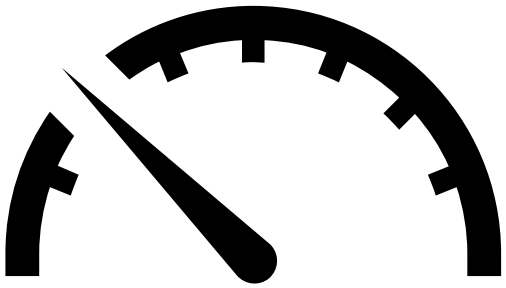

From Active to Passive

how much is too much?

Contents

Executive Summary

Market and media discourse continues to emphasise the transition away from active (mainly fundamentally-driven) to 'passive' management, including both index tracking and dynamic passive strategies like smart beta and risk premia. Views vary widely as to whether this constitutes a move towards more or less efficient markets.

Through the lens of new quantitative methodologies that regulators have embraced to explore these issues, this discussion explores how real this shift is and its potential implications and opportunities. These methodologies sit at the intersection of economics and computer simulation and offer new tools for both systematic and fundamental managers.

Common across the studies we critique is that it is dangerous to extrapolate how markets might be affected by looking at past empirical data alone. We see in simulations that market dynamics can suddenly and dramatically change with little warning. In one paper the tipping point at which the share of passive trading destabilises markets is as low as 35%. We believe it is worth entertaining the risk that market dynamics may suddenly and dramatically change with little warning.

Our overall conclusion is that simulation approaches look promising, offer additional insights to compliment theoretical and empirical work, and we need more research.

Addressing stability and regulatory issues

Regulators and market participants are increasingly questioning the implications of the rise in rules-based investing on underlying markets[1]. General industry discourse is focused on the explosive growth of smart beta, ETFs and other 'passive' strategy AUM and sensational headlines debate the death of active management. In recent years, there have also been several high-profile active/discretionary fund managers closing-up shop, referencing the rise in algorithms and indexing as a key contributing factor to weak returns and declining profits in their strategies[2].

As investing gets redefined into a smorgasbord of indices which vary in degree of activeness (i.e. the systematisation of fundamental investing) this note addresses questions such as:

- To what extent this shift is real or representing a reclassification of products/managers that were always primarily passive in nature?
- Does it represent structural or cyclical forces?
- What can we learn from other market examples? e.g. the financialization of commodities
- What are the implications for underlying market dynamics?
- Are trends towards automation causes or consequences?
- How well do we understand investor behaviour?

Conducting exercises using computer simulation models can help market participants explore changing market dynamics and go some way towards answering these questions. Regulators are increasingly interested in the possibility of systemic risks arising from passive investment and related feedback loops and are using agent-based modelling approaches to examine them. Concerns abound around issues like endogenous risks arising from the interaction between passive investments, decreasing redemption terms, securities lending and short selling squeezes.

Using quant tools to improve investment decision making

As the market share of AUM in rules-based strategies increases, managers could benefit from arming themselves with a deeper understanding of how such strategies behave. Better understanding the potential positioning, skews and flows of these strategies could lead to improved risk insights and return opportunities. There are also potential investment opportunities from understanding better the wider endogenous forces increasing in play in markets (that, for instance, may depress assets temporarily). New simulation-based tools that incorporate wider linkages, feedback and investor behaviours have much to offer. These could lead to better decision making: avoiding surprises and fire-sales; and possibly helping to identify value and improve timing/rebalancing decisions.

The note provides concrete examples of the above.

[1] For example, Braun-Munzinger, Liu and Turrell (2016). An agent-based model of dynamics in corporate bond trading. Working Paper No. 592
2 For example, https://www.bloomberg.com/news/articles/2017-12-15/john-griffin-to-close-blue-ridge-stock-hedge-fund-after-21-years

THE FOLLOWING OUTLINES THE TRANSCRIPT OF A PRESENTATION DELIVERED BY ROBERT HILLMAN – CIO, NEURON ADVISERS.

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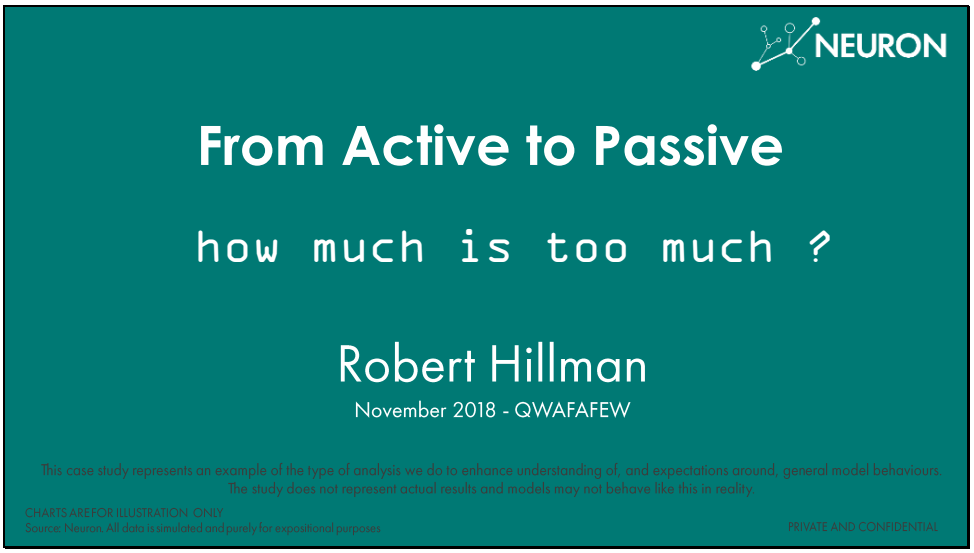
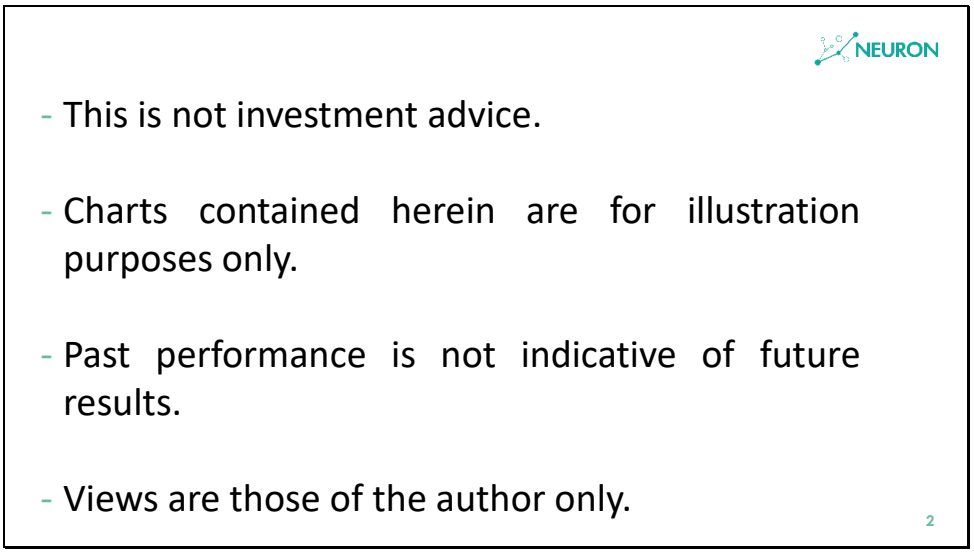
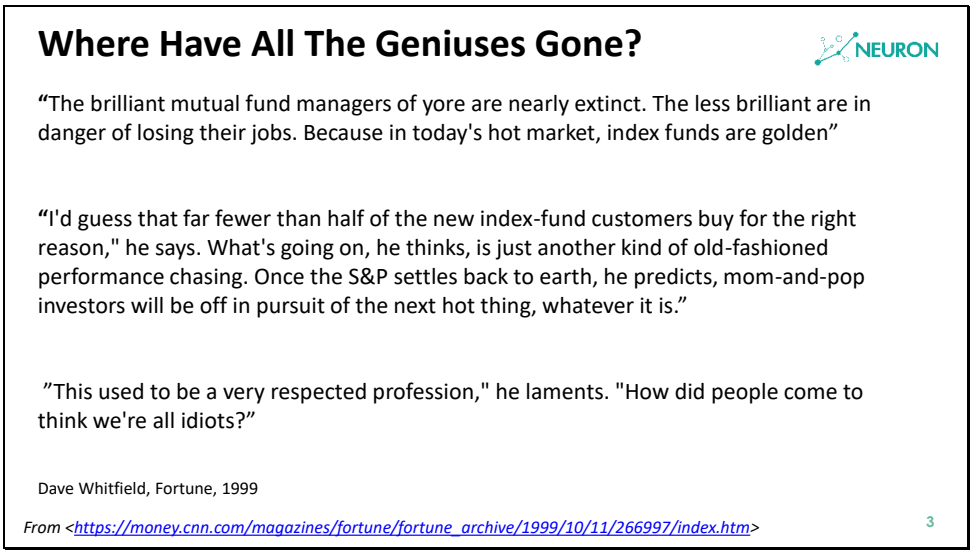
Introduction





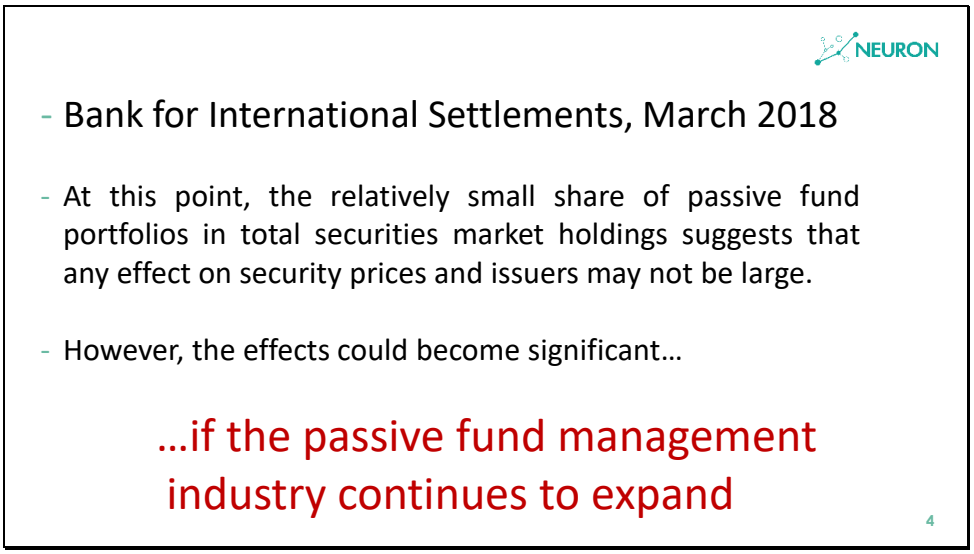
How did people come to think we're all idiots?

Today there is a lot of discussion – and controversy – surrounding an alleged shift away from active investing towards passive. But it is worth remembering that this issue has been around a long time. A great example of how similar some of the themes are can be found in an article in Fortune magazine from October 1999. The article colourfully describes the sense of disruption felt by active fund managers, who after a long bull run of the stock market, felt as if they had come to be perceived as "idiots".



Policy makers show interest

While there are some similarities between now and the late 90s, this time policy-makers and regulators are beginning to show a keen interest. In part this is because the financial crisis focused their minds on the potential for instability to arise from sectors of the economy which had undergone behavioural and technological change (for example the rapid rise of mortgage related financial products). And in part because policy makers are nowadays much more intrinsically involved in financial markets. No longer merely interested observers, many governments are exposed directly to financial volatility in markets in which they did not traditionally play (Japan with equities, the UK with corporate bonds for example).



The shift from active to passive investing is one area in which there seems to have been a pick-up in policy interest. That the passive fund management industry might pose a risk seems accepted. As a recent Bank for International Settlements article suggests, the risk seems to be one of when, rather than if[3].

An earlier rise of passive trading (in commodities 20 years ago)

When thinking about these issues today I reflect on an earlier period in which I had personal involvement. This was during the early 2000s when there was a sharp rise in capital following long-only commodity indices - a process that became known as the 'financialization' of commodity markets. As is often the case, multiple factors came together to create this rise in index-investing, including regulations and product innovations (for example using total return swaps enabling investors who might otherwise not have had the ability or inclination to do it themselves). Another key factor in building interest was how the potential returns to index investing were presented.

GSCI Commodity Futures Index Returns

	1970-2004	2005-2015
Income Return	8%	
Price Return	3%	
Total Return	12%	

Source: Erb & Harvey (2018) 5

Backtests

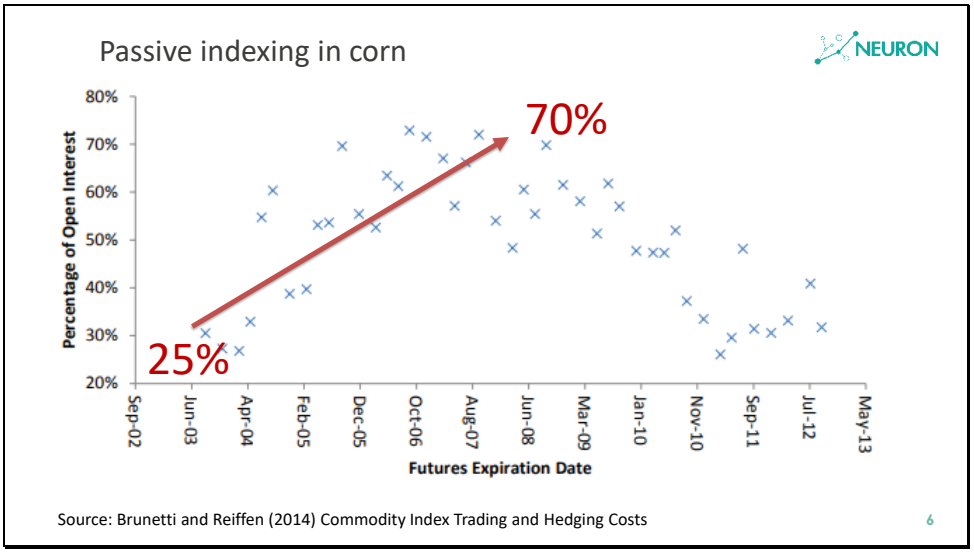
In a recent reflective piece, two economists who were very much part of the debate in the early 2000s, Claude Erb and Campbell Harvey (2018), described some of the data. They showed that a typical back-test investors might have been presented with demonstrated a total return of 12% per year between 1970 and 2004. The volatility of these returns was a bit higher than equities over the same period but crucially the commodity index return stream was barely or even negatively correlated with equities or bonds, the core components of a traditional investment portfolio. Not surprisingly this looked a great proposition, and it helped to influence investor thinking and establish the idea of commodities as an *asset class*, as opposed to a hotchpotch of inaccessible markets dominated by specialists.

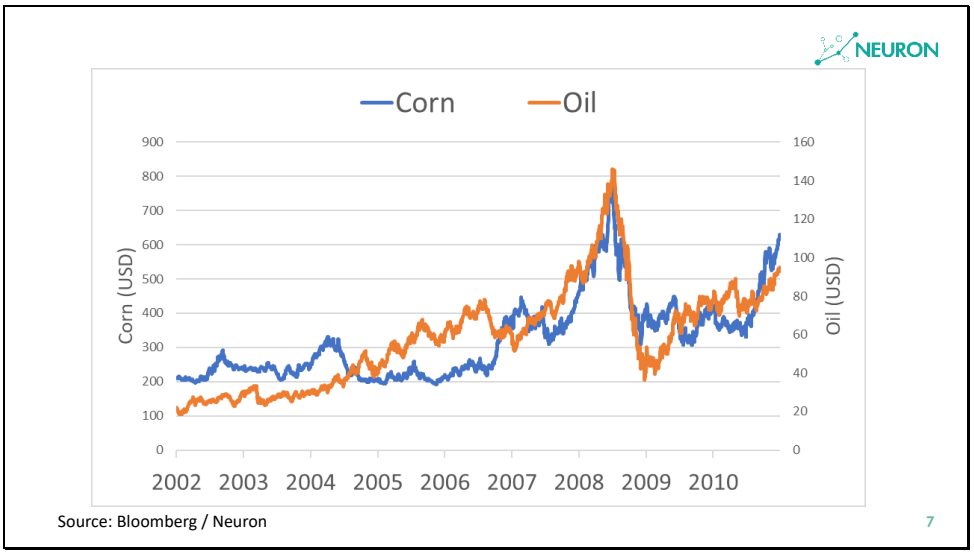
Rising comovement

Capital quickly flowed into these index products. For example, the proportion of front future contracts in corn being traded by commodity index investors rose from around 25% to 70% between 2003 to 2008[4]. As this money flowed in it meant that money managers were simultaneously entering long future corn contracts, alongside long oil contracts, long cattle contracts and so on. As capital into these index funds ebbs and flowed, so therefore did buying and selling demand for commodity futures. Perhaps not surprisingly, one of the issues raised by this process (and resonant again today) was that it could increase the comovement between commodity future prices - beyond what would have previously been experienced. An implication might be that the potential diversification benefits of building a portfolio

[3] Sushko, V. and Turner, G (2018) The implications of passive investing for securities markets
[4] See Brunetti and Reiffen (2014) Commodity Index Trading and Hedging Costs

of uncorrelated assets could be reduced if they start moving more closely together. We can visually see a sharp rise in comovement during 2008 between seemingly unrelated commodities like corn and oil for example.





Endogenous risk

Another reason why I am reminded of parallels between today's debates and the financialization of commodities surrounds the impact that index trading had not just across markets, but also within markets. Since starting work at the Bank of England in 2000 I have been interested in the potential for systematic trading to create endogenous risk. At the Bank I had looked at the potential risks from the systematic hedging of options (for example power-reverse-dual currency notes), and in the impact of trend-following, carry and other popular hedge fund strategies. By the time the commodity index investing fad took off in the mid-2000s I was working in a hedge fund. Now I was being presented with a whole new phenomenon – products specifically designed to exploit the market impact of systematic index trading.

Cannibalisation

Some traders noticed that the process of index investing was changing market relationships. The new index products achieved exposure to commodities by trading futures contracts, but never of course actually taking delivery of the

physical commodity[5]. The process of rolling from the nearest futures contract out to the next one as the contract's maturity rolled ever closer, was thought to lead to downward pressure on the front contract and upward on the next. Some investment banks, who having promoted the growth of commodity index trading (CIT) in the first place, were now proposing there was a trading opportunity to take advantage of this forced and predictable behaviour by the index providers (who by the way were often a desk within their own bank). We then started seeing the offering of 'enhanced' indices, ones that provided the hoped for long-term attractive return stream, but some extra juice from effectively front-running (legally) the large and growing first generation of index investors.

However, the attractiveness of CIT did not last very long. Apart from the massive increase in volatility in 2008, the subsequent returns to CIT fell dramatically. As Erb and Harvey (2018) demonstrated, between 2004 to 2015 the total return was negative 5% - a long way from the positive 12% in the back-test.

Digging a little deeper

Decomposing the total return reveals something interesting. We can break it into two components, the spot price return and an income return. In equities this is like breaking the total return into the spot return and the dividend return. The 'dividend' return from trading commodity futures has several drivers (and varies across commodities) but the slope of the futures term structure is often a key contribution. Often the price of further dated future contracts are lower than the nearest, or spot price. When the curve is in this state is said to be backwardated (as opposed to when the future prices are higher, called contango). So when the curve is backwardated, other things being equal, the process of taking a long exposure to commodities (going long the further contract until switching out once it nears maturity) means you experience a rise in price as you 'roll-up' the curve. This 'income' return is positive. In a much wider sense, this practice of earning income if the world stays stable is called carry-trading.

One appealing explanation as to why this income return could exist is that you are in effect being paid an insurance premium from producers. The entire reason the futures market began was so that producers could find a means to sell their product forward and therefore hedge against falling prices. If producers want a hedge, it makes sense to think they are paying someone on the other side of the trade for it. While there are some natural sources of supply for this insurance (for example consumers and processors who wish to avoid the risk of prices rising), many since Keynes have considered there would more often be more demand than supply of insurance leading to a normal state of backwardation[6].

GSCI Commodity Futures Index Returns

	1970-2004	2005-2015
Income Return	8%	-8%
Price Return	3%	3%
Total Return	12%	-5%

Source: Erb & Harvey (2018)

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[5] For many hedge funds this would have detrimentally affected their tax status.
[6] See Chang (1985)

Cognitive dissonance

Armed with this decomposition we can now see that the deterioration in total returns was driven entirely by a collapse in income return. Between 1970-2004 it was 8%, between 2005 and 2015 it was minus 8%. The actual price return in each sample period was the same, 3%. I would argue it is this price return that observers are most likely to see when they look at charts of past prices. Rarely would a newspaper for example show a chart of the roll-adjusted oil price, or the total return from rolling oil future contracts. They typically just show the spot oil price. It seems plausible to me this leads to problems of cognitive dissonance. People would naturally struggle to reconcile why their long commodity index product has lost money while the charts in newspapers show them commodity prices have risen.

Market distortion or market completion?

An intriguing idea about this drop in the income return is that it is probably exactly what you would expect if the increase in commodity index investors is seen as introducing a new supply of insurance to offset the hedging pressure that led to the curve backwardation in the first place. In this sense instead of thinking about the presence of CIT as creating a distortion in the market, see it instead as correcting an imbalance. Two different ways of describing the same thing but with very different connotations.

When the data is not enough

In a big picture sense there may be parallels between the rise and demise of CIT and lessons for today's broader debate about the shift from active to passive investing. The obvious ones are that in both cases there is a suspicion that the underlying markets might be affected in ways that they weren't before. But there are two broader comments I would make that may also be relevant to today's debate. Firstly, the CIT story hints that these shifts in tastes and trends in investing may be somewhat self-policing. Models (or more broadly, thinking) that can allow for evolutionary dynamics to be part of the story therefore seem attractive if we are to consider how these shifts in trading styles might wax and wane through time.

My second comment is that there is an intrinsic difficulty in resolving questions like 'how much is too much'? Even now nearly two decades since the CIT fad took off, there is not a clear consensus on the role of index investing in contributing to the 2008 volatility, or subsequent and ongoing effects on underlying markets. See for example Bhardwaj et al (2015) who look at much the same data as Erb and Harvey and come to different conclusions, downplaying the financialization effect. I don't think this is because economists are somehow habitually biased towards disagreeing with each other, or inept in understanding how the real world works. I suspect it is because there are genuinely rival theories and the single path of history we have lived through (and all we have to go on) does not contain enough information to empirically discriminate finely enough between them.

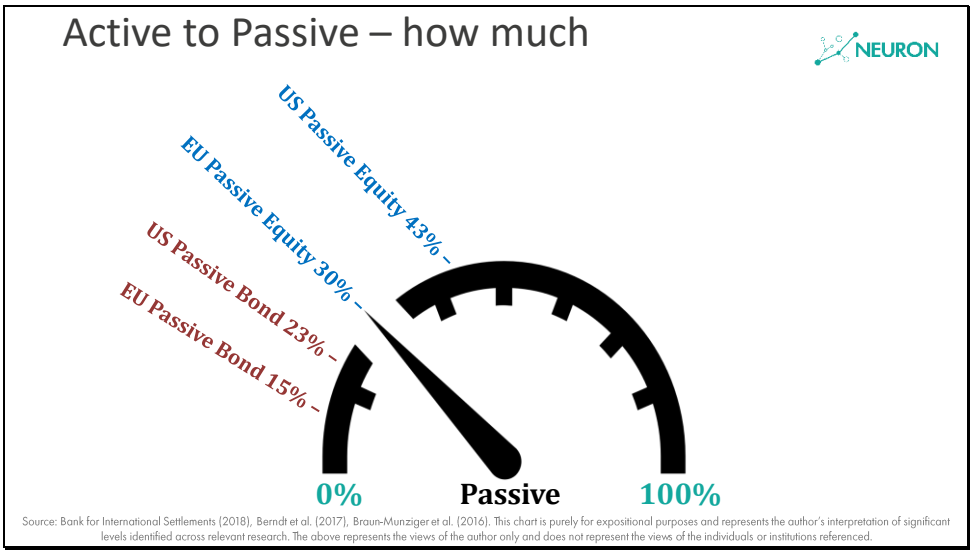
Where exactly are we today in terms of active versus passive?

Today's debate surrounds the rise of passive trading in equities and bonds. To begin we should ask what the passive share currently is. The short answer to this is we don't exactly know. A slightly longer answer follows. Using data from a recent BIS paper[7] suggests that of assets being managed in US equities, some 43% is managed passively. This mainly concerns cap-weighted index investing by mutual funds or ETFs. In the Europe the proportion is lower, around 30%. Passive investing in bond markets is lower than in equities, around 23% in the US and 15% in Europe.

It is mainly this sort of index investing that I am concerned with this in this presentation. There are lots of other indices that people invest in that are more active (like smart beta and factor indices), and there is no doubt a blurring in terms of what people consider active or passive. But I am talking about the shift towards index investing, that is away from

[7] Sushko and Turner (2018)

investing in managers who actively try and bet against the market, towards products that simply and try and reflect the market.



Another perfectly sensible way of describing the share of active versus passive is to consider how much capital is following either approach as a proportion of the total market cap (instead of as a share of assets managed). On this basis the numbers are much smaller. According to the same BIS paper in the US the share of total market cap managed passively is only 15%. In Europe it is as low as 3%.

Passive share of outstanding market cap

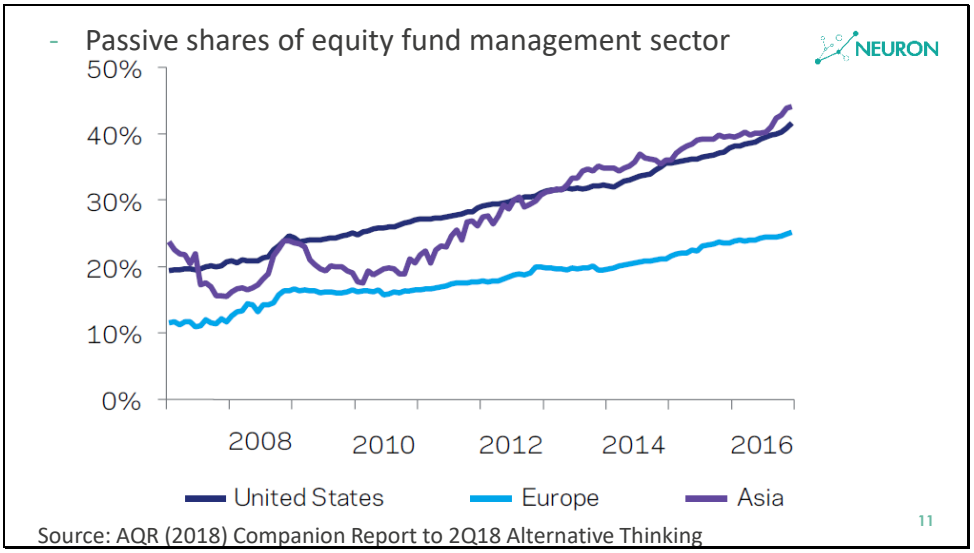
NEURON

	2007	2017
Equities		
Europe	2%	3%
US	6%	15%
Bonds		
Europe	1%	1%
US	1%	5%

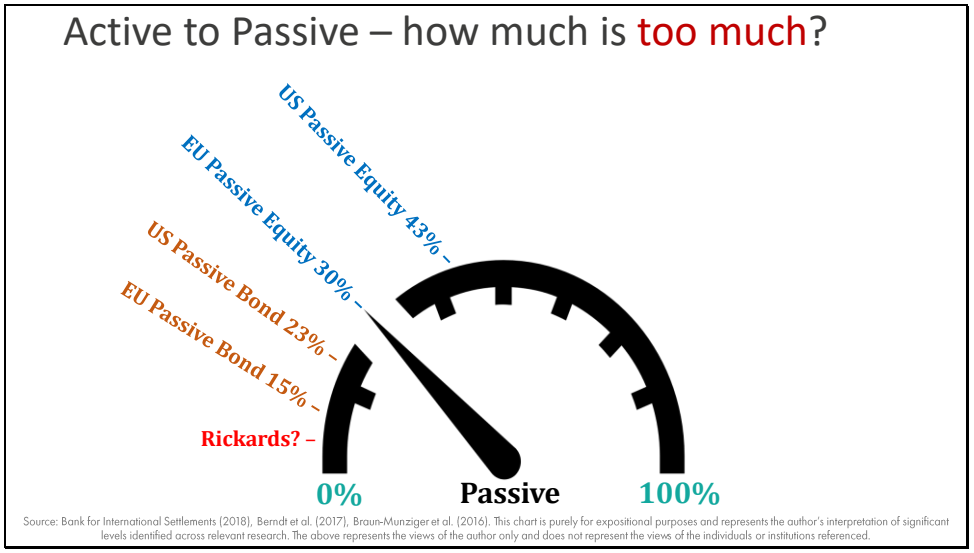
Source:
BIS March 2018 10

Levels uncertain but direction of travel clear

What does seem to be clear, and in my mind therefore warrants research into the potential implications of passive investing, is that across the board (asset classes and regions) the share (on whatever basis) of passive investing has been increasing. In an excellent paper from AQR they discuss in detail many of the issues around measuring the size of passive versus active, but also demonstrate unequivocally that whatever the numbers are – they are increasing.



Views on how much is too much



Are passive investors parasites?

Before moving onto to reviewing methods to explore the question of how much is too much, it is worth a very brief mention of whether anyone thinks the number should be 0% or 100%. I am not sure anyone really does take these extreme views, but if I really wanted to, I could stretch some arguments that are out there.

For example, James Rickards (Rickards, 2018) has vociferously argued that passive investors are nothing short of parasites. His basic argument is a free-rider one. He sees passive investors as riding on the efforts of active investors and their rise in popularity a 'dangerous' trend. Like most free-rider arguments he sees a negative externality. He makes an analogy that as the number of passive investors (parasites) increases eventually they will kill the market (their host). The free-rider argument is popular amongst critics of passive trading though I have not personally seen the exact nature and size of the supposed negative externality spelt out. Nonetheless, for purely expositional purposes I will suggest there are some, possibly Rickards, who would be happy to see almost no passive investors.

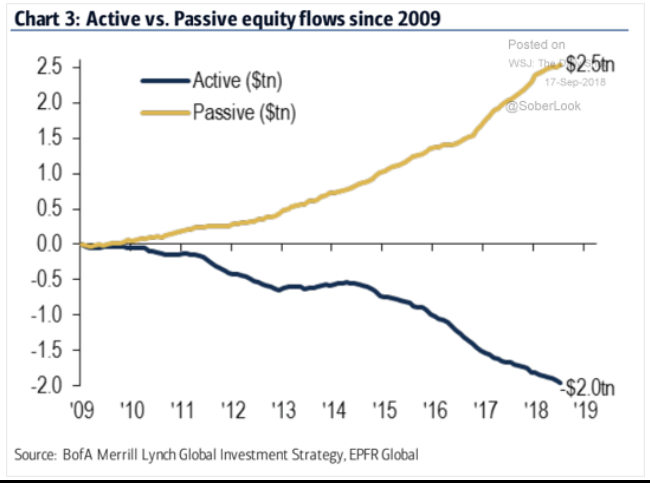
Free-Riding Investors Set up Markets for a Major Collapse

"The best example is a parasite on an elephant.

The parasite sucks the elephant's blood to survive but contributes nothing to the elephant's well-being"

Free-Riding Investors Set up Markets for a Major Collapse *From* <https://dailyreckoning.com/free-riding-investors-set-up-markets-for-a-major-collapse/> 14

"This chart reveals the most dangerous trend in investing today. "



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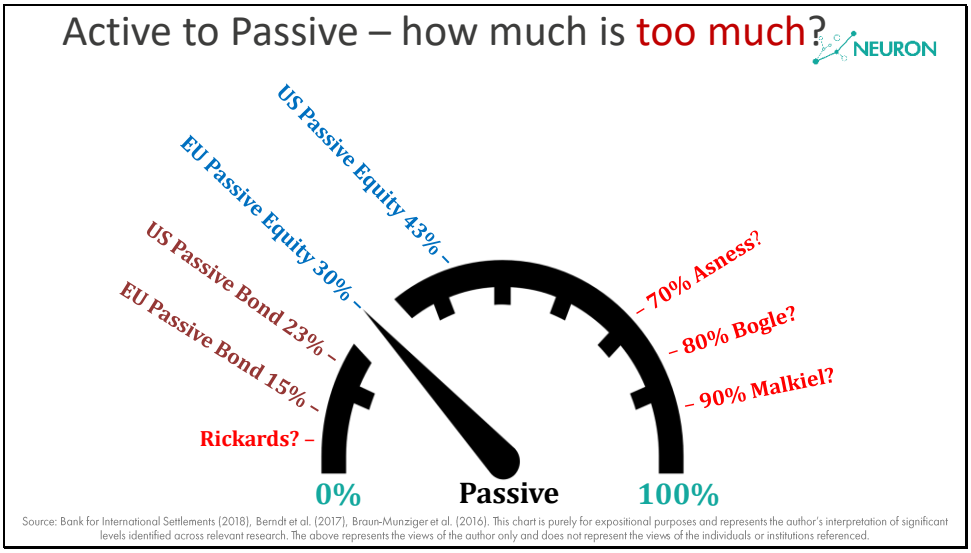
Could the entire market go passive?

At the other extreme, could anyone argue that it would be fine if the entire market was passive? Well, it is possible to construct a theoretical argument that you could probably get very close to that before there would be any concerns. The key to this argument rests on the idea that investors are to begin with either informed or misinformed[8]. The idea is that the number of informed active traders who are needed to ensure price discovery depends in part on the number of misinformed traders whose active trades add nothing but noise to market prices. If what we are observing is a shift of misinformed investors (or equivalently a shift of capital away from misinformed managers) then as this process continues the amount of capital required to be managed by informed active investors can be reduced. Taking it to an extreme, if all misinformed investors switched to indexing, then teases the idea that there would only need to be one active informed investor who wouldn't necessarily need to command much capital either. However, this argument throws up a conundrum. If the gains from active investing have been reduced, or even pushed to zero, it would seem natural that active investors would themselves withdraw, thus opening the door for the market to become less efficient again. Again, it seems to me that understanding the dynamic and evolutionary nature of these changes in investor styles is important.

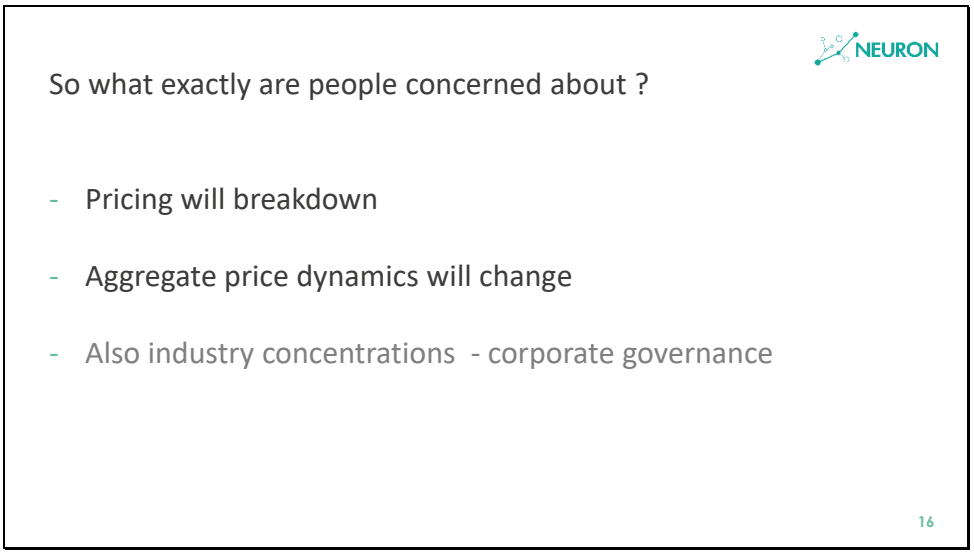
[8] I base this argument from ideas expressed in Fama and French's (2005) paper 'Disagreement, Tastes and Asset Prices'.

Somewhere in between?

While at a stretch I can just about make cases for while passive index investing should be arbitrarily close to either zero or 100%, the truth is that most people would suggest a safe number lies somewhere in between. Even Jack Bogle the founder of Vanguard, the first successful and largest index product provider has mentioned that above 80% might things get problematic[9]. Slightly further 'to the right' might be Burton Malkiel who has mentioned a figure of 90%[10]. Both of these observers are renowned espousers of index investing, and Malkiel in particular has been extremely vocal about the foolishness (for most investors) to consider anything else. One of today's most well-known active investors, Clifford Asness of AQR, has himself mooted that passive investing could probably get to 60-70% quite happily[5].



So what exactly are people concerned about?



[9] As discussed in an AQR Podcast that featured both Cliff Asness and Jack Bogle. https://www.aqr.com/Insights/Podcasts/The-Curious-Investor/Season-One/Active-versus-Passive

[10] Malkiel (2016)

Comovement, concentration and corporate governance

I think of there being two broad areas of concern about passive trading in today's debate. First, there are what I would term microeconomic concerns. This includes the idea just discussed that market efficiency could drop, and comovement might increase (and therefore portfolio diversification benefits could drop for example).

There are also concerns around industry concentrations and corporate governance. Vanguard is far and away the largest supplier of index investing[11]. While it is possible to speculate about the competitive implications of this sort of industry concentration, a practical concern is what might happen in the event of a cyber-attack or operational failure.

Table 3: Top five passive mutual fund and ETF managers as of March 2018

	Overall market share (percent)*		Passive fund AUM, March 2018 ($bill.)
	March 1999	March 2018	
Vanguard	11	23	3,404
BlackRock	0	8	1,410
State Street	0	3	613
Fidelity	14	9	422
Charles Schwab	0	1	174

*Asset manager's market share for all (actively *and* passively managed) mutual funds and ETFs.
Source: Center for Securities Pricing, Wharton Research Data Services.

Source: Anadu et al (2018) 17

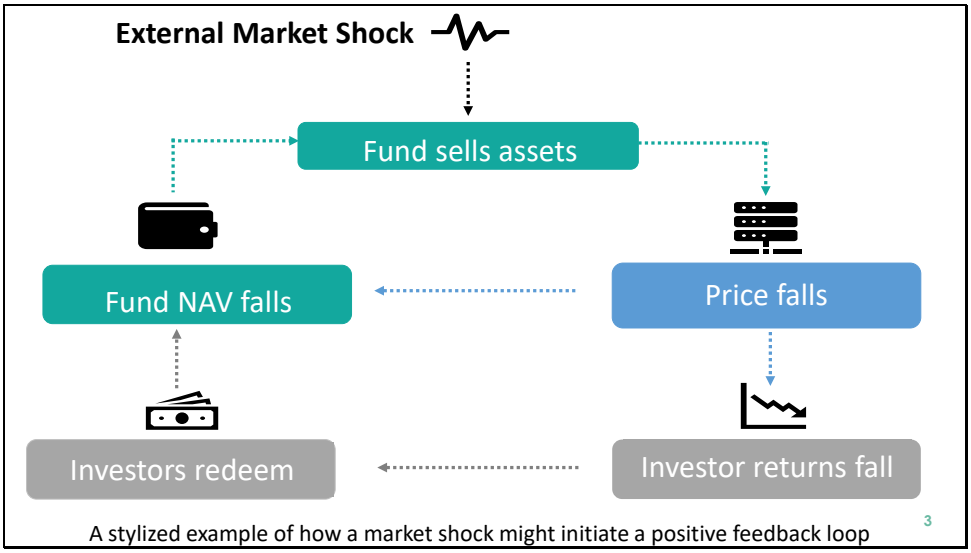
Regarding corporate governance, arguments go both ways. Some might argue that the rise of index investing will reduce the impact investors have on corporates through investor action. Others have argued to the contrary. They say that it is precisely because index investors are likely to be long-term that they have the incentive to influence firm behaviour, unlike active investors who are only interested in short term gains[12]. But to argue active investors are only short-term seems unfair. Lots of active managers (i.e. managers who hold portfolios that are very different to the market) are very long-term.

My take-away from this cursory contemplation of these controversies surrounding the active-passive debate is that, like the Fama-French[8] arguments surrounding index investing, it is important to look behind the classifications of active or passive, to consider other characteristics of investors who might be classified in either bucket.

Financial stability risk

Beside the microeconomic consequences of a shift toward passive investing, the other area of concern is related to aggregate price dynamics. There are two recent pieces of research that I will cover and both share a similar scenario that regulators have considered[13]. As we will see at the heart of the matter is how investors respond to performance.

[11] Anadu et al (2017).
[12] Jack Bogle made a point along these lines in the AQR podcast.
[13] As demonstrated by the papers cited within (BoE & BIS).



A stylized example of how a market shock might initiate a positive feedback loop

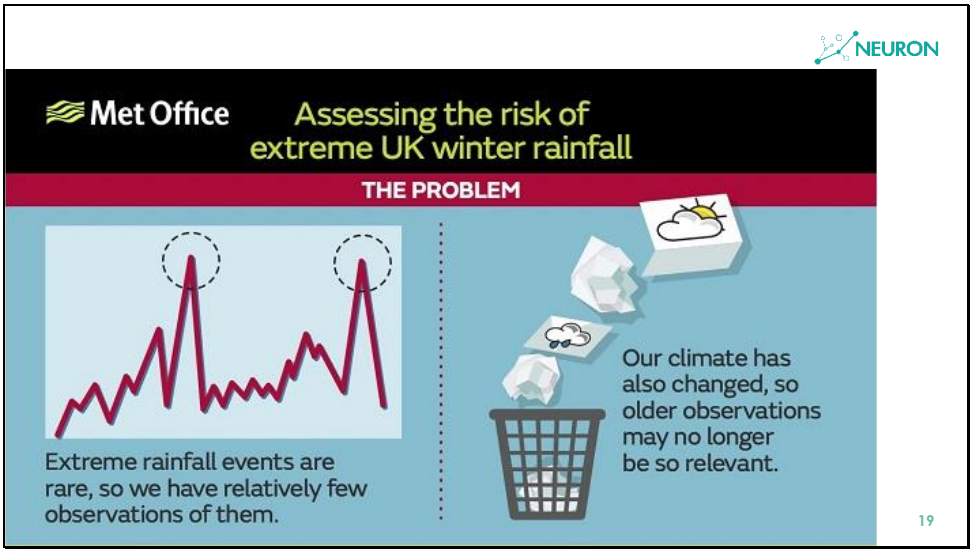
The flow chart above sketches an imaginary risk scenario. Imagine that we start with some sort of external shock that causes the price of an asset(s) to fall and volatility to rise. Some types of fund may need to reduce their holding of the asset, for example momentum funds that anticipate further falls, or funds that target volatility like risk-parity. As these funds sell their assets it causes the price to fall further. This reduces the NAV of the fund and produces lower returns for end investors. With a lower NAV the fund is likely to reduce its demand for the risk asset further, generating more selling. The potential first-round impact of this shock via this channel would probably be quite short-lived. But it is the response of investors to their experience of falling returns that some fear could lead to longer lasting positive feedback. If investors redeem this in turn generates further selling by the fund and can in principle exacerbate and prolong the feedback process. A problem that researchers face in understanding the plausibility of this kind of unpleasant potential scenario is that there have not been many examples in the past. In recent years researchers have turned to an alternative method - simulation.

A digression on simulation as a methodology

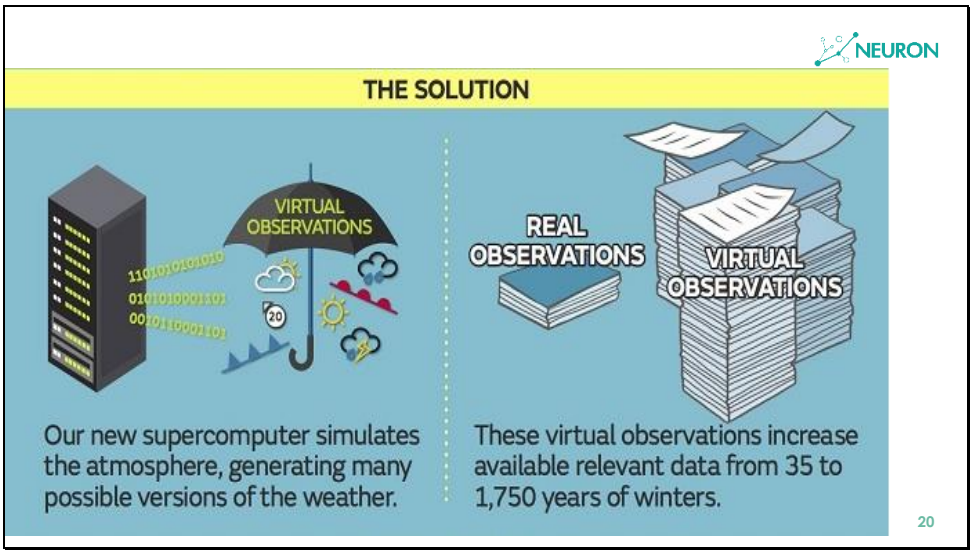
An example from meteorology

Simulation (and more generally 'generative' research methods) have been gaining traction in meteorology[14]. In the winter of 2013/2014 there were extreme floods in the UK. Extreme in the sense that they were well outside the historical record. Furthermore, forecasters had good reason to believe that the record was becoming less relevant - what I've called the dual problem of relevancy and sufficiency, Hillman (2017). To tackle these problems the Met Office has invested in more powerful computers to simulate the atmosphere. It enables them to simulate thousands of alternative virtual weather observations. Since bringing these simulation methods to bear the Met Office has issued revised guidelines on the frequency and scale of extreme weather events. Their models generate plausible, but as yet unseen, scenarios.

[14] See https://www.metoffice.gov.uk/news/releases/2017/high-risk-of-unprecedented-rainfall



Source for both charts on this page is https://www.metoffice.gov.uk/news/releases/2017/high-risk-of-unprecedented-rainfall



An earlier example from financial markets

Another debate took place almost exactly 30 years earlier which has many parallels with today's active-passive one. In the immediate wake of the 1987 crash Fischer Black argued to Harry Markowitz (HM) that portfolio insurers (PI) can't be too destabilising if there are at least as many portfolio rebalancers[15]. The rebalancers orders would outweigh the PI guys. Black had a dog in the race, he been working at Goldman Sachs a while and was involved in helping them compete in the PI space[16].

Some other stuff Markowitz did

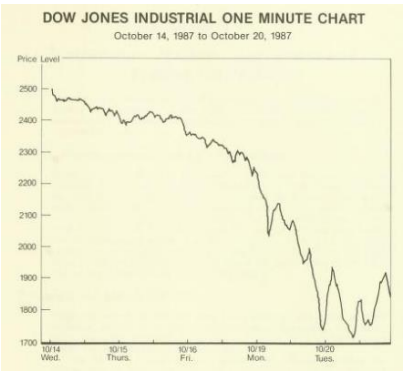
HM decided the best way to explore this was via simulation. Although HM is best known for modern portfolio theory he was in fact the creator of the first commercial simulation language, something he returned to at General Electric after publishing the portfolio work that made his name. I suspect he went down the mean-variance analytical route because computers didn't support the simulation approach which would have been his natural go-to. These days (in his 90s) he is writing four volumes revisiting his earlier work. Much of the second volume (known as 'Volume 2') is

[15] Markowitz, Harry (2016) Risk-Return Analysis, Volume 2, McGraw Hill
[16] Much of this is recounted in Perry Mehrling's (2012) biography of Black.

devoted to explaining how best to implement a simulation program, and how to think about portfolio choice decisions in terms of dynamic games that can be designed and tested within a simulation environment.

This is far from academic speculating. HM has been involved in consulting and commercial ventures for a long time, such as GuidedChoice[17]. I find it interesting also that Bill Sharpe (another Nobel Prize winning economist from a similar cohort) has been heavily involved in simulation approaches, decision support systems and commercial enterprises like Financial Engines. Sharpe's 2007 book[18], though not explicitly tackling dynamic problems, uses simulation explicitly to deal with the complexity that investor heterogeneity brings to portfolio decisions. Maybe it's just me but I suspect it is not commonly known that both Markowitz and Sharpe clearly embrace heterogeneity and utilise simulation to solve problems. I suspect quite a lot of people associate them primarily, if not solely, with a much narrower, and a frequently disparaged, representative-agent-rational-expectations-mean-variance orthodoxy.

Harry Markowitz proposed a way to deal with these issues in 1988 – build a computer model of the market and its participants - and simulate it



Source: Brady Commission Report https://archive.org/details/reportofpresiden01unit

Source: UC San Diego 2018

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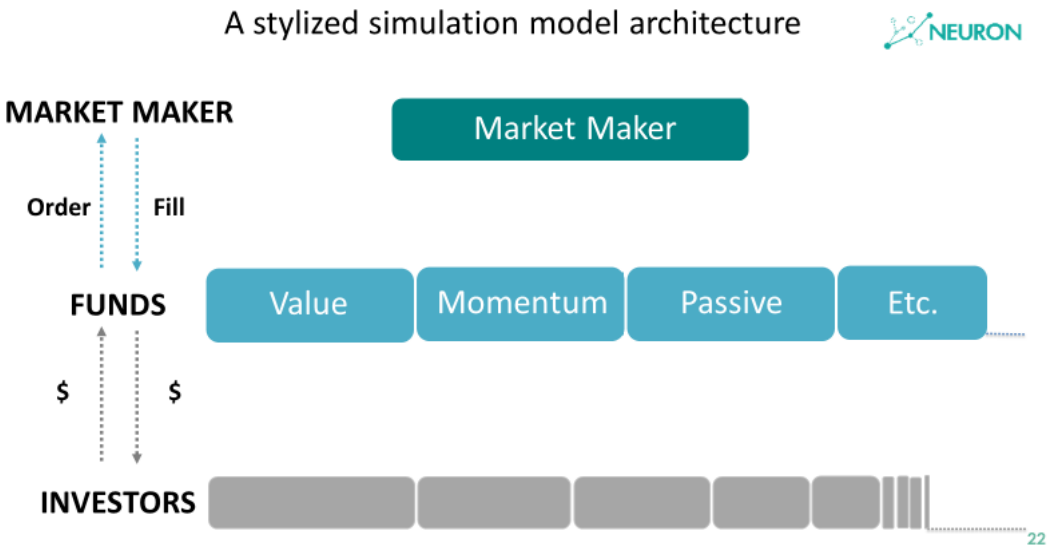
The model that Markowitz and co-author Kim developed ('K&M'[19]) was in many ways completely contrary to the orthodox approach of the day, a single representative agent, operating in continuous time. K&M also included practical constraints like leverage and margin. They also deliberately kick-started the model in a situation of disequilibrium because their explicit focus was on how markets behave out of equilibrium. These days economists are often ridiculed for not having taken factors like these into account before the financial crisis. It seems a shame in retrospect perhaps that this line of work that started with K&M didn't gain more traction. Bruce Jacobs and others did follow through with a number of papers (the 'JLM' simulator, described nicely in Lindsey & Schachter's book 'How I became a quant'). But I think it is fair to say this work has not yet gone mainstream.

What K&M found was that, contrary to Black's assertion, it was relatively easy for procyclical strategies to overwhelm theoretically stabilising strategies like portfolio rebalancing. Partly this is due to the potential for temporal liquidity mismatches. It doesn't matter how much AUM is following rebalancing. If the rebalancers are not active when the portfolio insurers want to trade, then PIs will drive the market and demand and supply will be heavily skewed one way or the other. You don't really need to do a simulation to argue this point, but the sim allows you to explore the issue quantitatively. More subtly, the K&M model helped shine a light on the role of leverage and margin. They found that when margin is introduced the price dynamics can become explosive, and market drops of the size of 1987 could be commonplace.

[17] See https://www.guidedchoice.com/video/dr-harry-markowitz-father-of-modern-portfolio-theory/
[18] Sharpe (2007)
[19] Kim & Markowitz (1989)

The return of simulation in today's active-passive debate

Today we are seeing a revival of interest in the research methodology pioneered by Harry Markowitz. Like the portfolio-insurer vs portfolio-rebalancer question, today's debate is about whether increasing amounts of capital following a particular trading style could lead to financial instability. There are two studies that have employed a similar simulation approach that are beginning to offer insights. Both studies share a similar underlying architecture. There are three main components. A market mechanism (in both cases a market-maker or dealer), a layer of trading funds (including a passive investing component), and a layer of investors. A stylized version is shown in slide 22. Each study differs in the details of how each component is modelled, and one is deterministic and the other stochastic (as will become clear soon). The key experiment that can be performed with both models is to play with varying the 'size' of the passive investment funds and see to what extent it changes characteristics of simulated market data.



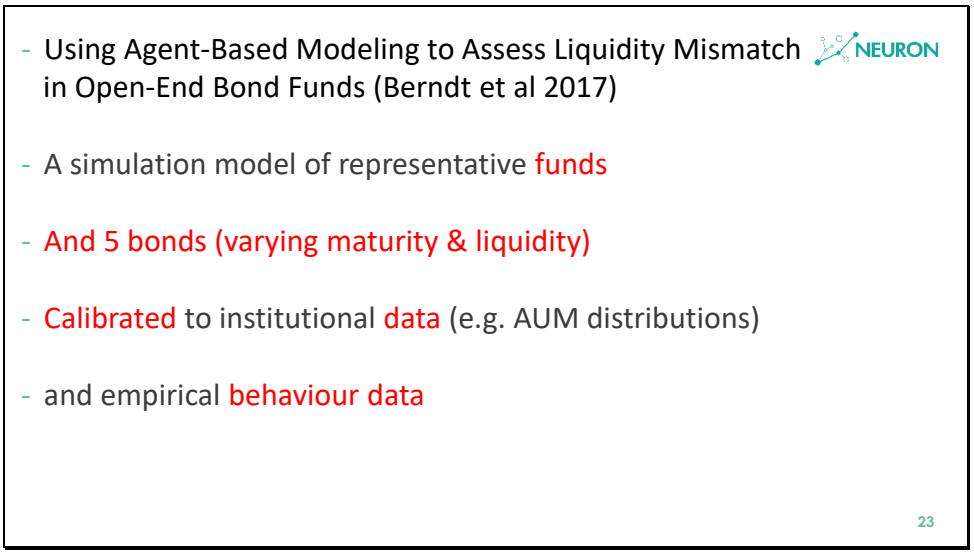
Why bond models?

Both models I will discuss are focused on corporate bonds. There are a few reasons why bonds have received more attention from policy-makers than equities. Firstly, the bond market is much close to both traditional and more modern methods of monetary policy (including 'unorthodox' mon policy like QE, operation twists, long end rate targeting etc). Policy makers naturally worry about the integrity of the bond market and have a vested interested in understanding what might be driving it. For example, no longer mere interested observers, as a result of QE implemented by the Bank of England, the UK Treasury is in effect a large passive investor in the UK corporate bond market. Another reason why policymakers have explored bonds is that corporate bonds have rapidly become a major source of company finance, taking over from banks since the crisis.

A deterministic simulation model from the US (Berndt et al 2017)

The model by Berndt et al (hereafter 'BBCM') has three layers: three dealers, two funds and investors. The dealers quote spreads to the last traded price, and the spread is a function of the dealer's inventory. In the model as run in the paper each dealer has inventory limits, beyond which they can unload inventory to an outside source (assumed to be a community of value investors but not explicitly modelled) who charge a wider spread. In the model there are five different bonds that vary in maturity, notional outstanding and coupon. Each dealer's specialization varies across the

bonds, in the sense that one dealer is typically more likely to offer a better spread for a certain bond than another. The idea is to represent some of the real-world heterogeneity that we observe.



There are two classes of fund represented in the model, insurance and mutual funds. Each class is modelled as a single fund. The insurance fund is assumed to target a constant equity-bond mix, e.g. 60/40. The mutual fund is assumed to be long only and wants to hold each bond in proportion to pre-set index weights.

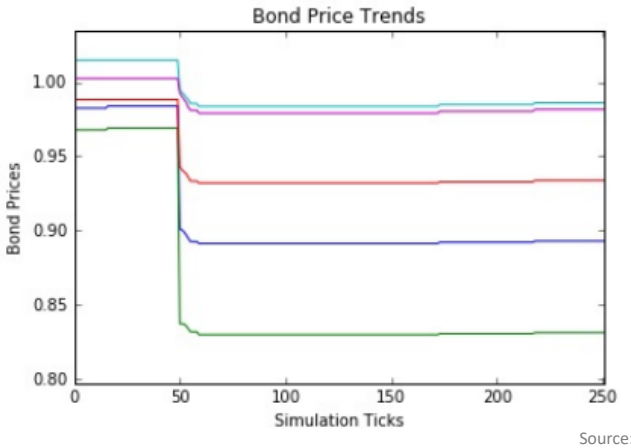
Investors are not modelled explicitly but rather the flows into and out of mutual funds are simulated. These flows are modelled as a function past fund performance in line with empirical work. Past performance for mutual funds is directly related to index returns because the funds are index trackers. When the index has been going up money flows into mutual funds. When it has been falling the funds see redemptions. Mimicking the empirical findings, the elasticity of flows to past performance is more sensitive on the downside. The empirical data suggests investors tend to be more sensitive to poor performance than good performance[20].

The experiment

The BBCM model is initialized by assuming each fund is fully invested and dealers have a zero inventory. The base case is that mutual fund share of bond holdings is 15% of the total outstanding notional. In this model there are no other investors and so no distinction between whether the passive share is measured as a proportion of funds under management, or total outstanding notional. To generate activity an economic shock is imposed that causes the price of all bonds to drop (it is an upward parallel shift in the yield curve of 100 basis points). There is some attempt to calibrate this shock to regulatory practice – as described in the BBCM paper, the IMF has estimated losses to mutual fund losses to be around 7% of NAV following a 100 basis point shock. This shock sets in motion the positive feedback loop described earlier. Mutual fund returns drop, investors withdraw capital, funds need to sell bonds and so on. The process is simulated for a subsequent 200 time steps (time is measured in days, and in the model the shock occurs at day 50).

[20] Both the papers I discuss draw on empirical work by Goldstein et al (2017).

- Bond price reactions with 15% passive

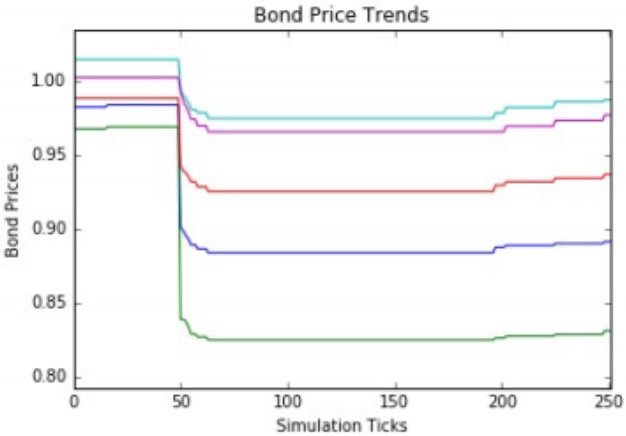


Source: Berndt et al (2017) 24

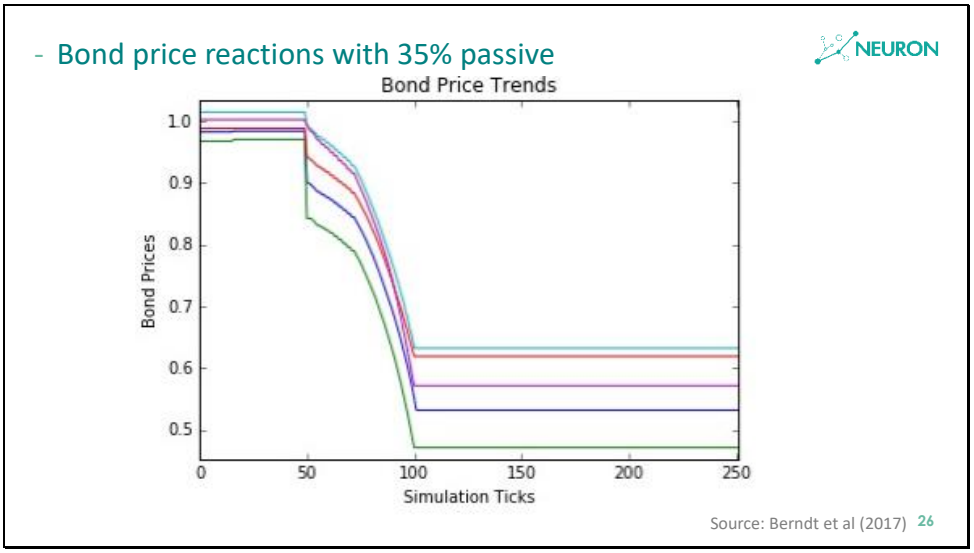
Results

The three charts presented here are taken from the Berndt et al paper. Each chart traces out the simulated price of each bond following the same identical shock at day 50, but under varying starting assumptions for the share of passive. With 15% passive we see that for each bond there is an initial repricing (drop in price) followed by a few days of subsequent falls. But within a few days prices level off. The longest maturity bond (shown in green) stabilises around 14% below its pre-shock value. With 25% passive we see a similar profile, but the process seems to take a little bit longer (a matter of days) before prices level off, slightly below where they stabilised in the 15% passive case. But with 35% passive we see something qualitatively different. After the initial price drop we now see several weeks (approximately 25 days) of steadily falling prices for every bond. We then we see a sudden acceleration in the price drop. The 25-year bond price finally stabilises around 75 days after the initial price shock at half its pre-shock value. Before commenting further we will look at another model.

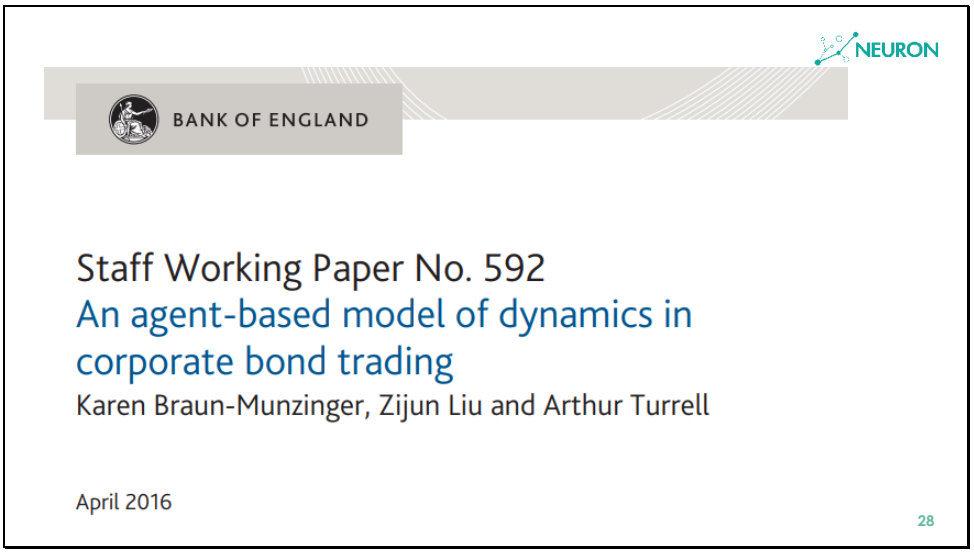
- Bond price reactions with 25% passive



Source: Berndt et al (2017) 25



A stochastic simulation model from the UK (Braun-Munziger et al, 2016)

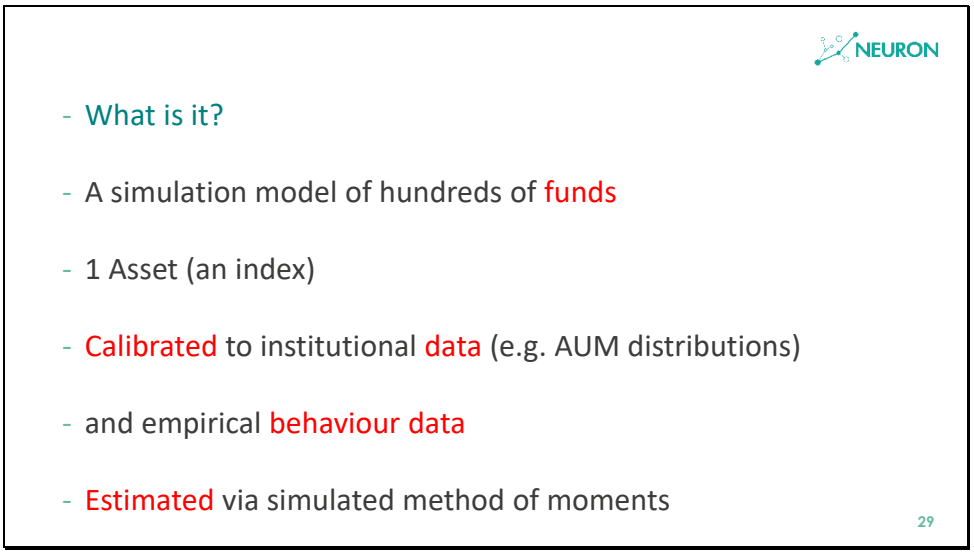


Varying degrees of heterogeneity

The model from the Bank of England (hereafter 'BLT') has some differences to the BBCM one. BLT have more heterogeneity at the investor and fund level, but less at the market level. While BBCM modelled 5 different bonds, BLT model the 'index' as a single price. While BBCM only modelled two classes of investor, with one representative fund for each, BLT simulate hundreds of mutual funds, calibrated to having starting AUMs that match the actual distribution of AUM across US corporate bond mutual funds. There are three classes of fund explicitly modelled. Value traders who could in principle act in a stabilising way, buying if a price drop pushes the market away from their sense of fair price. Momentum traders (aka trend followers) who will be destabilising, selling as prices fall and buying as they rise. And passive funds who are long-only index and only trade in response to investor flows. In BLT there is only one dealer, who adjusts prices according to excess demand. In their model the sensitivity to this excess demand can also vary in proportion to market volatility – a useful device to reflect dealer risk-aversion, or perhaps the difficulty of sourcing external demand to lay off inventory to. Both models share the same idea, and empirical foundation, for modelling investor flows. BLT has an extra degree of complexity because it allows investors to switch between mutual funds within the same strategy class (e.g. from one active manager to another) based on relative performance.

Stochastic versus deterministic, complete versus partial

There is one more key difference between the US (BBCM) and UK (BLT) simulation models. The BLT model is stochastic. What this means in practice is that as the model is simulated through time after a shock, a variety of future paths can be generated. The source of the variety comes from the way in which non-mutual funds are modelled. In a sense the BLT is more complete. It attempts to model all the participants in the corporate bond model. Some of these participants are modelled explicitly (like the mutual funds who follow rules-based strategies), but for the ones that aren't their presence is still felt in the model by adding a random source of orders, assumed to be the net order flow for these unmodeled participants. The BBCM is more partial. I think it is fair to think of it as simulating what might happen as a result of mutual funds interacting with dealers, ignoring the possibility that other players might also be active in the market.



The experiment

The BLT paper explores a number of different simulation experiments, but one is quite similar to that in BBCM. They too set the share of passive investing, and then assume there is an exogenous shock at a point in time and trace out the subsequent impact on prices. Remember there are many possible paths that can develop in the future depending on each path of random order flow in each simulation run. They vary the share of passive between 20% to 70%, and for each case end up with a distribution of terminal yields (or equivalently bond index prices) after 100 days. There are as many observations in the terminal distribution as there are simulation runs.

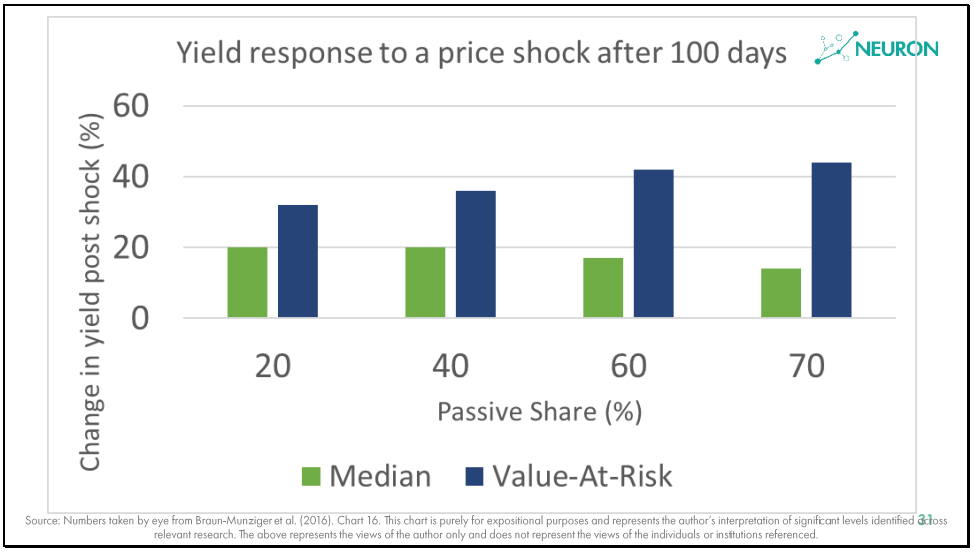
Results

The chart below shows one of their results[21]. They look at the difference between the terminal yields and the pre-shock yield and find that the 95th percentile of this yield impact distribution increases fairly linearly as the share of passive investing increases. Given the 95th percentile of this distribution are the greatest rises in yields, for a long only index investor this is tantamount to a 5% value-at-risk. My takeaway from this result is that the tail-risk increases as the proportion of passive investors increases, all be it linearly. However, perhaps a more interesting insight is that the median yield change is fairly stable between 20% to 40% share but then *drops* as the passive share increase further.

[21] Numbers taken by eye from Braun-Munziger et al. (2016) Chart 16. This chart is purely for expositional purposes and represents the author's interpretation of significant levels identified across relevant research. The above represents the views of the author only and does not represent the views of the individuals or institutions referenced.

As the authors report in the abstract:

> *"We also explore the impact of the growth in passive investment, and find that it increases the tail risk of big yield dislocations after shocks, though, on average, volatility may be reduced".*



Source: Numbers taken by eye from Braun-Munziger et al. (2016). Chart 16. This chart is purely for expositional purposes and represents the author's interpretation of significant levels identified across relevant research. The above represents the views of the author only and does not represent the views of the individuals or institutions referenced.

Some comments on the results of both papers

In the US paper (BBCM) price simulations seem to take on qualitatively different dynamics (i.e. nosedive!) as the share of passive investing gets above 30%. I think the price (fall) acceleration takes place as the positive feedback of redemptions gets to the point where it causes dealers to seek external liquidity at which point spreads take a step up triggering a speed-up in the redemption cycle. In this model there are several sources of nonlinearity that help to create discontinuities in the market. These nonlinearities are things like the level of cash buffer funds hold and inventory limits.

A subtle result - the "wrong kind of volatility"

In the UK model (BLT) what seems to happen is that at moderate levels of passive trading, the more passive trading there is, positive feedback from prices to investor flows increases the tail risk following a price shock. But at high levels of passive trading (50% or above by the looks of it) the fact more capital is managed by passive funds than momentum funds means there is less initial response to the shock. As the passive share gets very large it is the investor-performance feedback process that dominates the dynamics. Tail-risk remains high because there is still a similar chance that the market can fall into a rapid redemption spiral. But the *average* response is lower than when there are momentum traders present who would naturally push prices lower initially in each path. For all those paths that don't slip into the redemption spiral, the absence of significant numbers of momentum funds dampens the market volatility.

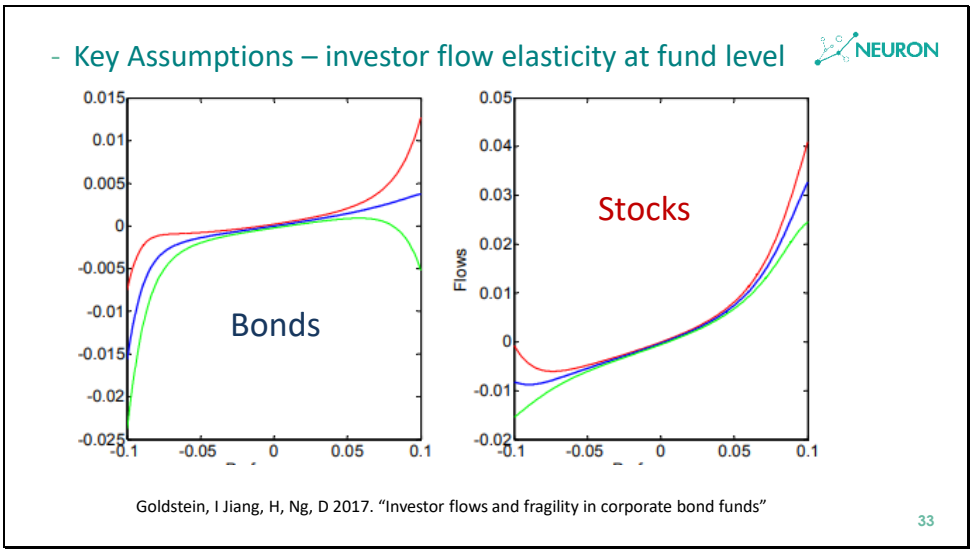
I personally find this an intriguing result. One complaint I hear anecdotally from traders when you ask why they didn't profit during periods in which it appears prices have moved substantially, is that "it was the wrong kind of volatility". If there has been a change in volatility dynamics I expect this could cause issues for many risk and money-management techniques that traders have heuristically (or more formally) developed over the years.

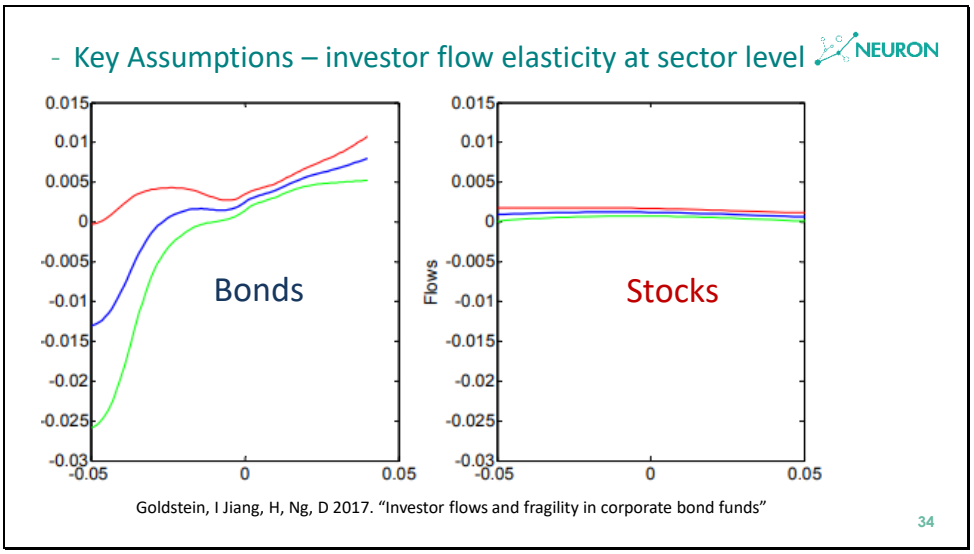
What both models share is that amplification effects can follow from exogenous market shocks, and the scale of the amplification varies according to the share of passive investing. Both models also demonstrate significant nonlinearity. In neither case is it safe to look at what happens to market dynamics as the share increases from 20% to 30% and extrapolate as to what we would expect to see as the share goes from 30% to 40%.

The key common ingredient – how do investors behave?

The empirical study that influences the simulation models

Beside differences in institutional details (funding limits, dealer limits and asset and fund heterogeneity) both models use similar functions that govern how investors react to performance. Both draw on the same empirical work by Goldstein and others. It is worth taking a closer look at this. The charts below are reproduced from the Goldstein et al 2017 paper. Each shows the response of flow to lagged performance, both measured monthly. Performance at the fund level is measured as the alpha for each fund. The blue line is the smoothed response, the red and green lines are confidence intervals around the response. There are two things worth noting. Firstly, the response to performance in corporate bonds is concave. As mentioned earlier, it appears outflows are larger than inflows for the same amount of negative or positive performance, at both the individual fund and the aggregate level. Secondly, there is a clear difference between bonds and stocks. At the individual stock fund level there is evidence of fear-of-missing-out performance-chasing. Flows seem to accelerate the more an individual fund outperforms. Underperformance leads to outflows, but the response appears linear. At the aggregate level however, there is no response at all. The amount of money flowing into and out of the equity mutual funds sector does not seem to be related to past performance of the stock index.

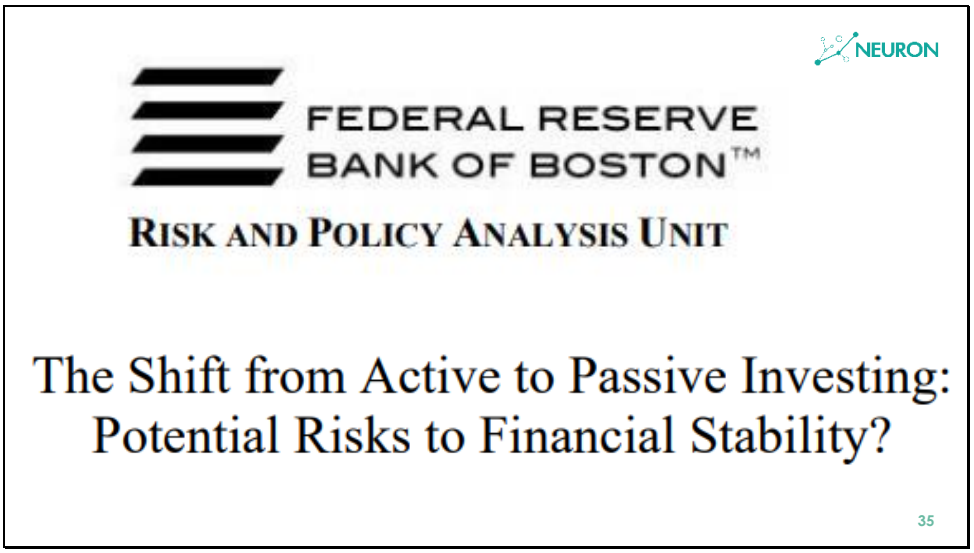




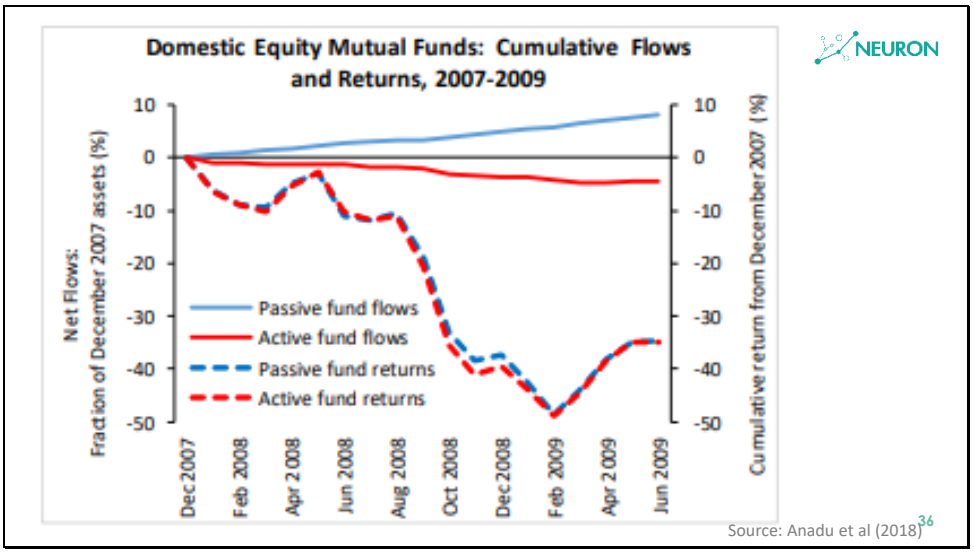
Some challenges revealed by recent empirical work

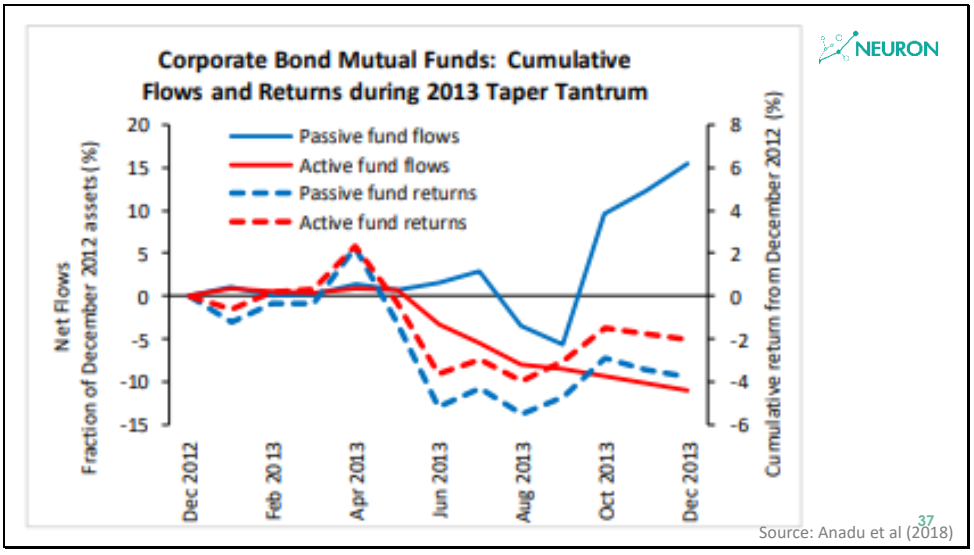
Do investors treat passive and active funds differently? - So it appears

Two recent empirical papers have thrown up some interesting results for researchers working with these simulation models. Both papers come from policy-maker types, one from the Federal Reserve Bank of Boston (Anadu et al, 2018) and the other from the Bank for International Settlements (Sushko and Turner, 2018).



Both papers look at the behaviour of flows for bonds and equities, and for active and passive managers separately. By contrast the Goldstein papers looked at mutual funds within each asset class, combining both active and passive. Each paper also studies the behaviour of flows during a number of different market stress episodes. The next two slides reproduce charts from the Boston Fed paper (the ones from the BIS who look at some different stress periods are qualitatively similar). The first observation is that the response of flows to performance is different depending on whether the fund is active or passive. The 2007-2009 crisis example is very clear. It suggests that both active and passive equity funds performed equally poorly, but passive flows recorded net inflows, active flows net outflows. This is consistent with the Goldstein result I discussed earlier. Overall, there was little flow into or out of the equity mutual fund sector, despite negative market wide performance. But this masks a switch under the surface.



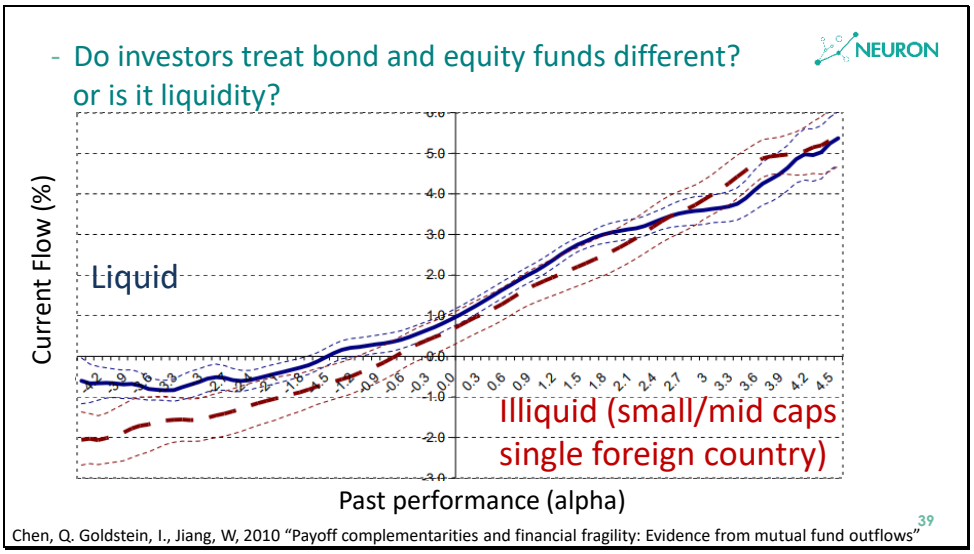


Source: Anadu et al (2018) [37]

Are investors in passive funds less likely to redeem than those in active? So it appears

Apart from the fact there seems to be differential response from performance to flows between active and passive, what both these recent papers show is that passive funds seem to receive net inflows during stress periods, and active funds net outflows! This seems to be the case across both equities and bonds. If these results are robust then it may challenge the conclusions of the preceding simulation studies. It would suggest, other things being equal, that as the market gets more 'passive' then perhaps the feedback process becomes dampened, or, even more intriguingly could the feedback process be one in which passive investors providing a stabilising force?

Perhaps it is more about liquidity than asset class



Chen, Q. Goldstein, I., Jiang, W, 2010 "Payoff complementarities and financial fragility: Evidence from mutual fund outflows" [39]

A final thought about the supposed differential elasticities of investor flow across bond and equities, and active and passive, is that perhaps the underlying issue is ultimately about fund liquidity. In an earlier paper by Goldstein and co-authors (Chen et al, 2010) they broke down the performance-flow relationship in equity fund into liquid (large cap) and illiquid funds (small cap, and mid cap single foreign country funds). They found that the downside performance elasticity was significantly higher for the illiquid funds, i.e. investors redeem more capital from illiquid funds than liquid for a given level of underperformance. Perhaps one reason we see the concavity in bonds mutual funds and not in equity funds is because bond funds are simply less liquid. It would be of interest to push deeper into these issues.

The Lucas Critique and policy experiments

A final quick point is that it is fundamentally difficult to do experiments of the nature we reported on. The reason is that it is far from clear that the behavioural relationships embedded in the model would be the same if the passive share was 20% or 60%. This is an implication of the Lucas Critique that I discussed in more detail in my 'Financial Market Simulation – rebooted' talk.

Conclusions

To sum up I feel that these kinds of simulation models are of value in answering questions like how much passive investing is too much. There are of course problems like the Lucas critique, and the reliability of any of the empirical studies that we use. One common finding is that these models suggest strong nonlinearities. We have seen that a passive share of 35% might generate profoundly different market dynamics to a share of 25%. For that reason alone we should continue pushing these models.

Apart from using simulation models to explore these kind of policy questions, there are practical applications for investors. It would be useful to explore the role of liquidity, perhaps picking up on the earlier empirical work by Goldstein that shows illiquid funds were more performance sensitive than liquid ones. Managers of these funds (and ETFs) should reflect on the potential for liquidity mismatch. Regulators already are. We can also consider calibrating these models ever closer to the real world and think about how they might produce real-time stress scenarios and forecasts[22].

[22] In some of our own work at Neuron we have built agent-based-models that provide structurally grounded volatility forecasts to compliment statistical models like GARCH.

- Conclusions – how much is too much ?

- Exploiting these structural simulation models seem at attractive way to mitigate scarce data – but very much an art

- Models so far suggest strong nonlinearity

  35% may generate profoundly different dynamics than 25%

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- Recommendations – how much is too much ?

- Calibrate closer to real market –
  start with smaller illiquid markets e.g.

  corp bonds

  small caps

  EM

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- Recommendations – how much is too much ?

- Immediate industry applications:

  Liquidity - cash management & redemption policies (anticipate regulators)

  Risk – simulate stress scenarios reflecting market impact (anticipate changing investor needs)

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