Quantitative Portfolio Strategy
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Does Passive Investing Affect Price Discovery and Market Stability?

European Quantitative Research Advisory Council

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PLEASE SEE ANALYST CERTIFICATIONS AND IMPORTANT DISCLOSURES BEGINNING ON PAGE 35.

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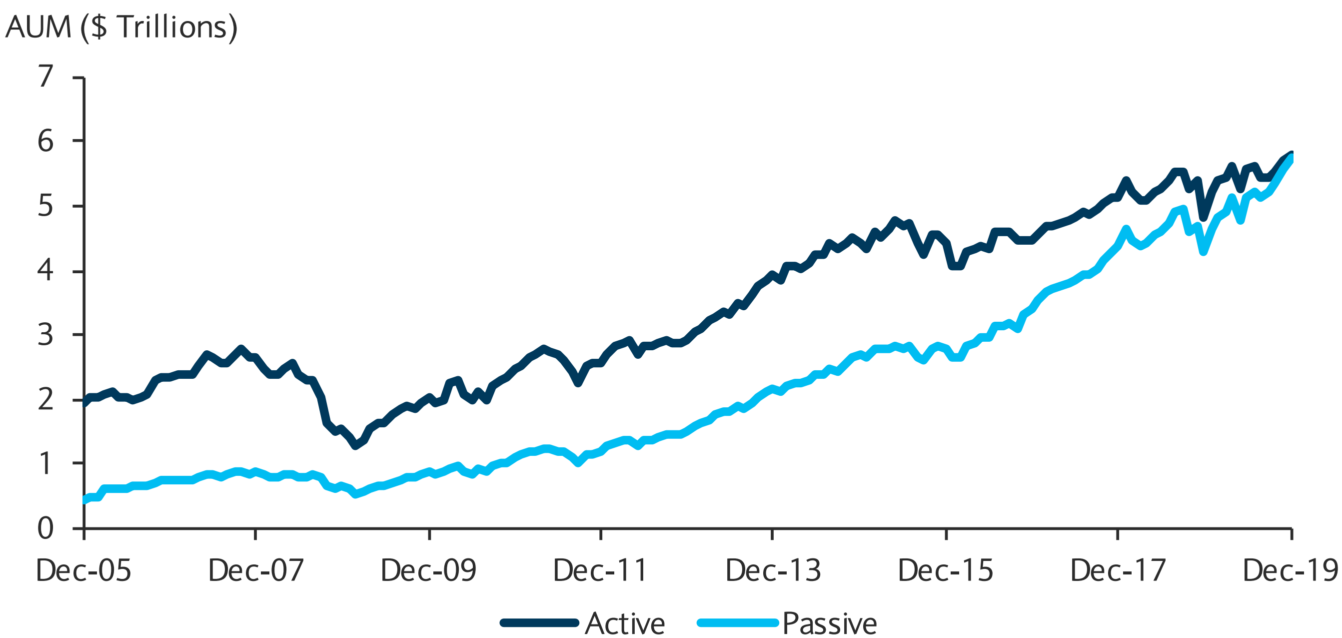
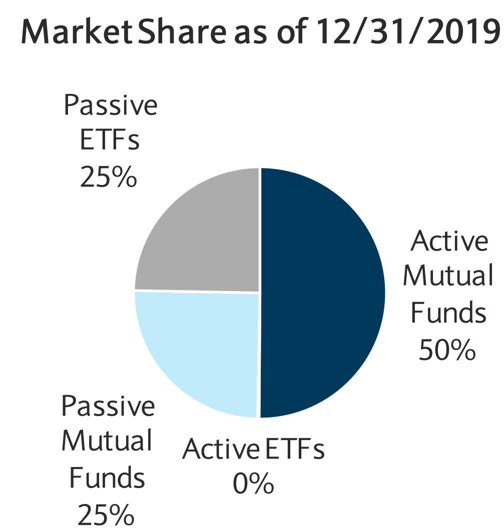
Macro Trend: Shift from Active to Passive Investing

- September 2019: Morningstar reports: “The end of August marked a historic investing moment. Money invested in passive U.S. equity funds surpassed 946,059 active funds.”
- Bloomberg: “August fund flows helped lift assets in index-tracking U.S. equity funds to $4.271 trillion, compared with $4.246 trillion run by stock-pickers, according to estimates from Morningstar Inc.”

Total AUM in US Equity Funds (Mutual Funds & ETFs)





Source: EPFR

Potential Side Effects of Increased Passive Investing

- The press has featured many hypotheses about how the rise of passive investing has the potential to disrupt the proper functioning of investment markets, including:
  - Loss of price discovery and creation of “bubbles” in asset prices
  - High-volume ETF trading on thinly traded underlying assets (liquidity mismatch) creates the potential for price instability
  - Share voting power is concentrated in the hands of a few passive managers – could have anti-competitive effects
  - Higher correlation among returns of index members – harder to diversify
  - Increased price volatility for index members
  - Possible explanation for “low-vol” effect: passive managers prefer high-beta stocks
  - Inefficiency of rules-based indices

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Q1: Does passive investing endanger underlying markets?

1. Yes – in equity markets only
2. Yes – in fixed income as well as equity
3. No

Outline of Discussion

- Background
  - Some hype from the press
  - Brief summary of a small sample of academic research:
    - Passive investing in general
    - Effect of ETFs in particular
    - Investigations by regulators
- Macro overview of selected markets
- Effect of passive investing on fixed income markets
  - Overview of “smart beta” ideas based on index inefficiency
  - Example of ETF-focused study in HY

“The Big Short’s Michael Burry Explains Why Index Funds are Like Subprime CDOs”

Bloomberg, 4 September 2019

- “Central banks and Basel III have more or less removed price discovery from the credit markets, meaning risk does not have an accurate pricing mechanism in interest rates anymore. And now passive investing has removed price discovery from the equity markets. The simple theses and the models that get people into sectors, factors, indexes, or ETFs and mutual funds mimicking those strategies – these do not require the security-level analysis that is required for true price discovery.”
- “This is very much like the bubble in synthetic asset-backed CDOs before the Great Financial Crisis in that price-setting in that market was not done by fundamental security-level analysis, but by massive capital flows based on Nobel-approved models of risk that proved to be untrue.”

Michael Burry (continued)

Liquid Instruments Built on Less Liquid Underlying

- “The dirty secret of passive index funds – whether open-end, closed-end, or ETF – is the distribution of daily dollar value traded among the securities within the indexes they mimic.”
- “In the Russell 2000 Index, for instance, the vast majority of stocks are lower volume, lower value-traded stocks. Today I counted 1,049 stocks that traded less than $5 million in value during the day. That is over half, and almost half of those – 456 stocks – traded less than $1 million during the day. Yet through indexation and passive investing, hundreds of billions are linked to stocks like this. The S&P 500 is no different – the index contains the world’s largest stocks, but still, 266 stocks – over half – traded under $150 million today. That sounds like a lot, but trillions of dollars in assets globally are indexed to these stocks. The theater keeps getting more crowded, but the exit door is the same as it always was. All this gets worse as you get into even less liquid equity and bond markets globally.”
- “I just don’t know what the timeline will be. Like most bubbles, the longer it goes on, the worse the crash will be.”

Consequences of Index-Linked Investing (Wurgler 2010)

A. Index inclusion effects

- "The increasing popularity of index-linked investing may well be reducing its ability to deliver its advertised benefits while at the same time increasing its broader economic costs."
- Index inclusion effects
  - SP500 has averaged 20-25 changes per year
  - ($915bn total index fund assets) / ($10.5 trillion total market cap) = 8.7% of each newly added stock must be bought by index fund managers – quickly!
  - Added stocks increased in value by about 9% around the event during 1990-2005; stocks deleted from the index fell by even more.
- Comovement effects – as soon as a stock joins an index, its behavior changes – correlated to SP500, rather than to small-stock avg

Jeffrey Wurgler, "On the Economic Consequences of Index-Linked Investing", NBER Working Paper 16376, September 2010

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Consequences of Index-Linked Investing (Wurgler 2010)

B. Bubbles and the Low-Vol Effect

- Detachment – valuation is different for index stocks
  - Morck and Yang (2001) – SP500 membership price premium about 40% as of 1997
- Bubbles and Crashes
  - 1987 crash – due to feedback loop based on SP500 futures
  - 2010 flash crash – again feedback due to SP500 E-mini futures
- Low-vol Effect
  - Within equities, high-risk stocks give lower returns
  - Top quintile by beta earned a negative real return from 1968-2008, while the low-beta portfolio has very high returns.
  - Hypothesis: managers benchmarked against an index will favour high-beta stocks, because they are measured by IR rather than Sharpe Ratio
- Possibility: Index investing is a bubble: good performance brings more investors in, which pumps performance up even more … "the popularity of indexing may not be simply a reflection of the fact that active managers are unable, on average, to beat the index – it may actually be contributing to their underperformance."

How does ownership by ETFs affect stocks? (Da & Shive 2018)

A. Increased correlation among underlying stocks

- Da & Shive (2018) study data on a large number of stocks and equity ETFs
- Analyse full matrix of which funds own which stocks, and how that affects both
- Measures that characterise a fund:
  - Holdings % = market cap of ETF / sum of MV of all stocks in underlying portfolio
  - SD shares = intensity of create/redeem activity = stdev of num ETF shares / mean (using daily time series of number of shares outstanding within a single month)
  - ETF turnover = monthly avg of (daily shares traded / num shares outstanding)
  - Average correlation among stocks held in the fund
- Which measure of ETF activity best predicts correlation among underlying stocks?
- Regressions show ETF turnover is most significant
- ETF daily returns are negatively autocorrelated, more negative when turnover is higher

Zhi Da and Sophie Shive, "Exchange Traded Funds and Asset Return Correlations", European Financial Management (24:1), January 2018, pages 136-168

How does ownership by ETFs affect stocks? (Da & Shive 2018)

B. Stock-level analysis – effect of ETF ownership on beta

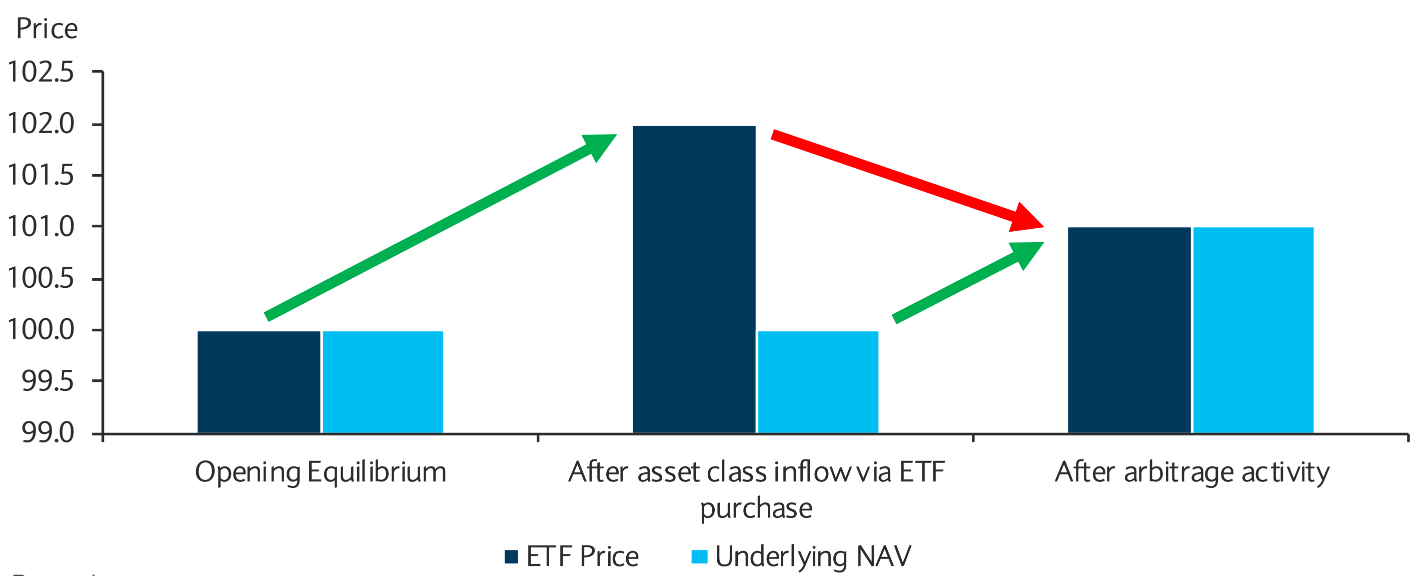
- Measures of ETF ownership that characterize a stock:
  - % ownership by ETFs
  - % ownership by mutual funds
  - Weighted average create/redeem activity of ETFs that hold the stock
  - Weighted average turnover of ETFs that hold the stock
- Analysis at stock level:
  - Correlation with "super-portfolio" is highly correlated (0.9) with CAPM beta
  - Higher total ETF ownership of a stock => more comovement with market
  - Effect of ETF holdings (1% increase in ETF ownership => beta up 0.03) is more than three times larger than effect of mutual fund or institutional holdings
- Does increased comovement reflect efficiency, or overshoot? Look for reversals:
  - Look at lagged market betas. Higher ETF activity or ETF ownership => negative lagged betas

How Might Secondary Trading in ETFs Affect Underlying Share Prices?

By the action of arbitrageurs

- Assume macro sentiment shifts towards equities, and some index investors shift assets from fixed income to equity using ETFs (or futures)
- Price pressure on ETF can cause a temporary dislocation between ETF price and NAV of underlying shares
- Arbitrageurs step in and close the gap – by buying shares and selling the ETF
- They can close their positions either by creating new ETF shares – or simply by reversing their initial transactions after prices converge

Hypothetical Price Movement of ETF and Underlying Share NAV



Source: Barclays Research

Do ETFs Increase Volatility? (Ben-David *et al* 2018)

A quasi-natural experiment

- Russell 1000 – top 1000 stocks by market cap
- Russell 2000 – next 2000 stocks by market cap
- Rebalance on last Friday of June every year
- [Banding rule, adopted in 2006: stocks switch index only if they move beyond a 5% range around the market cap of the 1000th stock]
- Although passive assets in Russell 1000 is 2-3.5 times larger than in Russell 2000, index weights of largest stocks in the Russell 2000 is 10 times larger than smallest stocks in Russell 1000
- Therefore, more passive money tracks the largest small-cap names than the smallest large-cap names
- Regressions:
  - Stage 1: show that switching indices causes a clear change in ETF ownership
  - Stage 2: increased ETF ownership comes with an increase in stock volatility

I Itzhak Ben-David, Francesco Franzoni and Rabih Moussawi, “Do ETFs Increase Volatility?”, **Journal of Finance**, December 2018 (**73**:6), pages 2471-2535

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The Impact of Flows into Exchange-Traded Funds: Volumes and Correlations (Madhavan & Morillo 2018)

Systematic market volatility is what drives correlations and ETF flows

- Agree that ETF trading is related to correlation among underlying stocks
- Disagree about cause and effect; they claim it is more likely that systematic vol drives ETF trading, not that ETFs cause high correlations:
  - View on a company => trade that company's stock.
  - Macro view on asset class => trade ETFs
- Level of ETF ownership and ETF flows are not sufficient to impact the market
- Need to distinguish between primary and secondary trading. Only primary market flows (create/redeem) should affect pricing at the individual security level:

  "Secondary trading in ETFs represents changes in ownership, not necessarily trades in the underlying securities."
- High correlation (0.76) of daily trading volumes between ETFs and stocks

Ananth Madhavan and Daniel Morillo, "The Impact of Flows into Exchange-Traded Funds: Volumes and Correlations" **Journal of Portfolio Management** (**44**:7), Summer 2018, pages 96-107

Q2: Which statistic in a given market should raise concern?

1. High percentage of AUM in passive fund structures (mutual funds or ETFs)
2. High volatility of primary fund flows (create/redeem) into passive ETFs
3. High percentage of secondary trading volume in passive ETFs relative to underlying market
4. None of the above – passive funds pose no danger to markets
5. Other

Passive Investing & Financial Stability (Anadu et al 2018, Boston Fed)

A. Study of relationship between flows and performance

- Academic literature shows that mutual fund inflows increase after positive returns
- Most of this research followed active funds – investors in passive funds are different
- Study fund flows and performance for active and passive funds separately
- Event studies: Financial crisis (2007-2009) and "Taper Tantrum" (mid-2013)
  - In both cases, both passive and active equity funds had negative returns, but passive funds had cumulative inflows, and active funds had cumulative outflows
- Regression studies:
  - Look at aggregate monthly flows by asset class for all (active/passive) (equity/corporate bond) funds. (Data from Morningstar – 2000-2019 for equity, 2010-2019 for bonds)
  - Regress against current month & past month performance
  - Find significant dependence of flows on performance for active funds but not for passive ones, in both equity and corporate bond funds

Kenechukwu E. Anadu, Mathias Kruttli, Patrick McCabe, Emilio Osambela, and Chae Hee Shin, "The Shift from Active to Passive Investing: Potential Risks to Financial Stability?", Working Paper RPA 18-04, 27 August 2018, Risk and Policy Analysis Unit, Federal Reserve Bank of Boston

Passive Investing & Financial Stability (Anadu et al 2018, Boston Fed)

B. How does the shift from active to passive investing affect financial stability?

- Affects the *composition* of financial stability risks: some increase, others decrease

Table 1. Mechanisms by which the active-to-passive shift may affect financial-stability risks

Risk type	Description	Impact of active-to-passive shift on financial stability risks
1. Liquidity transformation and redemptions	Funds redeem daily in cash regardless of portfolio liquidity; investor flows respond procyclically to performance	Reduces
2. Investing strategies that amplify volatility	Leveraged and inverse exchange-traded products require high-frequency "momentum" trades, even in the absence of flows	Increases
3. Asset-management industry concentration	Passive asset managers are more concentrated than active ones, so the shift to passive increases concentration	Increases
4. Changes in asset valuations, volatility, and comovement	Index-inclusion effects: Assets added to indexes experience changes in returns and liquidity, including greater comovement	Uncertain

Source: K. Anadu, M. Kruttli, P. McCabe, E. Osambela, and C. H. Shin, "The Shift from Active to Passive Investing: Potential Risks to Financial Stability?", Working Paper RPA 18-04, 27 August 2018, Risk and Policy Analysis Unit, Federal Reserve Bank of Boston

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Can ETFs Contribute to Systemic Risk? (Pagano et al 2019, ESRB)

A. Effect of Liquidity Mismatch

- Empirical research has so far identified three effects:
  - Co-movement: stocks tend to co-move more with index once included in ETF
  - Volatility: ETF trading increases price vol in underlying securities
  - Arbitrage between ETFs and constituents may operate imperfectly, leading to decoupling in times of stress; order flow may then have a strong adverse impact on ETF prices; could cause loss of faith and fire sales

- Express concern about ETFs on illiquid assets (eg. EM corporate bonds):
  - Create a liquidity mismatch between ETF and underlying assets
  - This is particularly attractive to short-term investors
  - => relative liquidity is inversely related to average holding period of ETF positions
  - Concern that in times of stress, the additional liquidity that investors expect from ETFs may evaporate under widespread selling pressure

Marco Pagano, Antonio Sánchez Serrano, Josef Zechner, "Can ETFs contribute to systemic risk", Reports of the Advisory Scientific Committee, European Systemic Risk Board, No. 9, June 2019

Can ETFs Contribute to Systemic Risk? (Pagano et al 2019)

B. Leveraged funds can lead to instability

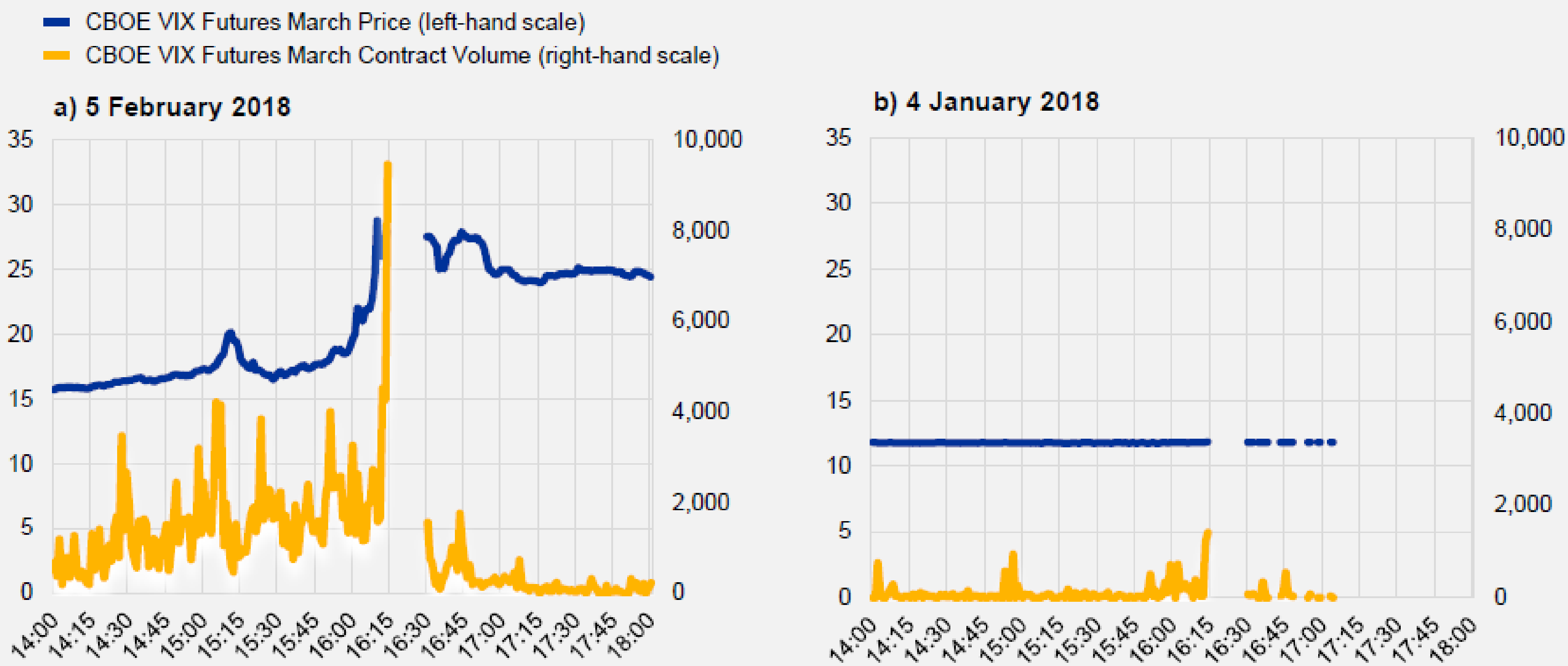
- Detailed case study of “Volatility Blow-Up” of 5 February 2018
- Short VIX products (XIV, SVXY) – lost roughly 95% of their value in a day
- Leveraged Long VIX products (TVIX, UVXY) – more than doubled their values
- What happened?
  - VIX had been rising early in the day
  - => market participants knew that both leveraged long ETPs and inverse ETPs had to buy VIX futures (longs to rebalance exposure, inverse funds to cover losses)
  - This created an adverse feedback loop that led to a spike in volatility
  - From 2PM to 4PM, prices of VIX futures increased 30%.
  - ETPs needed to buy a huge amount between 4:00 and 4:15, pushing prices even higher

Can ETFs Contribute to Systemic Risk? (Pagano et al 2019)

Chart C

Intra-day market developments in VIX futures and ETP markets on 5 February 2018 (left panel) and 4 January 2018 (right panel)

(prices and numbers of contracts)



Source: ESRB, Bloomberg
Reprinted from Marco Pagano, Antonio Sánchez Serrano, Josef Zechner, "Can ETFs contribute to systemic risk", Reports of the Advisory Scientific Committee, European Systemic Risk Board, No. 9, June 2019

FCA Study of Fixed-Income ETFs (Aquilina et al 2019)

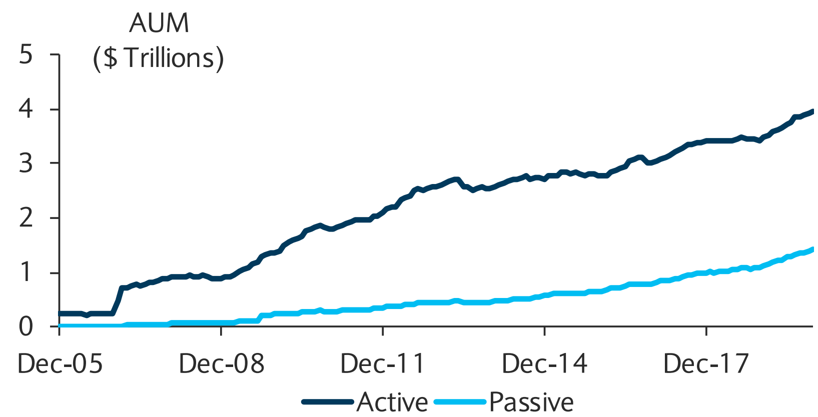
ETF primary markets work well even under stress

- Concerns have been raised about stability, especially for Fixed Income ETFs (and especially HY), which have greater liquidity mismatch
- Examine underlying operations of AP, motivations for create/redeem activity
- Dataset: from a regulatory data request to ETF manufacturers – all primary market transactions. Covers 257 ETFs ($381 B AUM), or about 7.2% of global ETFs
- Contains all create/redeem transactions in these funds in 2016-2018
- Study 3 stress periods: US Presidential Election (Nov 2016), Volatility spike (Feb 2018), fixed income selloff (Dec 2018)
- Key findings:
  - APs are very concentrated. 5 most active APs are responsible for 75% of primary market volumes in all asset classes, and 91% in fixed income markets
  - In times of stress events, alternative liquidity providers step up
    - More APs become active, concentration goes down
  - Further work – focus on ETFs with less liquid underlying assets

Matteo Aquilina, Karen Croxson, Gian Giacomo Valentini, Lachlan Vass, “Fixed income ETFs: Primary market participation and resilience of liquidity during periods of stress”, Financial Conduct Authority Research Note, August 2019

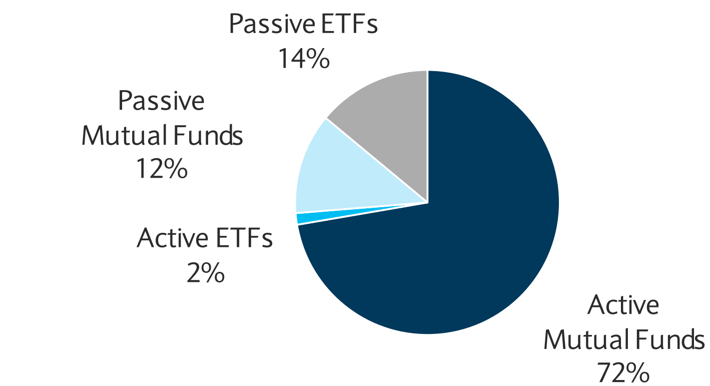
Macro Trends in Fixed Income Funds

Total AUM in US FI Funds



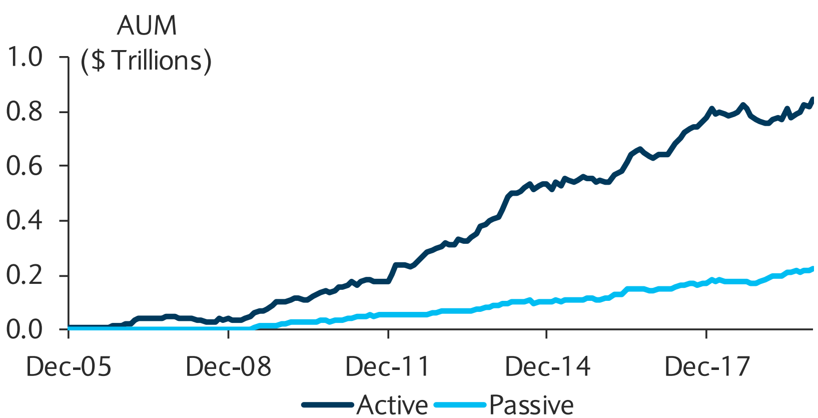
Source: EPFR

US FI Funds as of 12/31/2019



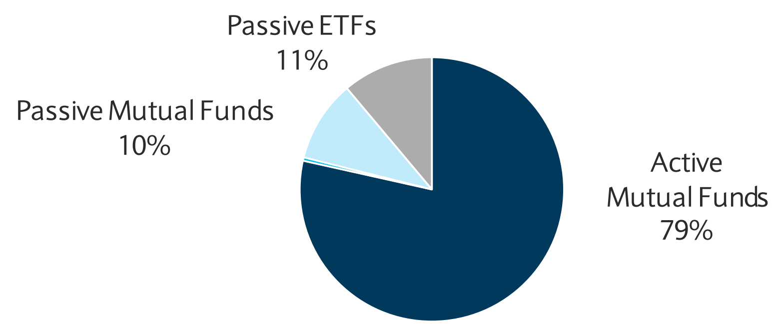
Source: EPFR

Total AUM in European FI Funds



Source: EPFR

European FI Funds as of 12/31/2019



Source: EPFR

Comparison of Trading Volumes in US IG Corporates

- We compare:
  - Total bond market size shown as MV of Bloomberg Barclays US Corp Index
  - Total trading volume reported by TRACE for all US Corp IG bonds
  - Total ETF Market Cap & Trading Volumes of largest 3 IG ETFs (LQD, VCSH, VCIT)
  - Total CDX.NA trading volume from DTCC repository
- We find that:
  - ETF turnover is more than 4x that of underlying bonds
  - These ETFs comprise 2% of market AUM, but their trading volume is equivalent to 8% of IG bond trading volume
  - For comparison, CDX.NA trading volume is much larger than that of ETFs

US Corp IG Markets, Averages over Q1-Q3 2019

	Corp Bond Index	ETFs	ETF % of Market	CDX.NA	CDX % of Mkt
Amount Outstanding (AUM), $ Billions	5,176	84	2%		
Quarterly Trading Volume, $ Billions	1,216	99	8%	673	55%
Quarterly Turnover Ratio (%)	23%	118%			

Source: Bloomberg, DTCC, FINRA TRACE Fact Book

Comparison of Trading Volumes in US HY Corporates

- We compare similar quantities for US HY corporate markets:
  - MV from US HY Corp Index, TRACE volume for US Corp HY Bonds, CDX.HY
  - Total ETF Market Cap & Trading Volumes of 2 largest HY ETFs (HYG, JNK)
- We find that:
  - Turnover ratios are significantly higher for HY bonds and especially for HY ETFs
  - ETF turnover is more than 9x that of underlying bonds
  - These ETFs comprise 3% of market AUM, but their trading volume is equivalent to 27% of HY bond trading volume
  - In this market, ETFs trading volumes approaching that of CDX

US Corp HY Markets, Averages over Q1-Q3 2019

	HY Bond Index	ETFs	ETF % of Market	CDX.HY	CDX % of Mkt
Amount Outstanding (AUM), $ Billions	1,239	36	3%		
Quarterly Trading Volume, $ Billions	590	159	27%	207	35%
Quarterly Turnover Ratio (%)	48%	440%			

Source: Bloomberg, DTCC, FINRA TRACE Fact Book

Q3: Which investment vehicles pose risk to market stability? (select all that apply)

1. Direct purchase of bonds
2. Active mutual funds
3. Passive mutual funds
4. Portfolio products (e.g. CDX & iTraxx)
5. ETFs
6. Futures
7. None of the above

Bond Market Inefficiencies Due to Passive Indexers

- Funds that seek to replicate bond index returns with minimal TEV need to exactly follow index rules. This includes:
  - Every month-end, portfolios rebalance:
    - Purchase all eligible new issues
    - Sell all bonds exiting the index, notably Fallen Angels – often at depressed prices due to this selling pressure
    - Extend duration (a natural combination of above two effects)
    - Hedged portfolios must roll forward currency hedges, leading to predictable FX transactions
  - The predictability of these transactions can present opportunity for active traders

  - Indices purchase all eligible debt. This results in large weights to the issuers and sectors that issue the most debt. Strategies that can help:
    - Constant sector weights
    - Reduce exposures to “prolific issuers”

Prior QPS Studies: “Smart Beta” from Index Inefficiencies

- Theme 1: **Fallen Angels**
  - We have addressed forced selling of fallen angels from two directions:
    - **Downgrade-Tolerant Benchmarks**[1] – IG investors hold on to downgraded bonds
    - **Fallen Angel Reversal (FAR) Strategy**[2] – HY investors buy FA bonds cheaply

- Theme 2: **Issuance Dynamics**
  - A disadvantage of market-weighted benchmarks is that as an issuer (or sector) takes on more debt, the MW allocation rises and poor performance follows
  - We have explored strategies[3] to reduce the impact of this effect at two levels:
    - Sector level: **Constant sector weights**
    - Issuer level: **Avoid prolific issuers** – using issuer scoring

[1] Capturing Credit Spread Premium: Alternative Benchmarks for Credit Investors, Barclays Research, 3 June 2010

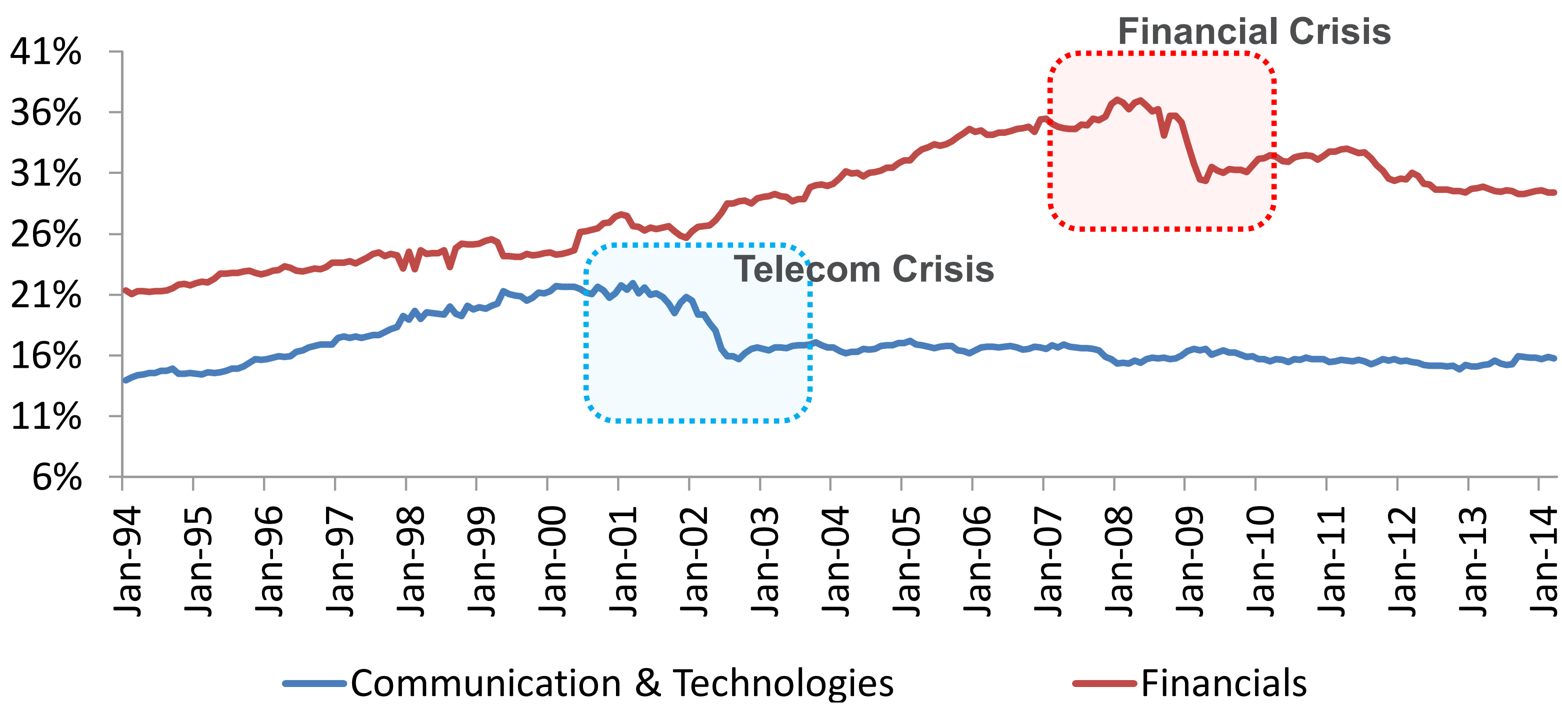
[2] Introducing the FAR Scorecard (Fallen Angel Reversal), Barclays Research, 6 June 2019

[3] Issuance Dynamics and Performance of Corporate Bonds, Barclays Research, 15 September 2014

Issuance Dynamics at Sector Level

- Market sector weights are dynamic
- They are a function of issuance and tend to follow credit cycles
- Weight dynamics tend to adversely affect MW index performance
- A leveraged sector enters a crisis with a high weight and recovers with a low weight
- If we keep sector allocations constant, we should lose less when such a sector collapses and gain more when it recovers

Historical Market Weights of Selected Corporate Sectors



Source: Barclays Research

Issuance Rate (ISR) Signal: Avoid Aggressive Issuers

- We calculate an issuance rate (ISR) signal as:
  - percentage year-on-year growth in total liabilities for non-financials
  - percentage year-on-year growth in debt for financials
- Based on ISR we separate issuers into aggressive and moderate within each sector
  - Aggressive: issuer ISR is higher than sector-average ISR
  - Moderate: issuer ISR is lower than sector-average ISR

Performance of Aggressive and Moderate Issuers Rated B & above, Feb. 1995 – Dec. 2015

Statistics	Index (IG & Ba/B)	Aggressive	Moderate	Mod - Index	Mod - Aggr
Avg Exc Ret, bp/yr	66	0	123	57	123
Volatility, bp/yr	506	506	476	76	132
Information Ratio	0.13	0.00	0.26	0.75	0.93

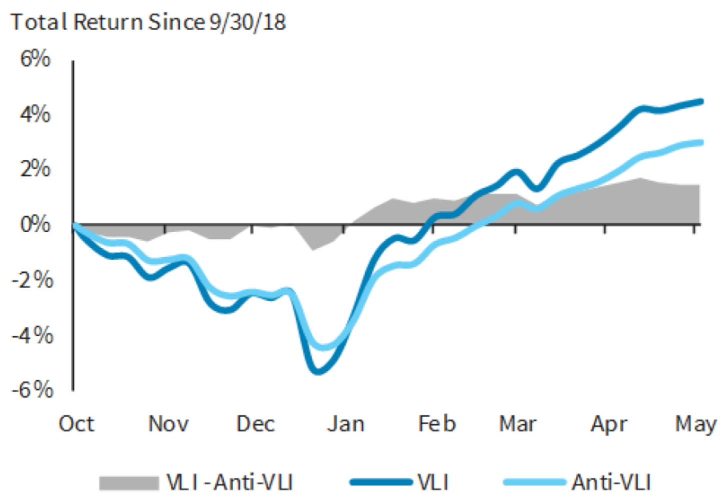
Source: Barclays Research, Bloomberg Barclays Benchmark Indices

HY Example: Does ETF Inclusion Affect Bond Returns?

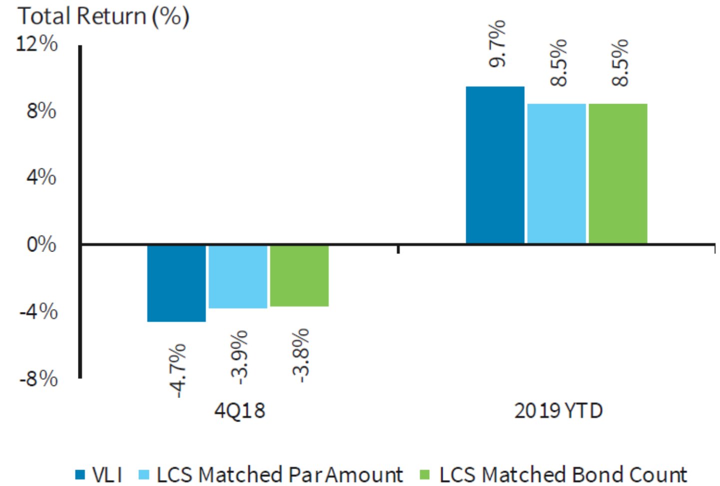
Analysis of US High Yield Very Liquid Index (VLI) vs. Alternatives

- HY VLI: at least $500mn outstanding, issued in past five years
- Largest HY ETFs are linked to VLI or a similar iBoxx index
- "Anti-VLI" contains all HY index bonds not in the VLI
- LCS can be used to form alternate definitions of a Liquid HY index: choose the most liquid bonds in the HY index, to match the VLI by either number of bonds or MV
- Recommend buying bonds in LCS-based liquid indices, not in VLI, that have underperformed despite being rated Overweight by fundamental credit

VLI underperformed in Q4 18 but Outperformed in 2019 Rebound



LCS Matched Indices Outperformed VLI in the Selloff, Underperformed in Rally



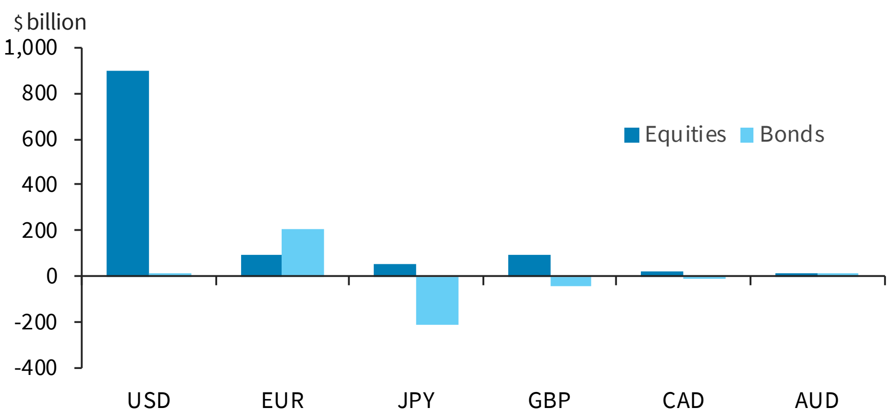
Analysis from: B. Rogoff, R. Hussain, and S. Schachter, Liquid Alternatives, 10 May 2019, Barclays US High Yield Research
Data source: Bloomberg Barclays Indices

FX Example: Month-End Rebalancing Strategy

Capitalising on Predictable FX Flows from Month-End Rebalancing

- Investors in global markets need to rebalance at month-end
- MTD differences in local market returns can drive predictable month-end FX flows
- For example, gains in USD equity markets and losses in JPY bond markets will both lead to investors needing to sell USD and buy JPY, shortly before 4PM London
- This leads to a strong signal to sell USDJPY
- Strategy trades once a month, from 12 Noon to 4 PM London, with good performance

Intra-month Movement in Equity and Bond Indices, December 2019



Strategy Performance Record

	Nov 2002 - Dec 2019	Jan 2015 - Dec 2019
Annualized Avg. Rtn.	0.56%	0.39%
Annualized St. Dev.	0.62%	0.54%
Information Ratio	0.91	0.73
Hit Ratio	58.0%	54.2%
Max Monthly Loss	-0.45%	-0.25%
Max Monthly Gain	1.52%	0.69%

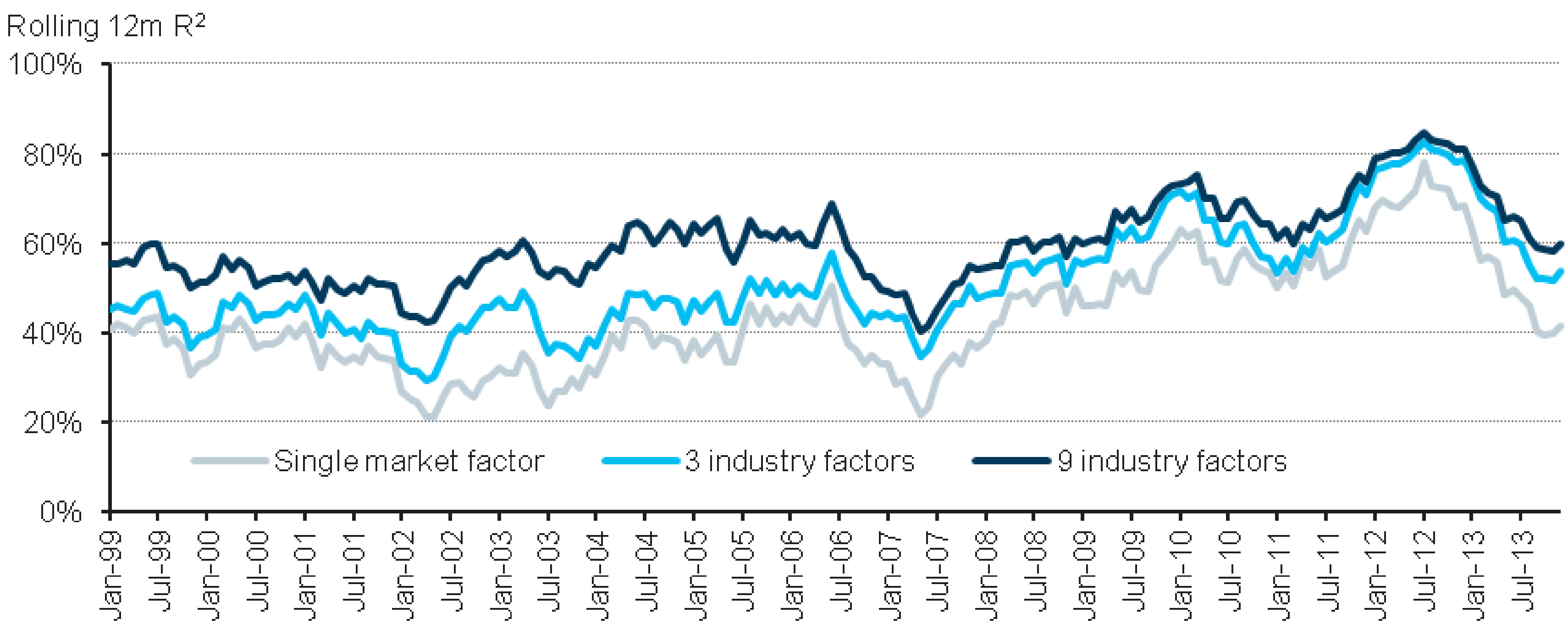
Source: A. Keshvani and J. Prada, FX Month-End Rebalancing: Mixed USD Selling, FX Instant Insights, 27 December 2019, Barclays Research

QPS analysis has found increase in systematic risk

A 2013 study showed that a single factor explained most of corporate volatility

- We built a simple risk model to explain corporate bond excess return variance with either a single market wide risk factor, 3 industry factors, or 9 sector factors
- The trend is for increased explanatory power in the single market-wide factor, and a decrease in the importance of sector rotation
- Might this be related to the trend of increased passive investing?

How well can a 1, 3, or 9 Spread Factor Model Explain Excess Returns?



Source: Barclays Research

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Q4: Which do you see as the primary effect of the increased level of passive investing on the underlying bond market?

1. A concern for market stability
2. Offers opportunity to find mispriced bonds, capitalise on index inefficiencies
3. Increased correlations make it hard to diversify portfolios, generate value from security selection
4. Has increased the volume and importance of portfolio trades
5. Don’t see any significant effect
6. Other

Q5: Which best characterises the role of passive trading in price-setting in corporate bond markets today?

1. Pricing is dominated by fund flows at asset class level, causing all bonds in an index to move together, often leading to mispricing of specific bonds
2. Pricing is dominated by active trading, driven by macro and company news and analyst views
3. Depends on the day
4. Depends on the market
5. Depends on which names

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