Deutsche Bank
Markets Research

Global

Quantitative Strategy

Academic Insights Special Edition

Date
10 November 2014

Proceeds from our 2014 Global Quantitative Strategy Conference

Innovative but Practical Ideas from Academia

Bridging the gap between theory and practice

Deutsche Bank held its second annual Global Quantitative Strategy Conference in London on October 8th and 9th. The event was attended by nearly 200 buy-side investment professionals who participated in presentations and discussions covering both bottom-up and top-down strategies.

Nine presentations over two days

The nine speakers who presented were drawn from the best of academia and industry, with an emphasis on those doing cutting-edge but practical research. The goal with every talk was that each would contain at least one useful, implementable idea. We think the speakers met, and indeed exceeded, that expectation. In this report, we try to summarize some of those ideas.

Debating the hottest topics in the world of quant

The conference also featured a dinner discussion and networking event where participants discussed and debated the strategies brought forward during the conference. We look forward to seeing all of you at our next quantitative strategy conference. For a summary of the ensuing discussion, please contact a member of the Deutsche Bank Quantitative Strategy team.

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A letter to our readers

Conference Summaries

We were delighted to host almost 200 of you at Deutsche Bank's 2nd annual Global Quantitative Strategy Conference in London during October. Markets have been challenging this year, so we really appreciate you taking time out from your busy schedules to share your time with us.

The conference was run over two days covering both bottom-up and top-down strategies. Both strategies are important, and increasingly both approaches are being used simultaneously in holistic systematic strategies. This is a response to the current environment which is challenging as big macro themes are dominating investors' thinking.

In this report, we summarize the key takeaways from each presentation. For those of you who were able to attend, we hope it will be a useful document to augment your own notes. For those who couldn't make it, we hope this will give you a flavor of the topics discussed. Either way, we hope you can join us for next quantitative strategy conference! For a summary of the ensuing discussion, please contact a member of the Deutsche Bank Quantitative Strategy team.

Regards,
Deutsche Bank Global Quantitative Strategy

Conference Agenda

Figure 1: Presentation schedule from Deutsche Bank's 2014 Global Quant Strategy Conference

Alessandro Beber, Cass Business School Realized and Anticipated Macroeconomic Conditions Forecast Stock Returns	Harald Lohre, Deka Investment The Use of Correlation Networks in Parametric Portfolio Policies
Chandler Lutz, The Copenhagen Business School The Impact of Unconventional Monetary Policy on Real Estate Markets	Xi Li, The Hong Kong University of Science and Technology A Tale of Anomalies Related to Earnings, Cash Flows, and Accruals
Jerome Teiletche, Unigestion Active Risk-Based Investing	Steven Crawford, University of Houston The Use of Social Media in the Buy-Side Profession
Victor DeMiguel, London Business School Practical Portfolio Construction	Ananth Madhavan and Aleksander Sobczyk, BlackRock Price Dynamics and Liquidity of Exchange-Traded Funds
Dr Pawel Bilinski, Cass Business School The Usefulness of Analyst Forecasts to Investors	

Source: Deutsche Bank

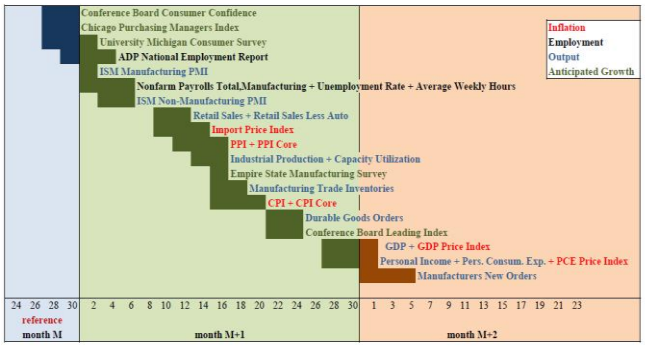
Realized and Anticipated Macroeconomic Conditions Forecast Stock Returns

- Professor Alessandro Beber, Cass Business School and Blackrock
- Overview: In this presentation, Professor Beber proposed a simple cross-sectional technique to construct real-time systematic macroeconomic factors from economic news releases available at different dates and frequencies. The technique is applied to extract real-time measures of inflation, output, employment, and macroeconomic sentiment, as well as anticipated growth. The approach employed provides more timely and accurate forecasts of the evolution of the economy than other real-time forecasting approaches in literature, and allows for much stronger predictability of stock returns than has been documented with low-frequency macroeconomic predictors or higher frequency risk indicators like VIX and the volatility risk premium.

Key takeaways

- As released data on macroeconomic news is obtained from Bloomberg since January 1997 for the US, UK, Europe, and Japan (see Figure 2). The data is populated into a T (days) x N (number of economic time series) matrix by country. The missing data problem in between release dates for the different macroeconomic series is solved by forward filling (see Figure 3). The issue of different starting and ending dates for the various series (i.e. different data length) is addressed using the methodology of Stambaugh (1997).
- Results from predictability regressions on future stock returns suggest that the traditional predictors do not do as well as the real-time macro factors constructed. Consistent evidence is available internationally in support of this result. The degree of predictability is state-dependent and rather concentrated in periods of recession.
- The global growth factor constructed is at least as strong a predictor as the local growth factor, and explains a significant fraction of financial volatility dynamics.
- The observed predictability has economic relevance as demonstrated through a country timing strategy, a style timing strategy, and a strategy which employs "macroeconomic" stock baskets.

Figure 2: Economic News Flow Data Series



Source: Professor Beber

Figure 3: Forward-Filling

	j=1	j=2	…	j=5	j=6	…	j=N
1	…	…	…	*missing*	…	…	…
…	…	…	…	*missing*	…	…	…
…	…	…	…	*missing*	…	…	…
t-22	$A_{t-22,1}$	$E[A_{t-22,2}]=A_{t-43,2}$	…	*missing*	$E[A_{t-22,6}]=A_{t-43,6}$	…	…
t-21	$E[A_{t-21,1}]=A_{t-22,1}$	$A_{t-21,2}$	…	*missing*	$A_{t-21,6}$	…	…
…	$E[A_{\dots,1}]=A_{t-22,1}$	$E[A_{\dots,2}]=A_{t-21,2}$	…	*missing*	$E[A_{\dots,2}]=A_{t-21,6}$	…	…
t	$A_{t,1}$	$E[A_{t,2}]=A_{t-21,2}$	…	$A_{t,5}$	$E[A_{t,2}]=A_{t-21,6}$	…	…
t+1	$E[A_{t+1,1}]=A_{t,1}$	$A_{t+1,2}$	…	$E[A_{t+1,5}]=A_{t,5}$	$A_{t+1,6}$	…	…
…	$E[A_{\dots,1}]=A_{t,1}$	$E[A_{\dots,2}]=A_{t+1,2}$	…	$E[A_{\dots,5}]=A_{t,5}$	*discontinued*	…	…
…	…	…	…	…	*discontinued*	…	…
T	…	…	…	…	*discontinued*	…	…

Source: Professor Beber

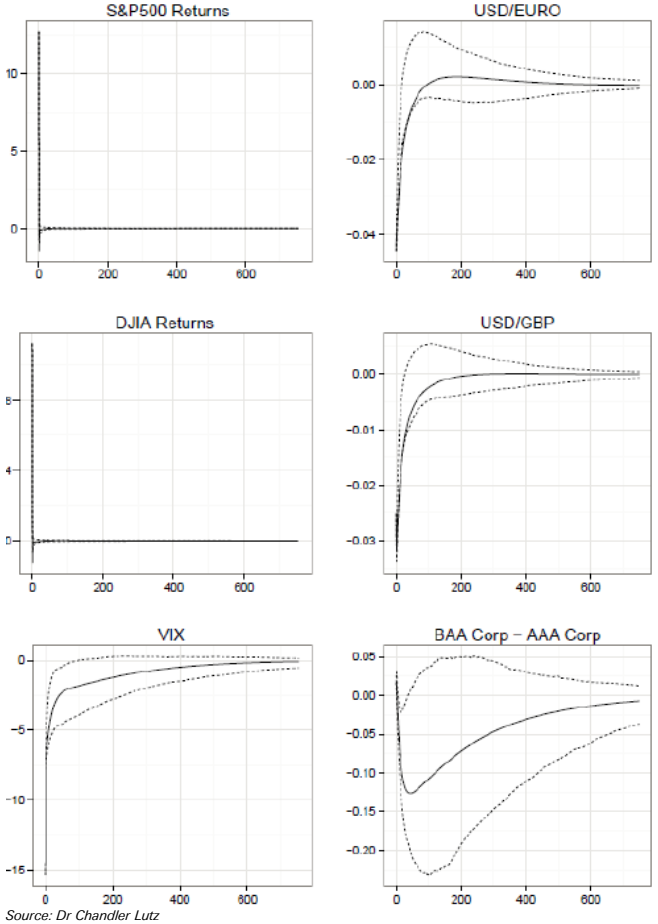
The Impact of Unconventional Monetary Policy on Real Estate Markets

- Dr Chandler Lutz, The Copenhagen Business School
- Overview: Dr Lutz applies an interesting econometric model to estimate the time effect of monetary policy shocks onto financial assets including REITs.

Key takeaways

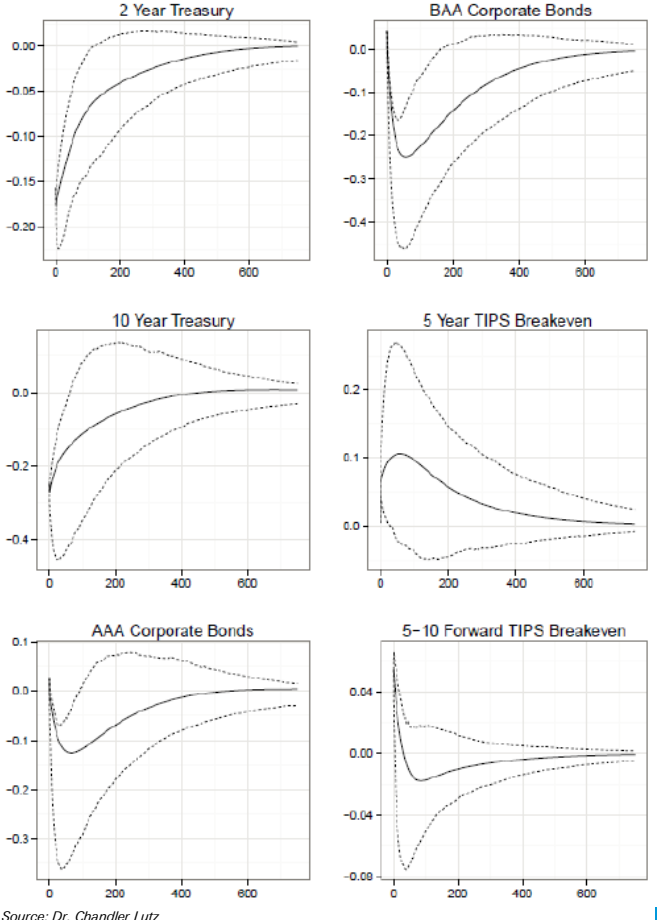
- The factor augmented vector autoregressive model (FAVAR) provides a robust framework for estimating the time-varying effect of endogenous and exogenous variables on a set of dependent variables. It accommodates multiple time series, avoids omitted variable bias and allows for accurate measurement of shocks compared to standard techniques.
- An expansionary monetary policy shock lowers housing interest rates and lifts REIT returns. The effect on other financial variables varies across asset classes, though it is generally more prolonged in volatility and currency markets. The greater the number of monetary policy shocks, the longer the effect lasts.

Figure 4: Impulse response functions on asset returns given policy shock, plotted against time horizon



Source: Dr Chandler Lutz

Figure 5: Impulse response functions on asset returns given policy shock, plotted against time horizon



Source: Dr. Chandler Lutz

Active Risk-Based Investing

- Jerome Teiletche, Unigestion
- Overview: Risk-based portfolio construction solutions are considered as taking no views on asset returns. Some people criticize the "no-views" feature as it would lead ironically to more risk. Teiletche's paper introduces an analytical framework to introduce active views on top of a risk-based solution. He illustrates the methodology with a typical asset allocation problem with over 40 years of data using views based on macro regimes.

Key takeaways

- The objective of the paper is to offer a methodological framework to risk-based investors desiring to reincorporate views. A solution is to use a Black-Litterman framework where the no-views or passive equilibrium portfolio is a risk-based portfolio.
- Teiletche offers closed-form formulas for the weights of the active portfolio and associated active metrics such as the tracking-error relative to the initial risk-based portfolio.
- For a given portfolio, implied returns are such that a mean-variance optimal investor will select the portfolio for a given variance-covariance matrix of returns. Using implied risk-based returns as priors and assuming a complete set of absolute views, the solution to the unconstrained mean-variance portfolio is given in Figure 6.
- Using US macroeconomic indicators (Chicago Fed National Activity Indicator and Industrial Production and CPI), Teiletche forms return views based on shifting economic regimes. He then implements active risk-based portfolios using weights calculated from equations in Figure 6. He compares this portfolio to passive risk based, equal weight, and maximum Sharpe ratio portfolios, and the results are presented in Figure 7.

Figure 6: Unconstrained mean-variance portfolio solution

$$\mu_{COMB} = \mu^*_{RB} + c\,(\mu_v - \mu^*_{RB})$$

$$w_{COMB} = w_{RB} + w_{ACT}$$

$$w_{ACT} = c\left(\frac{\sigma_T}{SR_{RB}}\right)\Omega^{-1}(\mu_v - \mu^*_{RB})$$

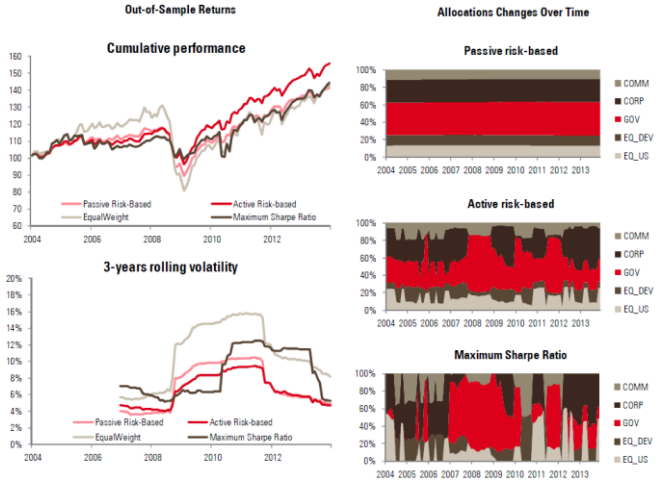
$$SR_{RB} = \frac{\overline{SR}}{CF(\overline{\rho})}$$

$$w_{ACT,i} = \frac{c}{\sigma_i^2\,(1-R_i^2)}\left(\frac{\sigma_T}{SR_{RB}}\right)\left[\left(\mu_{v,i} - \sum_{j\neq i}^{n}\beta_{ij}\,\mu_{v,j}\right) - \left(\mu^*_{RB,i} - \sum_{j\neq i}^{n}\beta_{ij}\,\mu^*_{RB,j}\right)\right]$$

$$TEV_{VIEW} = \left(\frac{\sigma_T}{SR_{RB}}\right)\sqrt{(\mu_v - \mu^*_{RB})^T\,\Omega^{-1}(\mu_v - \mu^*_{RB})}$$

Source: Jerome Teiletche

Figure 7: Regime based active view performance



Source: Jerome Teiletche

Practical Portfolio Construction

- Professor Victor DeMiguel, London Business School
- Overview: Professor Victor DeMiguel presented a study on practical portfolio construction methodologies, in which the focus was to quantify the impact of estimation errors embedded in conventional sample-based portfolio optimization processes. The presentation focused first on empirically comparing various methodologies to the estimation-error-free 1/N portfolio, and then analytically deriving the critical (rather large) data window to eliminate estimation error from conventional optimization processes. This was followed by suggestions of practical techniques to improve real-world portfolio construction.

Key takeaways

- The simple 1/N portfolio is hard to beat.
- Conventional sample-based portfolio optimization (mean-variance, etc.) performs poorly out-of-sample, compared to the simple 1/N.
- Estimation error dominates the conventional sample-based portfolio optimization methodologies
- Even techniques specifically designed to handle estimation error will still require unduly large data samples to eliminate estimation error.
- Better portfolio construction outcomes can be achieved through more accurate estimations of the input parameters before passing through to the optimizer.
- Use of higher frequency data, discretionary data/estimates, and constraints on short-selling are robust measures to improve the sample-based portfolio optimization

Figure 8: Empirical performance of sample-based portfolios and the benchmark 1/N portfolio

Strategy	Sector Portf.	Indust. Portf.	Inter'l Portf.	Mkt/ SB/HL	FF 1-fact.	FF 4-fact.
1/*N*	0.19	0.14	0.13	0.22	0.16	0.18
mean var (In sample)	0.38	0.21	0.21	0.29	0.51	0.54
Classical approach that ignores estimation error						
mean variance	0.08	-0.04	-0.07	0.22	-0.07	0.00
Bayesian approach to estimation error						
Bayes Stein	0.08	-0.03	-0.05	**0.25**	-0.06	0.00
data and model	0.14	-0.05	0.10	0.02	0.07	**0.24**
Moment restrictions						
minimun variance	0.08	0.16	0.15	0.25	**0.28**	-0.02
market portfolio	0.14	0.11	0.12	0.11	0.11	0.11
missing factor	0.19	0.13	0.12	0.06	0.15	0.15

Source: Professor Victor DeMiguel

Figure 9: Empirical out-of-sample Sharpe ratio comparison with short-selling constraints

Strategy	Sector Portf.	Indust. Portf.	Inter'l Portf.	Mkt/ SB/HL	FF 1-fact.	FF 4-fact.
1/*N*	0.19	0.14	0.13	0.22	0.16	0.18
mean var (In sample)	0.38	0.21	0.21	0.29	0.51	0.54
Shortsale constraints						
mean variance	0.09	0.07	0.08	0.11	**0.20**	0.20
Bayes Stein	0.11	0.08	0.08	0.15	**0.20**	0.21
minimum variance	0.08	0.14	0.15	0.25	0.15	**0.36**
Optimal combinations of portfolios						
mean & min-var	0.07	-0.03	0.06	0.25	-0.01	0.00
1/*N* & min-var	0.12	0.16	0.14	0.25	**0.26**	-0.02

Source: Professor Victor DeMiguel

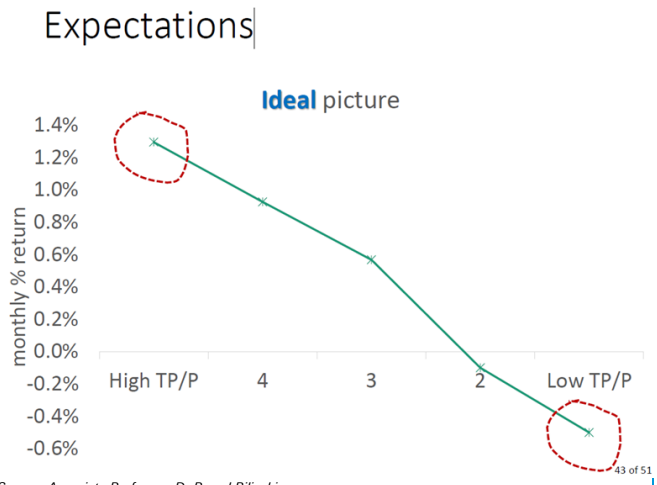
The Usefulness of Analyst Forecasts to Investors

- Associate Professor: Dr Pawel Bilinski
- Abstract: "Using an international sample of 16 countries, this presentation examines if analyst- and country-specific characteristics explain the variation in target price (TP) accuracy. We find that significant variation in average TP accuracy across countries is due to differences in accounting disclosure quality, the origin of the legal system, cultural traits, and IFRS regulation. We also find that analysts exhibit differential and persistent ability to forecast target prices accurately, which confirms that some analysts have superior TP forecasting ability."

Key takeaways

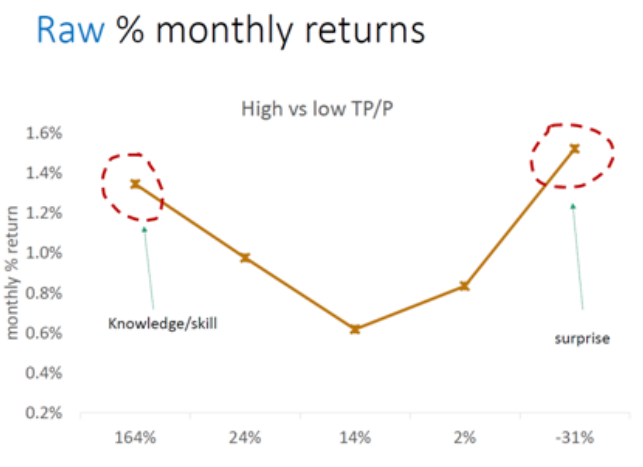
- Sale side analysts' target price returns are on average optimistic. However, analysts' target price estimates are on average more accurate than simple models that attempt to estimate firms' target prices Analysts that issue more accurate target price forecast are on average: better past target price forecasters, have greater sale side work experience, cover more firms, country-specialized, and employed by a large broker.
- There are country effects when analyzing the accuracy of analysts' forecasts. The country effects are likely a result of country specific accounting disclosure rules, the origins of the legal system, cultural traits, and IFRS regulation. Analysts Dividend forecasts are more accurate than target price forecasts
- Portfolios formed using analyst's price targets as rank signals show some unexpected results. Portfolios based on a high target price implied return show outperformance (Figure 10). However, even portfolios based on low price target returns (a contrarian strategy) shows outperformance (Figure 11). This evidence is based on US stocks only. Further research analyzing non-US companies, transaction costs, and changing trends will help unravel details about the contrarian strategy.

Figure 10: Expected returns



Source: Associate Professor: Dr Pawel Bilinski

Figure 11: Actual returns



Source: Associate Professor: Dr Pawel Bilinski

The Use of Correlation Networks in Parametric Policies

- Dr Harald Lohre, Deka Investment GnbH
- Overview: The research presents the use of correlation networks to reveal the rich picture of market risk structure dynamics and an investment framework for both market timing and sector allocation. The work extends upon work developed by Brandt and Santa-Clara [2006] and Brandt, Santa-Clara and Valkanov [2009] resulting in a parametric policy that reflects the sector network topology conditional on a given level of risk utilizing minimum spanning trees.

Key takeaways

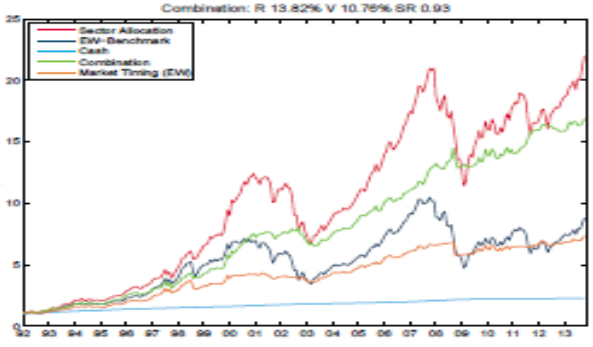
- Two key measures are used to exploit the embedded information within a correlation network. Firstly, the network diameter is used for market timing where the priori is that a compact network is indicative of a healthy market while a spread out network indicates fragility. Secondly, for sector allocation node betweenness which represents the degree of centrality is used. Both of these measures appear not to be subsumed by other variable as evidence by their low degree of correlation with other predictors (Figure 12).
- A market timing strategy is then presented based upon the Euro Stoxx 50 and Eur-Cash. All the input data (Ted Spread, Default Spread, Term Spread, Dividend Yield, Diameter and Average Correlation) is standardize relative to past 12 months and then using monthly data since 1987 optimal coefficients are calculated on an expanding 60 month basis. Overall the strategy yields an annualized return of 10% with a Sharpe Ratio of 0.57
- From a sector timing perspective an empirical study is then presented based upon the 15 Euro Stoxx sectors comprising 3 steps, namely: Identification of suitable sector characteristics (centrality, momentum and volatility), Benchmark-relative optimization, and combining sector allocation with market timing.
- By overweighting peripheral relative to central sectors, as determined by node betweenness, the resulting strategy offers an attractive combined strategy with annualized returns of 13.8% and a Sharpe Ratio of 0.93 (green line - Figure 13)

Figure 12: Centrality (Node Betweenness) lowly correlated with other predictors

	TED Spread	Default Spread	Term Spread	DY	Avg. Corr.	Diameter	Radius	MeanDeg	MeanNodeEcc	MeanClose	MeanNodeBtw	A
TED Spread	1.00											
Default Spread	0.38	1.00										
Term Spread	-0.32	0.14	1.00									
DY	0.19	0.63	0.11	1.00								
Avg. Corr.	0.02	0.27	0.09	0.59	1.00							
Diameter	0.07	-0.11	0.01	-0.37	-0.70	1.00						
Radius	0.06	-0.13	0.00	-0.39	-0.71	0.99	1.00					
MeanDeg	0.00	-0.38	-0.10	-0.63	-0.88	0.72	0.73	1.00				
MeanNodeEcc	0.07	-0.13	0.01	-0.38	-0.72	0.99	0.98	0.76	1.00			
MeanClose	-0.05	0.23	-0.05	0.44	0.74	-0.85	-0.84	-0.86	0.88	1.00		
MeanNodeBtw	0.20	0.63	0.12	0.54	0.35	-0.04	-0.06	-0.46	-0.06	0.21	1.00	
AvgPathLen	0.06	-0.23	-0.02	-0.48	-0.80	0.94	0.93	0.86	0.96	-0.94	-0.19	1.00

Source: Dr Harald Lohre

Figure 13: Combined Sector Allocation and Market Timing Strategy



Source: Dr Harald Lohre

A Tale of Anomalies Related to Earnings, Cash Flows, and Accruals

- Professor Xi Li, The Hong Kong University of Science and Technology
- Overview: There has been a significant amount of research in relation to earnings, cash flow and accruals – typically on an individual basis. Given that the anomalies relating to these metrics are likely to be related, this research looks to investigate the three anomalies in an integrated framework

Key takeaways

- The analysis is conducted using annual data from Worldscope and Compustat (US firms only) from 1996 to 2011. Financials are excluded from the analysis.
- For earnings component anomalies, 12 month forward excess returns are regressed against both accruals and cash flow independently as well as in combination while controlling for size, market to book, earnings yield and beta. All the independent variables are deciled and regressions are conducted on a country by country basis
- To investigate earnings level anomalies excess returns are regressed against Net Income (NI) as well as Unexpected Earnings (SUE), again controlling for size, market to book, earnings yield and beta.
- Putting the analysis into this integrated framework shows that the magnitude of the abnormal returns is largest for cash flow, followed by earnings and then accruals (Figure 14). In fact much of the accruals anomaly disappears once controlling for cash flow and the cash flow anomaly appears to be stronger in countries with a stronger profit anomaly
- Furthermore, company characteristics rather than factor beta explain the cross-sectional returns for both cash flow and earnings. While Investor Attention (IA) is more important than limit to arbitrage (LOA) – Figure 15.

Figure 14: One-year-ahead abnormal returns on earnings and earnings components

	Dependent Variable= one-year-ahead Abnormal Returns						
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
NI	0.085***					0.001	0.070***
	(3.76)					(0.08)	(4.25)
OCF		0.139***		0.144***	0.133***	0.139***	
		(7.75)		(8.59)	(7.01)	(8.37)	
ACC			-0.078***	0.007			
			(-7.09)	(0.79)			
CF_Res							0.012***
							(9.98)
ACC_Res					-0.013		
					(-1.63)		
Control Vars							
Fixed effects	Country, industry, year						
No. of obs.	318,661	318,661	318,661	318,661	318,661	318,661	318,661
Adj.R^2	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Source Professor Xi Li

Figure 15: Interaction between country and firm characteristics

	Investor sophistication				Limits-to-arbitrage			
	Institutional holdings		Analyst following		IVOL risk		Amihud illiquidity	
VARIABLES	Low	High	Low	High	Low	High	Low	High
	Country Cluster 1							
OCF	0.113***	0.091***	0.128***	0.101***	0.085***	0.136***	0.116***	0.156***
	(7.28)	(3.98)	(5.54)	(4.24)	(3.55)	(6.51)	(6.46)	(8.58)
OCF(low=high)	χ^2= 5.42**		χ^2= 5.33**		χ^2= 4.71**		χ^2= 3.52*	
No. of obs.	22,996	23,042	46,734	46,265	86,327	86,418	85,133	85,221
Adj.R^2	0.09	0.07	0.07	0.06	0.06	0.07	0.06	0.08
	Country Cluster 2							
OCF	0.069**	0.057**	0.110***	0.080**	0.037**	0.102***	0.069***	0.097***
	(2.36)	(2.50)	(3.52)	(2.53)	(2.16)	(3.75)	(3.05)	(5.13)
OCF(low=high)	χ^2= 1.03		χ^2= 2.18		χ^2= 18.69***		χ^2= 6.53**	
No. of obs.	16,309	16,028	21,351	21,911	41,087	41,165	40,735	40,807
Adj.R^2	0.12	0.09	0.12	0.07	0.10	0.10	0.08	0.11
	Country Cluster3							
OCF	0.133***	0.058	0.119***	0.120***	0.134***	0.147***	0.146***	0.124***
	(3.71)	(1.05)	(3.32)	(4.14)	(8.16)	(9.15)	(4.13)	(7.26)
OCF(low=high)	χ^2= 2.47		χ^2= 0.03		χ^2= 0.64		χ^2= 0.65	
No. of obs.	4,806	4,841	7,762	7,614	21,804	21,876	21,500	21,562
Adj.R^2	0.11	0.11	0.11	0.09	0.08	0.08	0.08	0.08

Source: Professor Xi Li

The Use of Social Media in the Buy-Side Profession

- Assistant Professor Steve Crawford, University of Houston
- Overview: The research focuses on the intersection of social media technologies and buy-side investment professionals. The interaction between people and businesses has been transformed by social media In this regard, the topic of the study focuses on technologies developed specifically for buy side professionals and analyzes whether there are incentives to share proprietary investment ideas or not; whether these technologies help fund managers to identify and share profitable ideas; whether there is investment value in the buy-side recommendations shared online and whether online social networks matter for financial markets.

Key takeaways

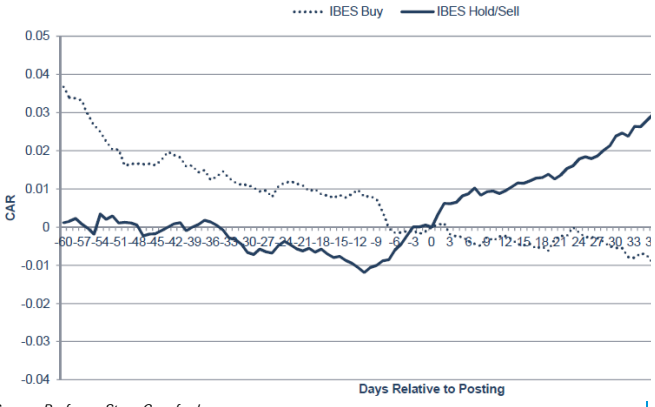
- There seems to be value in the investment recommendations shared through VIC e.g. see Figure 16 for the long run (abnormal) returns of the VIC investment recommendations. However the return of strategies based on these recommendations could be explained by the value biases of the recommendations: the long (short) recommendations tend to be skewed towards high (low) book to market stocks.
- From the analysis of the recommendations submitted on SumZero, it seems that the value of these submitted recommendations is mostly short term and returns are more prominent for contrarian BUY recommendations (e.g. see Figure 17).

Figure 16: Long-run returns of VIC investment recommendations (sorted by size)

	Long Recommendations			Short Recommendations		
	One-Year	Two-Year	Three-Year	One-Year	Two-Year	Three-Year
All	**0.61%**	**0.49%**	**0.40%**	-0.03%	0.02%	-0.13%
1 (Small)	**0.76%**	**0.52%**	**0.45%**	**-3.16%**	**-1.96%**	**-1.46%**
2	**1.03%**	**0.73%**	**0.69%**	-0.42%	-0.30%	0.01%
3	**0.78%**	**0.59%**	**0.70%**	-0.44%	-0.54%	-0.55%
4	**0.73%**	**0.80%**	**0.70%**	0.22%	-0.04%	0.08%
5 (Large)	0.47%	0.39%	0.25%	0.54%	0.34%	0.11%
1-5	0.29%	0.14%	0.20%	**3.71%**	**2.29%**	**1.57%**

Source: Professor Steve Crawford

Figure 17: CARs to BUY Recommendations, Sorted by IBES Consensus



Source: Professor Steve Crawford

Price Dynamics and Liquidity of Exchange-Traded Funds

- Ananth Madhavan and Aleksander Sobczyk, BlackRock

- Overview: Exchange traded funds (ETFs) have grown in diversity and size, generating considerable interest in their pricing and trading. Common themes include premiums/discounts, mispricing, and volatility transmission. We develop a model that emphasizes arbitrage as a driver of ETF liquidity and price dynamics to analyze questions concerning dynamics of premiums and discounts, price discovery & speed of arbitrage, and volatility and propagation of liquidity shocks.

Key takeaways

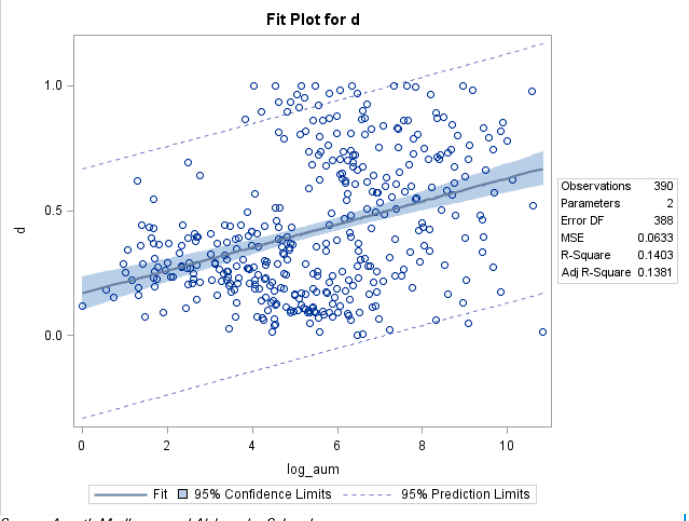
- Staleness in the prices of the assets underlying the ETF used to calculate NAV increase as we move from the most liquid asset classes (domestic equities) to less liquid asset classes (fixed income), consistent with expectations (Figure 18).
- The speed with which premiums and discounts are arbitraged away (which is measured inversely by ψ) increases with liquidity, ranging from a median of 0.20 in domestic equity to 0.90 in international fixed income. This corresponds to an implied half-life for reducing a given pricing error by 50% to 6.56 days, respectively. Consistent with intuition, domestic equity ETFs exhibit relatively fast pricing corrections compared to international fixed income ETFs (Figure 18).
- An ETF premium can be separated into two terms: Price Discovery and Transitory Liquidity. The percentage of the variance of the ETF premium attributable to the price discovery component declines as fund size drops. In other words, transitory liquidity shocks constitute a larger fraction of the premium volatility for smaller, less actively traded funds (Figure 19).

Figure 18: State Space Model Estimates across Asset Classes and Exposures

Asset Class		Equity		Fixed Income		All Funds
Exposure		Domestic	International	Domestic	International	
NAV Staleness Coefficient (φ)	Mean	-0.08	0.15	0.40	0.41	0.10
	Median	-0.05	0.15	0.45	0.33	0.00
	Std. Dev.	0.11	0.18	0.35	0.26	0.26
	Wtd. Mean	-0.02	0.22	0.51	0.32	0.12
	Fr. Significant >0	0.03	0.74	0.83	0.95	0.47
Arbitrage Speed Parameter (ψ)	Mean	0.24	0.43	0.61	0.79	0.39
	Median	0.20	0.44	0.71	0.90	0.34
	Std. Dev.	0.23	0.50	0.33	0.21	0.41
	Wtd. Mean	0.28	0.19	0.69	0.68	0.32
	Fr. Significant >0	0.80	0.77	0.96	1.00	0.82

Source: Professor Ananth Madhavan and Aleksander Sobczyk

Figure 19: Price Discovery by Fund Size, Domestic Equity



Source: Ananth Madhavan and Aleksander Sobczyk

Appendix 1

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