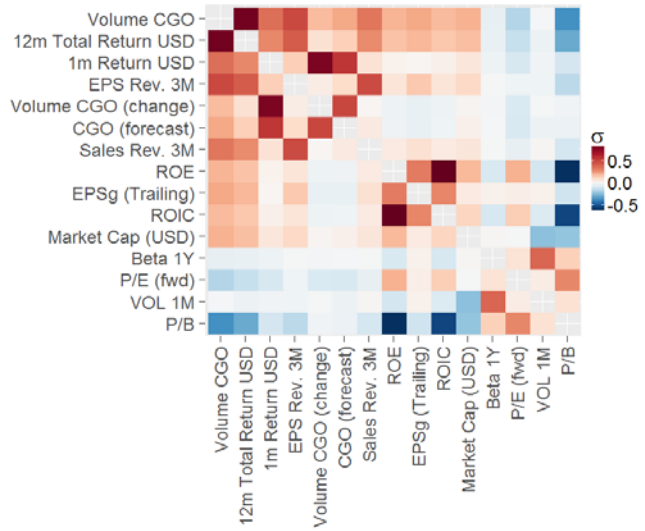


Source: FactSet, MSCI, UBS Quant

Figure 15 shows the results of this strategy. On the left, we show the performance of the forecast change in capital gains overhang; on the right, we condition long-term (12-month) momentum on the positive change in forecast capital gains overhang—essentially looking at the top right corner in Figure 17.

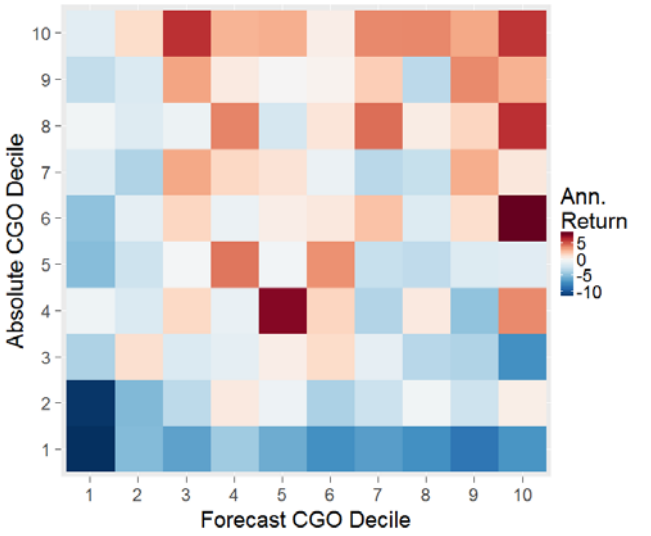
The results are encouraging; naturally while not as impressive as the unachievable foresight-biased result, this yields a significant improvement on the unimpressive lagged results. The correlation with short-term momentum has increased, which is understandable given the high-frequency nature of the components. However, this moderate correlation to short-term momentum implies high turnover, potentially limiting the scalability of the strategy.

Figure 16: Correlated with short-term momentum



Source: FactSet, MSCI, UBS Quant

Figure 17: Forecast CGO change and absolute intersection



Source: FactSet, MSCI, UBS Quant

What are the current pain trades?

In Figure 18 we show the Top 10 largest pain trades globally. These are the stocks with the largest aggregate unrealised loss amongst active institutional investors in the database; we further screen on more than 50 fund holders, and those having a forecast change from our CGO forecast model as described in the report.

The return distribution shows a smoothed histogram of the unrealised returns that these funds are carrying in their positions. The left-most side corresponds to a 100% loss, and the right-hand side is clipped at a 150% gain. The value-weighted average is just the average return weighted by the nominal holding value.

To recap, the implication of these stocks being pain trades is that active managers are reluctant to realise the loss which induces temporary price support. However, this has negative subsequent implications; pain trades are expected to continue to underperform, particularly if there is a corresponding negative forecast change.

Figure 18: Global top-10 pain trades

Asia

Ticker	Name	Industry Group	Country	Price (LOC)	Return Distribution (-100% to +150%)	#Active Holders	Avg Return (equal weight)	Avg Return (value weight)	Forecast Change
NOBL SP	Noble Group Ltd	Capital Goods	Singapore	0.18		70	-70%	-75%	2%
SMM SP	Sembcorp Marine Ltd	Capital Goods	Singapore	1.33		58	-52%	-54%	0%
494 HK	Li & Fung Ltd	Consumer Durables & Apparel	Hong Kong	3.92		101	-42%	-56%	4%
7211 JT	Mitsubishi Motors Corp	Automobiles & Components	Japan	562		112	-41%	-48%	2%
STO AT	Santos Ltd	Energy	Australia	3.73		85	-37%	-54%	-15%
EXCL IJ	XL Axiata Tbk PT	Telecommunication Services	Indonesia	2480		70	-37%	-38%	-11%
IDEA IS	Idea Cellular Ltd	Telecommunication Services	India	80		53	-33%	-43%	-4%
SAKP MK	SapuraKencana Petroleum Bh	Energy	Malaysia	1.64		74	-33%	-47%	-1%
3765 JT	GungHo Online Entertainmen	Software & Services	Japan	258		72	-32%	-46%	13%
9507 JT	Shikoku Electric Power Co Inc	Utilities	Japan	971		72	-32%	-43%	4%

Global Emerging Markets

Ticker	Name	Industry Group	Country	Price (LOC)	Return Distribution (-100% to +150%)	#Active Holders	Avg Return (equal weight)	Avg Return (value weight)	Forecast Change
KOMB CK	Komercni banka as	Banks	Czech	921.9		126	-72%	-82%	3%
ALPHA GA	Alpha Bank AE	Banks	Greece	1.6		62	-37%	-55%	1%
EXCL IJ	XL Axiata Tbk PT	Telecommunication Services	Indonesia	2480		70	-37%	-38%	-11%
TAVHL TI	TAV Havalimanlari Holding AS	Transportation	Turkey	13.36		80	-35%	-37%	0%
PGE PW	PGE Polska Grupa Energetyczr	Utilities	Poland	10.7		75	-34%	-33%	-3%
ENG PW	Energa SA	Utilities	Poland	8		58	-47%	-51%	-
FIBR3 BS	Fibria Celulose SA	Materials	Brazil	23.07		101	-34%	-38%	7%
EMBR3 BS	Embraer SA	Capital Goods	Brazil	15.66		92	-33%	-33%	5%
IDEA IS	Idea Cellular Ltd	Telecommunication Services	India	80		53	-33%	-43%	-4%
SAKP MK	SapuraKencana Petroleum Bh	Energy	Malaysia	1.64		74	-33%	-47%	-1%

North America

Ticker	Name	Industry Group	Country	Price (LOC)	Return Distribution (-100% to +150%)	#Active Holders	Avg Return (equal weight)	Avg Return (value weight)	Forecast Change
WFT UN	Weatherford International PLC	Energy	United States	6.3		144	-41%	-59%	3%
ENDP UW	Endo International PLC	Pharmaceuticals, Biotechnolog	United States	20.81		172	-40%	-56%	-3%
CCO CT	Cameco Corp	Energy	Canada	10.7		130	-39%	-48%	-2%
CF UN	CF Industries Holdings Inc	Materials	United States	25.92		354	-37%	-39%	3%
HFC UN	HollyFrontier Corp	Energy	United States	24.44		173	-29%	-31%	-3%
POT CT	Potash Corp of Saskatchewan	Materials	Canada	21.89		243	-29%	-46%	4%
NRG UN	NRG Energy Inc	Utilities	United States	11.52		151	-28%	-27%	-2%
HSE CT	Husky Energy Inc	Energy	Canada	15.93		112	-28%	-45%	-4%
SIG UN	Signet Jewelers Ltd	Retailing	United States	80.01		191	-27%	-19%	-7%
PRGO UN	Perrigo Co PLC	Pharmaceuticals, Biotechnolog	United States	90.31		243	-26%	-16%	5%

Europe

Ticker	Name	Industry Group	Country	Price (LOC)	Return Distribution (-100% to +150%)	#Active Holders	Avg Return (equal weight)	Avg Return (value weight)	Forecast Change
UBI IM	Unione di Banche Italiane SpA	Banks	Italy	2.542		106	-52%	-60%	0%
POP SQ	Banco Popular Espanol SA	Banks	Spain	1.091		475	-51%	-65%	1%
UCG IM	UniCredit SpA	Banks	Italy	2.28		475	-50%	-57%	3%
DBK GY	Deutsche Bank AG	Diversified Financials	Germany	13.12		539	-50%	-58%	2%
RBS LN	Royal Bank of Scotland Group	Banks	Britain	190		224	-44%	-45%	1%
SAB SQ	Banco de Sabadell SA	Banks	Spain	1.229		486	-38%	-40%	0%
AGN NA	Aegon NV	Insurance	Netherlands	3.85		343	-37%	-45%	0%
CBK GY	Commerzbank AG	Banks	Germany	6.075		261	-36%	-47%	5%
EZJ LN	easyJet PLC	Transportation	Britain	918.5		298	-34%	-30%	3%
BBVA SQ	Banco Bilbao Vizcaya Argenta	Banks	Spain	6.17		1769	-33%	-31%	3%

Source: FactSet, MSCI, UBS Quant

What are the current gain trades?

Similar to Figure 18, we show stocks with the largest unrealised gains globally in Figure 19. Conversely, the implication of these names having a high unrealised gain is that this induces temporary selling pressure as investors exhibit a disposition to irrationally realise these gains. This has positive subsequent implications for the stock price performance, however.

Figure 19: Global top-10 gain trades

Asia

Ticker	Name	Industry Group	Country	Price (LOC)	Return Distribution (-100% to +150%)	#Active Holders	Avg Return (equal weight)	Avg Return (value weight)	Forecast Change
175 HK	Geely Automobile Holdings Lt	Automobiles & Components	China	8.73		120	86%	99%	16%
7974 JT	Nintendo Co Ltd	Software & Services	Japan	24345		227	73%	91%	11%
ALL AT	Aristocrat Leisure Ltd	Consumer Services	Australia	15.54		85	69%	35%	-7%
2018 HK	AAC Technologies Holdings In	Technology Hardware & Equip	China	77.1		133	64%	88%	-2%
BAF IS	Bajaj Finance Ltd	Diversified Financials	India	1134.3		52	62%	61%	2%
2413 JT	M3 Inc	Health Care Equipment & Serv	Japan	3420		155	61%	69%	1%
NTES UW	NetEase Inc	Software & Services	China	263.53		172	58%	50%	10%
AIA NZ	Auckland International Airport	Transportation	New Zealand	6.82		90	57%	60%	-6%
TWE AT	Treasury Wine Estates Ltd	Food Beverage & Tobacco	Australia	11.47		128	57%	54%	4%

Global Emerging Markets

Ticker	Name	Industry Group	Country	Price (LOC)	Return Distribution (-100% to +150%)	#Active Holders	Avg Return (equal weight)	Avg Return (value weight)	Forecast Change
175 HK	Geely Automobile Holdings Lt	Automobiles & Components	China	8.73		120	86%	99%	16%
RADL3 BS	Raia Drogasil SA	Food & Staples Retailing	Brazil	68.97		107	73%	99%	3%
MDIA3 BS	M Dias Branco SA	Food Beverage & Tobacco	Brazil	139		51	71%	46%	6%
2018 HK	AAC Technologies Holdings In	Technology Hardware & Equip	China	77.1		133	64%	88%	-2%
BAF IS	Bajaj Finance Ltd	Diversified Financials	India	1134.3		52	62%	61%	2%
BVT SJ	Bidvest Group Ltd/The	Capital Goods	South Africa	16901		125	61%	60%	-7%
NTES UW	NetEase Inc	Software & Services	China	263.53		172	58%	50%	10%
696 HK	TravelSky Technology Ltd	Software & Services	China	17.36		64	56%	74%	20%
700 HK	Tencent Holdings Ltd	Software & Services	China	214.2		646	54%	81%	5%
EQTL3 BS	Equatorial Energia SA	Utilities	Brazil	54.07		72	52%	72%	-6%

North America

Ticker	Name	Industry Group	Country	Price (LOC)	Return Distribution (-100% to +150%)	#Active Holders	Avg Return (equal weight)	Avg Return (value weight)	Forecast Change
AEM CT	Agnico Eagle Mines Ltd	Materials	Canada	65.33		224	62%	78%	-10%
IDXX UW	IDEXX Laboratories Inc	Health Care Equipment & Serv	United States	110.48		109	59%	85%	-1%
AMAT UW	Applied Materials Inc	Semiconductors & Semicondu	United States	28.43		407	56%	58%	3%
EW UN	Edwards Lifesciences Corp	Health Care Equipment & Serv	United States	117.68		278	55%	53%	0%
SLW CT	Silver Wheaton Corp	Materials	Canada	32.41		200	55%	57%	-11%
NEM UN	Newmont Mining Corp	Materials	United States	36.35		358	51%	40%	-16%
DOL CT	Dollarama Inc	Retailing	Canada	102.8		154	49%	63%	3%
DPZ UN	Domino's Pizza Inc	Consumer Services	United States	166.36		98	47%	53%	1%
ULTA UW	Ulta Salon Cosmetics & Fragra	Retailing	United States	252.36		197	46%	51%	-17%
MSCI UN	MSCI Inc	Diversified Financials	United States	82.9		142	45%	82%	-3%

Europe

Ticker	Name	Industry Group	Country	Price (LOC)	Return Distribution (-100% to +150%)	#Active Holders	Avg Return (equal weight)	Avg Return (value weight)	Forecast Change
ADS GY	adidas AG	Consumer Durables & Apparel	Germany	156.65		539	77%	79%	-10%
FRES LN	Fresnillo PLC	Materials	Britain	1646		135	59%	67%	-32%
DSV DC	DSV A/S	Transportation	Denmark	335.6		164	49%	66%	-3%
NESTE FH	Neste Oyj	Energy	Finland	40.14		184	47%	67%	-8%
PGHN SE	Partners Group Holding AG	Diversified Financials	Switzerland	501		213	45%	62%	5%
SIK VX	Sika AG	Materials	Switzerland	4666		225	39%	53%	2%
DWNI GY	Deutsche Wohnen AG	Real Estate	Germany	30.33		262	38%	65%	-6%
HOT GY	HOCHTIEF AG	Capital Goods	Germany	125.45		133	38%	56%	-2%
SGE LN	Sage Group PLC/The	Software & Services	Britain	722.5		193	36%	50%	-2%
LONN VX	Lonza Group AG	Pharmaceuticals, Biotechnolog	Switzerland	184.9		234	36%	26%	-4%

Source: FactSet, MSCI, UBS Quant

Appendix

Volume-implied capital gains overhang

Grinblatt and Han (2005) introduced a model to estimate the reference price R_t based solely on market data. This reference price is their best estimate of the cost basis of disposition investors, but in theory this could be any weighted average of historical market prices. Their approach essentially estimates the fraction of shares purchased on date $t-n$ at price P_{t-n} and still held by their investors as of date t.

They represent these fractions via the weights ω_t, in which the volume ratio V_t is the aggregate weekly share volume divided by the number of shares on issue, and φ is simply a normalizing constant to make the weights sum to 1. We adopt daily prices over two years instead and use the ratio of the daily volume as a fraction of the total volume during the period:

$$\omega_t^n = V_{t-n}\prod_{\tau=1}^{n-1}[1-V_{t-n+\tau}]$$

$$R_t = \frac{1}{\varphi}\sum_{n=1}^{500}\omega_t^n\, P_{t-n}$$

$$\varphi_t = \sum_{n=1}^{500}\omega_t^n$$

From their theoretical model they introduced a proxy for the capital gains overhang $g_t = (P_{t-1}-R_t)/P_{t-1}$, simplified to $g_t = (P_t-R_t)/P_t$ in Frazzini (2006). We simply adopt the investment return $r_t = (P_t-R_t)/R_t$ instead:

a. It is more intuitive and corresponds to how investors interpret their positions; which is particularly pertinent when explaining behavioural effects

b. Note g_t is positive if and only if r_t is positive; ie, both definitions are consistent in their distinction of gains and losses

c. Further, there is a monotonic bijection between the two definitions: $g(r) = r/(1+r)$, $(-1,\infty)\rightarrow(-\infty,1)$; ie, ordering is preserved and backtests are unaffected anyway

Mixed data sampling regressions

MIDAS is a popular technique to perform regressions on signals sampled at mixed frequencies introduced by Ghysels (2004), eg, how to use a high frequency signal like monthly employment to forecast (or nowcast) a low frequency signal, like GDP.

Roughly the idea is to introduce a functional form defining a highly parsimonious distributed-lag polynomial into a mixed-frequency regression; hyper-parameterising an unconstrained setting and avoiding the proliferation of parameters that might otherwise result—at the cost of becoming a non-linear optimisation problem (with respect to the introduced hyper-parameters). See Foroni and Marcellino (2013) for an excellent review of the state-of-the-art.

We incorporate a daily series of the volume-implied capital gains overhang x_t over three months, assuming 20 trading days per month to forecast (nowcast) the

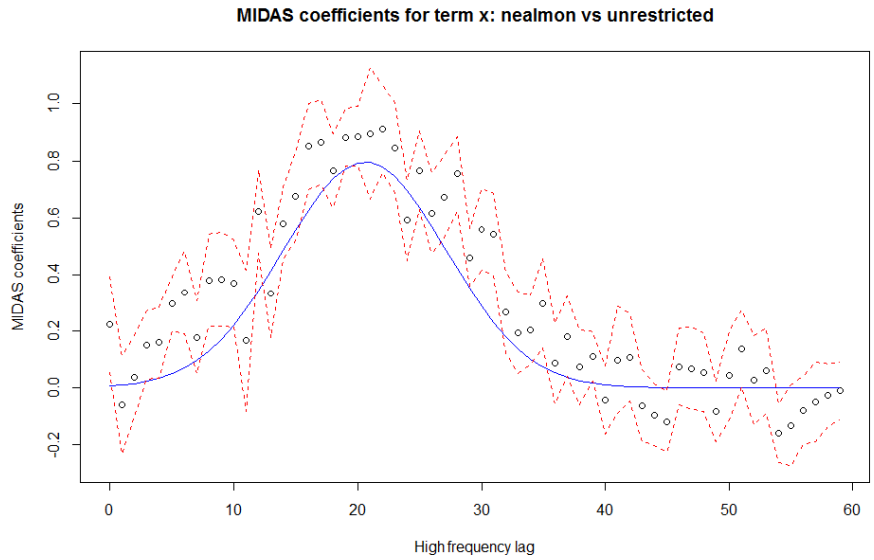
lagged holdings-based capital gains overhang y_t; both series are first-order differenced beforehand. We adopt the standard exponential-Almon lag polynomial with hyper-parameters estimated via NLS using the BFGS algorithm, with starting values $\boldsymbol{\gamma} = (1, 2, -0.05)^T$. More precisely, our problem takes the form:

$$\Delta y_t = \sum_{j=0}^{60} \beta_j \Delta x_{20t-j} + \varepsilon_t$$

$$\beta_j = \gamma_0 \frac{\exp(\sum_{s=1}^{2} \gamma_s j^s)}{\sum_{j=0}^{60} \exp(\sum_{s=1}^{2} \gamma_s j^s)}$$

This is estimated for each stock individually using an expanding window of history; the out-of-sample forecast at each point in time is the factor CGO (forecast) as shown in the backtests. Figure 20 shows the estimated MIDAS co-efficients compared to their unrestricted counterparts, for Microsoft as of September 2016.

Figure 20: Restricted and unrestricted MIDAS co-efficients for Microsoft



Source: UBS Quant

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