vba Journaal

CFA Society Netherlands | vba

150TH ANNIVERSARY EDITION
THE FUTURE OF INVESTING

VOLUME 37 | EDITION 150 | SUMMER/AUTUMN 2022

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CALL FOR PAPERS

Myths, fallacies, rules-of-thumb and beliefs

Dealing with risks and uncertainties on a daily basis is an inherent part of life. No one knows what the future holds for us and that is why every investment decision also entails a large degree of uncertainty. Nevertheless, investors often look for something to go on – for instance pieces of wisdom such as: *"Diversification is the only free lunch in investing"* (Harry Markowitz), *"Markets can remain irrational longer than you can remain solvent"* (John Maynard Keynes) and *"Whether we're talking about socks or stocks, I like buying quality merchandise when it is marked down"* (Warren Buffet).

In our spring issue we will track down patterns and rules of thumb that investors can rely on. And at the same time, we would like to prove that some of the dogmas that are unjustly being followed are actually myths. Our idea is to publish research articles as well as opinion pieces. The following questions may serve as a source of inspiration; the editors are also open to receiving articles that in some way offer investors something to go on or help them avoid pitfalls.

1. What are the generally accepted beliefs and often-used rules of thumb with regard to Asset & Liability Management, Strategic Asset Allocation and Tactical Asset Allocation or in fact on the level of a particular asset class, such as equities, bonds and private equity? Act as a fact checker and indicate, based on experience and research, how accurate each of the identified beliefs and rules is.
2. You could use the same method for examining other aspects of investing, such as risk management, trading and performance measurement. What are useful beliefs and rules of thumb for those areas, and which are losing their validity?
3. What about the beliefs regarding Responsible Investment and ESG? Which are based on facts, which are half-truths and which are just plain nonsense?
4. What relationships between macroeconomic developments and investment returns can be identified? Should you be invested in value stocks and commodities when inflation and interest rates are rising? Does the stock market run six months ahead of the actual economic developments? Which relationships are worth printing and framing and which should be dismissed as myths?
5. Many investment organisations have defined investment beliefs. Exactly why did they put those beliefs on paper? How are beliefs used in practice and how do they help the organisation to make choices and navigate during times of uncertainty?

By means of this call for papers we invite interested authors to contact the editorial team (irma.willemsen@cfavba.nl) no later than 30 November 2022. Contributions must be original articles that have not previously been published elsewhere and must comply with the style instructions https://cfavba.nl/uploads/vbajournaal/VBA%20Journaal%20stijlinstructie.pdf.

150th anniversary edition
The Future of Investing

Amid the recent storms on the financial markets, unprecedented economic turmoil, and far reaching regulatory changes, the members of CFA Society VBA Netherlands had at least one certainty: VBA Journaal was published every quarter. The aim of the journal is to be the leading independent knowledge provider in the Dutch investment management sector and a leading knowledge provider on Dutch investment expertise for international readers. In the coming years, the journal will stay relevant, because more changes can be expected from, for example, financial innovations, digitalization, climate change, or regulations to name just a few. In this spirit, the 150th anniversary edition is a special edition on the future of investing from a secular perspective. We are very pleased that internationally recognized leading academics and practitioners were willing to share their knowledge and insight on a range of important secular themes that are relevant for investors.

In the "The future of responsible investing", Rob Bauer shares his personal perspective on the responsible investing phenomenon. He describes the transformation of responsible investing in the past two decades and provides asset owners and asset managers with his perspective on the future, encouraging them to discuss their financial and non-financial objectives more openly. Enhanced transparency on this matter would possibly strengthen institutional investors' legitimacy in society.

Next, Alexander Carlo, Piet Eichholtz and Nils Kok shed light on the determinants of pension fund allocation to real estate, in their article "The Determinants of Institutional Capital Allocation to Real Estate". Their study provides new insights in both the dynamics over time and the spread across pension funds.

In "DeFi and the foundation of a new finance", Campbell Harvey claims that a more profound digital development than cyber currencies is occurring in the financial system and that this development remains largely under the radar. Specifically, the emergence of decentralized finance, or DeFi, is starting to change the shape of the entire financial system. In his article he motivates his firm opinion and discusses the risks.

Ralph Koijen shares his passion for research into financial markets in "A survey of the developments in quantitative finance". In the interview, he shares his thoughts on various topics, including ESG, factor investing, and – of course - his latest research on the elasticity of markets, or in other words: *'why do financial markets fluctuate as much as they do?'*

In "Broadening our thinking as the basis for finance professionals – Dawn of the complexity paradigm", Theo Kocken gives us a grand tour through the past and the current state of education and practice and the expectations for the future of the finance profession. He argues that these insights, including those arising from behavioral research and complexity theory, will lead to requirements for a broader and more diverse set of competences for a financial professional 'fit for the future'.

David Blitz and Pim van Vliet reflect on the developments in the field of quant investing and argue that the future looks bright, in their article "Signals are green for quant investing". As investors, they have learned in practice that a long-term winning formula can sometimes feel like riding a rollercoaster in the short run. However, they predict a bright future in which data and computing power is swiftly increasing, giving rise to next-generation quant. They also shed light on how this could and should shape the investment organization of the future.

Finally, we are honored with two columns from our former editors-in-chief Hans de Ruiter (2001 – 2008) and Jaap Koelewijn (2009 – 2016): "Unfortunately people are not donkeys" and "Not yet over: 2008". They reflect on the past and draw lessons for the future of investors.

We hope that this collection of six articles and two columns from influential scholars and leading market practitioners will help our readers to shape the changes in the financial industry of the Netherlands and to contribute to the society in the coming years.

On behalf of the editorial board,
Mark Geene, Roy Hoevenaars and Gerben de Zwart

ACKNOWLEDGEMENT
We would like to thank Irma Willemsen for her endless energy to make every edition a new success.

The Board of CFA Society VBA Netherlands congratulates the Editorial Board of the VBA Journaal with their achievement of the 150th edition

We as Society have reached a fantastic milestone, the 150th edition of our VBA Journaal. A renowned and outstanding professional journal with very high quality articles and relevant themes that the industry looks forward to reading each quarter with pleasure. A professional journal we are rightly proud of. But also a journal that is not created overnight. What I am personally most proud of is our unrelenting VBA Editorial Board. Volunteers who are constantly working to provide us with fresh insights, sharp opinions and relevant research. Not an easy task and yet they get it done every quarter. Dear VBA editors, congratulations on your milestone, we are incredibly proud!

Melinda Rook, president
On behalf of the Board of
CFA Society VBA Netherlands

GRADUATION CEREMONY

Postgraduate VU VBA education Investment Management

CFA Society VBA Netherlands and the Vrije Universiteit Amsterdam congratulate the following persons with successfully completing the education.

Name	Company
Bob Boelens MSc RBA	ORTEC Finance
Marcella Burggraaf MSc RBA	ABN AMRO
Bert Hodes MSc RBA	ING
John Kuijt MSc RBA	ORTEC Finance
Thijs Lammerink MSc RBA	BpfBOUW
Gregory Landbrug MSc RBA	a.s.r.
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Samy Saleh MSc RBA	NN Group
Rob Schippers MSc RBA	a.s.r.
Valeriia Schouten MSc RBA	ABN AMRO
Juliette Tesselhoff MSc RBA	APG Asset Management
Rozl Smits MSc RBA	Triodos

The graduates of Postgraduate VU VBA education Investment Management

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CFA SOCIETY VBA NETHERLANDS CONGRATULATES THE NEW CFA® CHARTERHOLDERS

We applaud and celebrated with those who became CFA® charterholders in 2021/2022 and joined our community of 170,000 charterholders worldwide. Their value isn't measured in experience and test results alone. It's reflected in their commitment to the highest standards of ethical conduct in the financial community. Together, we are building a better world for investing.

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GRADUATION CEREMONY

Postgraduate VU Risk Management for Financial Institutions

CFA Society VBA Netherlands and the Vrije Universiteit Amsterdam congratulate the following persons with successfully completing the education.

Name	Company
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Jasper Bugter MSc RMFI	De Nederlandse Bank
Kimberly Ernest MSc RMFI	Deloitte
Joost Kaptijn MSc RMFI	ABN AMRO
Susan Verploegen MSc RMFI	EY
Peter Vogelzang MSc RMFI	Cardano

The graduates of Postgraduate VU Risk Management for Financial Institutions

The future of responsible investing

Rob Bauer

INTRODUCTION

I am very honoured and thankful that the VBA Journal invited me to contribute to its special 150th edition. In this article, I will share my personal perspective on the responsible investing phenomenon. I will first look back at the past two decades in which responsible investing transformed from a niche product to a hyped set of investment solution services. I will then highlight several implicit trade-offs and conflicts of interest that materialize in the many manifestations of responsible investing such as divestment, engagement, and ESG-integration strategies. Moreover, I will encourage asset owners and asset managers to discuss more openly their financial and non-financial objectives. Greater transparency on this matter would possibly strengthen institutional investors' legitimacy in society.

MY OBSERVATIONS

"Responsible investing: beyond the hype?" was the title of my inaugural speech when I started my "Institutional Investors" chair at Maastricht University (Bauer, 2008). The speech back then summarized my view on the responsible investment hype in the prior decade (the 1990s) and gave a preview for the years to come. At the time, I expected this hype to end soon – like any hype does by definition – and predicted a gradual integration of its relevant parts into mainstream investment practice. Responsible investing as such would become archaic if not obsolete.

How wrong I was back then. Challenging the theories on the rise and fall of hypes, the responsible investing movement evolved into an almost sacred utterance with magical and spiritual powers that promised high returns and low risks. At the same time, these investments were set up to save the people and the planet. Observing this movement today, I wonder whether it was largely induced by smart marketers who, riding the waves of civil society's multifaceted concerns, created a plethora of responsible (investment) products. Moreover, many of those products have fuelled a conspicuous consumption pattern: consumers have used the spending on luxury goods (e.g., buying an expensive electric car) and services (e.g., responsible investing products) as a public display or signalling device which has helped them attain or maintain a certain social status (Riedl and Smeets, 2017).

Alternatively, and certainly a less cynical observation, the hype becoming a trend may also have been consistent with a sincere and authentic awakening of those who had prudently watched over large sums of money that the people had entrusted to them. These agents increasingly started realizing that certain risks and opportunities related to environmental and social challenges that companies were facing could impact investors' long-term bottom lines in material ways. Additionally motivated by explicit demands put forward by civil society, asset managers and asset owners started building a multifaceted set of responsible investment products and services. While exclusion and divestment were buzzwords in the previous century (as a matter of fact, both still are highly in the money), the first two decades of the twenty-first century can be characterized by the introduction and implementation of many new investment concepts. The explicit integration of environmental and social information into investment decision-making, active ownership strategies, and impact investments made its appearance.

These two sides of the same coin are consistent with how I prepared my frequent interactions as an academic with the responsible investment industry in this period. In the first decade of this century, I was confronted with many sceptical views on the integration of nonfinancial information into investment decision-making. In frequent interactions with the investment community, I tried to show the other side of the coin backed by objective evidence of an increasing number of high-quality

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Maastricht University School of Business and Economics

Table 1
Must-read papers

Paper	Topic
Berg, F., J. Kölbel, and R. Rigobon, 2022, Aggregate confusion: the divergence of ESG ratings, Review of Finance, forthcoming.	The authors show that measurement divergence is the main driver of differing ESG ratings and demonstrate that there is a fundamental disagreement about the underlying data. Measurement divergence is problematic if one accepts the view that ESG ratings should ultimately be based on objective observations that can be ascertained.
Berk, J. and J. van Binsbergen, 2021, The impact of impact investing. Stanford Graduate Business School Working Paper Series (3981).	The authors find that the impact on the cost of capital is too small to meaningfully affect real investment decisions. Empirical results indicate that to have an impact, instead of divesting, socially conscious investors should invest and exercise their rights of control to change corporate policy.
Bolton, P. and M. Kacperczyk, 2021, Do investors care about carbon risk?, Journal of Financial Economics, 142:2, 517-549.	The authors study whether carbon emissions affect the cross section of US stock returns and find that stocks of firms with higher total carbon dioxide emissions (and changes in emissions) earn higher returns. Overall, their results are consistent with an interpretation that investors are already demanding compensation for their exposure to the risk of carbon emissions.
Edmans, A., 2022, The end of ESG, ECGI Finance Working Paper N° 847/2022.	The author states that "ESG" is both extremely important and nothing special. It's extremely important because it's critical to long-term value, and thus any practitioner or academic should take it seriously, not just those with "ESG" in their job title or list of research interests. Thus, ESG doesn't need a specialized term, as that implies it's niche. It's nothing special since it's no better or worse than other intangible assets that drive long-term value and create positive externalities for the wider society, such as management quality, corporate culture, and innovative capability.
Hong, H., F. Li, and J. Xu, 2019, Climate risks and market efficiency, Journal of Econometrics, 208:2, 265-281.	Climate science finds that the trend towards higher global temperatures exacerbates the risks of droughts. The authors investigate whether the prices of food stocks efficiently discount these risks. A poor drought trend ranking for a country forecasts relatively poor profit growth for food companies in that country. It also forecasts relatively poor food stock returns in that country. This return predictability is consistent with food stock prices underreacting to the risks of climate change.

academic studies that had emerged in the meantime. Table 1 lists my current top five of must-reads. However, the last few years I have been regularly confronted with proponents of responsible investing who seem to follow a mantra that deems all activities in this space valuable, worthwhile, return-enhancing, and risk-reducing. This mantra again spurred me to increasingly challenge their opinions by again being inspired by sound academic contributions in the field.[1]

WHAT DRIVES RESPONSIBLE INVESTING?

Why do we expect retail and institutional investors to wholeheartedly embrace responsible investing? This question is not easy to answer. Investors operate in certain legal and societal contexts that are the key drivers in accounting for differences in their sustainable investments. Laws relevant to, for instance, pension funds; the laws' interpretations; and subsequent trajectories differ markedly per jurisdiction, as do regulatory bodies' attitudes towards the responsible investment topic. When browsing legal scholars' contributions to this discussion, references to the prudent person rule often occur (also known as prudent man, prudent investor, or prudent expert) in which prudence and loyalty play important roles. In general, pension fund boards must manage their capital with the care, caution, expertise, and competence that beneficiaries expect from a reasonably competent and reasonably acting pension fund (Maatman and Huijzer, 2019). The loyalty principle requires trustees to give priority to the beneficiaries' interests under all circumstances. If trustees fail to do so and thereby harm their beneficiaries, then they are liable in principle. Failing to investigate the impact of climate change on the risk to investment portfolios, and not acting on obtained insights, could be an example in some jurisdictions (e.g., the EU) of not following the prudent person rule.

Now the question is: what exactly are the best interests of beneficiaries? Is it merely the financial best interest as is the case in (the interpretation of) many Anglo-Saxon law contexts? Or is it also linked to other nonfinancial interests such as the ability to enjoy retirement in a world worth living? Inspired and convinced by recent developments, such as the emergence of the Planetary Boundaries Concept in 2009 (Rockström, 2009) and the launch of the United Nations Sustainable Development Goals (SDGs) in 2015, many institutional investors have started shifting gears in integrating environmental and social information into their objective functions.[2] Contributing to a better world has become part of the mission and vision of many asset owners and, consequently, service providers in the asset management industry. This involvement increased the intensity by which the global financial industry developed new products and services in this domain.

Opponents of this development often claim that investors have no direct role in solving societal problems (US Department of Labor during the Trump administration, 2018 and 2020). They argue that the people allocate this role to parliaments and governments in a well-functioning democracy. In such a context, laws and regulations would make sure that the will of the people – all of us are investors in some way – would be represented adequately in the long term. This logic may apply to some local or national challenges, but which government represents the planet and which environmental laws are truly applied and enforced globally? Moreover, does the average politician have a truly long-term mindset? Probably not. Nonetheless, I agree with these words of caution voiced by opponents, but in another dimension. Having more objectives than instruments is a well-known problem that was put forward by Jan Tinbergen, the first Nobel Prize winner in economics (Tinbergen, 1952). Analogously,

investors do encounter many trade-offs in decision-making, but these are rarely made explicit. Having both financial (e.g., adequate pensions) and nonfinancial objectives (enjoying retirement in a world worth living) may be hard to accomplish with just one instrument: the investment portfolio. At the very minimum, objectives need to be prioritized to avoid confusion or stalemates in investment management (Bauer, Christiansen, and Doskeland, 2022). Additionally, we may search for other instruments, such as better-functioning democracies that make nonfinancial objectives in the investment strategy obsolete.[3]

A related concern is that many asset managers and asset owners focus heavily on "doing good" in their investment strategies. Private investments in energy transition initiatives are good examples. This relatively small subset of investments draws a lot of attention but does not suffer short-term pressures on returns and risks from the public market. It is related to several key SDGs (although the impact cannot always be precisely measured) and often contributes to the reputation of the institutional investors who are involved in it. However, these investors, in my observation, pay much less attention to "doing-no-harm" in such matters: solving the climate crisis will not necessarily remove injustices related to human rights abuses, inequality, workers' rights, and many other topics that fall under SDGs. You simply cannot do it all. This observation is in fact another trade-off which investors must deal with and communicate about. Moreover, budgets for managing the products and services of responsible investments are constrained as well. Diligently checking all portfolio companies for whether they are involved in severe human rights issues in the supply chain is a tedious and costly task. Also, data quality and consistency are not necessarily a given (Berg, Kölbel, and Rigobon, 2022). The same holds for assessing whether these companies adequately compensate stakeholders for the costs and damage occurred. In other words, living up to the promises made in the OECD guidelines or upcoming EU regulation is a difficult task for companies and for those who invest in them. Given these challenges, it is understandable that many investors highlight salient and easy-to-communicate "doing good" investments.

MANAGING THE INHERENT TRADE-OFFS

Agents, including asset owners and asset managers, who supply the products and services of responsible investment increasingly receive guidance and direction from the evolution of hard and soft law in this field. Moreover, civil society organizations (such as NGOs but also beyond) exert influence on both companies and investors. Asset management organizations, insurance companies, and especially pension funds are increasingly being directly targeted on topics related to the environmental and the social challenges of society. Many pension funds in the Netherlands even go one step further. They send surveys to beneficiaries, the "ultimate" asset owners, to elicit their sustainability preferences. Subsequently, the output of these surveys informs boards on the direction and intensity of the responsible investment strategy and how to manage some of the aforementioned trade-offs.

Interestingly, upcoming EU-law (European Commission, 2022) will require investment firms that provide advice and portfolio management services to retail investors to not just inquire about their risk and time preferences but also about their sustainability preferences. The last iteration of this delegated EU regulation, understandably, aims at making sure that financial objectives are not dwarfed by sustainability objectives. Nonetheless, eliciting sustainability preferences may still be associated with some looming risks for retail investors as the measurement of any preferences is not an easy task. Simple survey techniques are prone to potential biases such as misrepresentation and most prominently social desirability (Bauer and Smeets, 2021, and Bauer, Ruof and Smeets, 2021) that subsequently leads to wrongly informed management about clients' preferences. Moreover, commercial service providers may have perverse incentives. From their perspective, guiding retail investors into high-cost sustainable private equity funds may be commercially attractive while it may not necessarily be a proper solution from the perspective of a client's financial objectives. The quality and analysis of surveys need to be checked carefully and independently. Self-regulation by the sector will not be the ultimate answer.

> MANY INVESTORS HAVE BEEN FORMULATING AXIOMS DISGUISED AS INVESTMENT BELIEFS STATING THAT RESPONSIBLE INVESTMENTS WILL LEAD TO HIGHER RETURNS AND LOWER RISKS

However, a strong focus on clients or beneficiaries in the management of trade-offs may reduce the attention to other stakeholders, most notably those that are negatively and directly affected by the companies that these investors have in their portfolio. Balancing these interests between clients and stakeholders, and among stakeholder groups, is another example of the inherent trade-offs in institutional investment decision-making. For some reason, institutional investors' communication strategies do not very often explicitly mention this balancing act. Instead, they have been formulating axioms disguised as optimistic investment beliefs stating that responsible investments will lead to higher returns and lower risks in the long term. These beliefs cannot be true in equilibrium. And, more importantly, financial service providers in the broadest sense must communicate transparently about how they deal with these trade-offs and how they may affect clients and other stakeholder groups.

DIVESTMENT, ENGAGEMENT, OR BEYOND? ANOTHER TRADE OFF

Fuelled by newly stated responsible investment beliefs, institutional investors have developed many different responsible investment products and services. Most of these can be attributed to either divestment strategies, active ownership strategies

(including proxy voting and engagement), and integration strategies.[4]

Again, the decision on which of these strategies to follow is associated with many inherent trade-offs. The recent divestment wave in oil and gas companies by pension funds is an example. Last year, several pension funds (across the globe) announced that they would divest from oil and gas companies. The accompanying communication often stated that this decision would not negatively impact long-term risk-adjusted returns but would positively contribute to solving the climate crisis. Moreover, these investors claimed that this course of action was in line with their beneficiaries' preferences (e.g., ABP, 2021). Generally, these communication statements did not provide enough detail on the assumptions which these decisions were based on, nor on the wide confidence intervals surrounding many of the parameters driving this direction. For instance, does divestment from the oil and gas sector have a negative impact on the diversification and efficiency of a portfolio? What is the impact of the fact that these companies most likely would be increasingly owned by investors who do not care too much about climate change? Subsequently, will this development influence the speed of the global energy transition? Will it affect the cost of capital for fossil fuel firms (see also Berk and van Binsbergen, 2021)? These are questions which are not easy to answer and all of which may be associated with trade-offs between financial and nonfinancial objectives. Many investors shy away from explicitly raising or even answering these questions, or they more aggressively choose to formulate beliefs that make these concerns irrelevant or redundant.[5]

> INSTITUTIONAL INVESTORS MUST CLEARLY STATE THE OBJECTIVES OF THE RESPONSIBLE INVESTMENT STRATEGY INCLUDING THE TRADE-OFFS THAT COME WITH IT

One alternative to divestment is to set up an active ownership "program". In the past decade, many institutional investors have started public and private dialogues with companies on matters related to sustainability and governance in the broadest sense. They have often used external agencies to assist them in managing this process and providing the knowledge and experience necessary for success. In my view (Bauer, 2008), potentially, shareholder engagement can be deemed one of the more sustainable, in the old-fashioned meaning of the word "sustainable", courses of responsible investment action. If investors collaborate (e.g., Climate Action 100+) in targeting companies on financially material sustainability issues, it may well be that companies' trajectories will be positively influenced.[6] However, in this context, there are substantial trade-offs. Which topics should institutional investors focus on? Do clients or beneficiaries play an explicit role in this decision, and if they do, how do other stakeholders' interests weigh in? How successful is engagement in bringing change? And if so, do engagement benefits exceed engagement costs? How are these benefits measured properly and communicated?

We can learn quite a bit on the effectiveness of engagement from the albeit scarce academic literature. For instance, the filing of shareholder proposals with companies in which there is more concentrated institutional ownership is more likely to be successful (Bauer, Moers, and Viehs, 2015). Private engagement on financially material topics has more potential for getting a positive response from targeted companies, although engagement is not successful in most cases (Bauer, Derwall, and Tissen, 2022). Relatedly, collaboration between investors makes engagement on these topics more effective (Dimson, Karakaş, and Li, 2021). There is an abundance of collaborative engagement efforts, nationally and internationally, but which ones to join? Again, several trade-offs do appear. As an asset owner, for instance, the decision to team up with commercial asset managers who may be conflicted because of commercial motives or strictly financial objectives, or who simply may have different intentions and views, is challenging. BlackRock's recent decision (May 2022) to support fewer climate shareholder proposals probably is a good example of how these trade-offs can influence decision-making.[7]

It is also worthwhile to mention that civil society's engagement with companies sometimes may be consistent with investors' objective functions. A good example is the recent engagement effort by Follow This in the oil and gas sector. Since 2015, this Dutch civil society initiative has been pushing oil and gas companies across the globe to follow Paris-aligned decarbonization strategies. It has recently been very successful in influencing several US oil companies to commit to transition paths that are consistent with "Paris" (Follow This, 2022). Interestingly though, in the past few years, I have observed quite often that engagement successes are claimed simultaneously by many institutional investors. As soon as some of the engagement triumphs became apparent, many public statements from asset owners and managers followed rapidly, while many of these investors were not necessarily "ahead of the curve" when Follow This started the engagement program. Some, even now, vote very conservatively on climate-related proposals.

The above shows that divestments and engagement strategies are associated with many trade-offs and uncertainties for decision-makers. Is simply buying companies with a high sustainability score maybe the ultimate answer?

"ESG" INTEGRATION

In the recent past, an increasing number of institutional investors have started integrating sustainability information into their portfolio management, also dubbed "ESG integration". Driven by investment beliefs that are not necessarily grounded in financial economic theory, many investors have created subtle or significant tilts based on financially material information on sustainability in these portfolios. But how sustainable is this

course of action, really? If investors indeed have started pricing the risks and opportunities associated with this information (Hong, Li, and Xu, 2019, and Bolton and Kacperczyk, 2021), the expected returns of highly sustainable companies will be lower because their associated risks (ceteris paribus) are lower. Intangible sustainability information probably is less easy to interpret than financial information, although many of the corporate frauds (Enron is a good example) in the past decades indicate otherwise. Some investors may therefore face difficulties during price discovery which may from time to time provide opportunities for investors who have a deeper knowledge or an information advantage. However, investors will gradually learn, and more and higher quality information will become available that will make it very difficult to keep this advantage.

Interestingly, organizations that represent management and asset owner organizations group their investments by offering combinations of regular equity portfolios that do not use any significant sustainability-related screens and sustainability-tilted investments with varying intensities of ESG integration. This observation of a certain segregation shows that there are most likely other forces at work in these organizations. It is fair to assume that the financial sector attracts (and has attracted) human talent which is interested in allocating and making money. Any restrictions in the way portfolio managers can create portfolios will not be met with a lot of enthusiasm. This context could create tensions in these organizations in which management's strategic decisions to prioritize sustainability objectives are not necessarily applauded by portfolio managers or traders. It will likely slow down achieving whatever objectives have been formulated and lead to inconsistencies in the products and services that are being offered to clients as well as the communication surrounding them.

ENGAGEMENT IS NOT SUCCESSFUL IN MOST CASES

These inherent conflicts of interest can be illustrated with an example (Bauer, Christiansen, and Doskeland, 2022). Targeting companies through active ownership strategies (engagement, proxy voting, threats of divestments, and more) has the objective of helping companies perform better, and as such focuses on the total return space, in contrast to beating a benchmark. For instance, if an investor engages with a chemical company to upgrade its environmental-management system to encourage the company to be better prepared for future legislative changes and to spur process innovations, this engagement may have a positive impact on the company's stock price in the long run. If the engagement is successful in both sustainability and financial performance terms, all investors in that company, including those who did not engage (the free riders), will profit from the rise in the stock price.

Now, suppose that a portfolio manager has invested in this chemical company with a weight lower than the company's benchmark weight. This investment might be the case when the portfolio manager has severe doubts on the viability of the company's general business model. Successfully engaging with this company would increase the total return of the portfolio (ceteris paribus), but the active return versus the benchmark would be negatively affected as the weight versus the benchmark would be negative: if the engagement were successful and the market were to acknowledge that, it would hurt the "alpha" (active return). The target setting and incentive schemes in the asset management sector, to a large extent, are related to active returns versus benchmarks or reference portfolios. Thus, a conflict of interest between strategic objectives and portfolio managers' objectives would be born.

HAVING BOTH FINANCIAL AND NONFINANCIAL OBJECTIVES MAY BE HARD TO ACCOMPLISH WITH JUST ONE INSTRUMENT: THE INVESTMENT PORTFOLIO

Similar examples of potentially conflicting goals can be framed for other active ownership strategies such as filing shareholder proposals, starting class-action lawsuits, and proxy voting. The example shows that the objective to intensify and extend the active ownership effort may be at odds with the objective to "harvest" active returns. It also asks the question: who decides which objective is prioritized in which context? In essence, this is another example of having one instrument (the investment portfolio) and two objectives (active ownership impact and active returns). Again, I wonder what Jan Tinbergen would think of this conflict.

ESG-integration is not the solution to avoid trade-offs and may even be associated with unexpected conflicts of interest. Moreover, it is not clear whether these strategies would in the end offer any superior investment results in the first place. So, what's next (Edmans, 2022)?

THE WAY FORWARD

In my view, the institutional investment industry needs to regroup and rejuvenate in various ways. First, authenticity and a sincere interest in the responsible topic are critical. In too many cases, commercial motives play a central role at the expense of sincerity. Examples of greenwashing (or "cheap talk") by companies and investors are still omnipresent.[8] Clients and beneficiaries who value that their savings and pensions are deployed to support sustainability objectives should be able to trust that their financial service providers are truly interested in and knowledgeable about the sustainability dimension and that they execute the different manifestations of responsible investment strategies authentically and effectively. This execution requires leadership from financial institutions, not just

by issuing fancy external communications by their CEOs, but also by:

- stating clearly, consistently, and earnestly the objectives of the responsible investment strategy as well as making explicit the trade-offs that come with this decision;
- stating explicitly the key beliefs that underpin the responsible investment strategy and the uncertainties that are associated with them;
- evaluating regularly, transparently, and publicly the investment beliefs on which this strategy is based;
- eliciting preferences of clients or beneficiaries by properly using modern elicitation techniques;
- making sure that internal organizations are prepared for the challenge, which implies investing in human capital (including and beyond financial economics);
- creating an organizational culture and compensation structure in which conflicts of interest (internal and external) are minimized, managed, and made transparent to the general public and major stakeholders.

This change in gears will help private and institutional clients to better select the organization they feel most comfortable with given their financial and nonfinancial objectives (Bauer and Smeets, 2015).

SIMPLY SWEEPING TRADE-OFFS UNDER THE RUG IS NOT A SUSTAINABLE SOLUTION

Asset owner organizations, who are the agents of plan participants, have a crucial role going forward. As intermediaries, they must challenge the asset management industry by demanding responsible investment products and services that fit their mission and purpose. Pension plan participants are generally illiterate in both financial and sustainability dimensions. Hence, there is an important role for the leadership of asset owners to elicit their participants' sustainability preferences. Moreover, in the context of the Dutch pension sector, beneficiaries of collective defined benefit schemes are not (yet) able to switch their pension provider which implies that asset owner organizations have a strong responsibility to make sure that they act in the best interest of their beneficiaries. That responsibility requires having an open dialogue on what "the best interest" means, how this interest is going to be prioritized, and whether the strategy is associated with any (financial) trade-offs. A genuine interaction with the membership must exceed the survey instrument; it requires identifying and discussing openly the inherent trade-offs that come with responsible investments. Simply sweeping trade-offs under the carpet is not a sustainable solution.

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Notes

1 This reminds me: the scientific society to which I belong myself also needs to realize that part of the resurgence or continuation of the hype can be attributed to the way academics are incentivized in their publication strategy. Top academic journals do not very likely accept empirical studies that show the absence of significant results when testing a certain hypothesis or research question. This lack of acceptance creates the so-called file drawer problem or bias. For instance, papers that genuinely show that there is no direct link between the diversity and financial performance of an organization are less likely to be published by these journals than papers that show either side of this coin.

2 A good example is PGGM's mission statement: "We work for good, affordable, and sustainable pensions for pension funds – our clients – and their participants. We also contribute towards a liveable world, occupational health and retaining vitality in old age".

3 The recent podcast by Berk and Binsbergen (2022) discusses a similar trade-off: "When it comes to what's good for business and what's good for society, ..., people would like to have it both ways. .... It is unlikely that they can".

4 This category also includes impact investing. However, I do not include this topic as it has many different appearances and interpretations and, as such, falls outside the scope of this article.

5 A good example (one of many) is this statement in the Responsible Investment Framework of AEGON Asset Management: "A growing body of academic research demonstrates that sound ESG practices can enhance corporate financial performance in the long term. This value can manifest itself in the form of lower cost of and access to capital, better operational performance, reduced reputational risks and, in turn, potentially superior long-term returns on investments."

6 However, a recent report by independent think tank Carbon Tracker (2022) shows that 134 highly carbon-exposed companies provided little evidence that they had considered the impacts of material climate-related matters in preparing their financial statements.https://carbontracker.org/reports/still-flying-blind-the-absence-of-climate-risk-in-financial-reporting/

7 Financial Times (2022), May 10 and July 28: https://www.ft.com/content/4a538e2c-d4bb-4099-8f15-a28d0fefcea2 and https://www.ft.com/content/48084b34-888a-48ff-8ff3-226f4e87af30

8 See, for instance, the recent greenwashing accusation of DWS: https://www.ft.com/content/1094d5da-70bf-40b5-98f4-725d50620a5a. Another example showing the ambivalent communication by some investors is Blackrock's letter to Texan trade organizations in January 2021: https://www.tipro.org/UserFiles/BlackRock_Letter.pdf.

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The Determinants of Institutional Capital Allocation to Real Estate

Alexander Carlo, Piet Eichholtz and Nils Kok

Pension funds around the world are increasingly investing in alternative assets, and the most important of these "alternatives" is real estate. We employ the CEM global pension fund database to shed light on the determinants of pension fund allocation to real estate, both over time and in the cross-section. We find that pension funds' strategic allocation to real estate – net of return effects – is the result of the historical performance of real estate relative to other asset classes, and that pension funds quickly adjust their actual allocation rate to their strategic allocation decisions. We do not find evidence of return chasing, and attitudes toward market risk, measured by the credit risk spread and the term spread, do not seem to play a role in the real estate allocation. Finally, while we find that pension fund real estate allocations have increased over time, this is not the case when we correct for capital appreciation: in terms of real estate assets, pension fund portfolios are generally getting smaller, most notably in the U.S.

1 INTRODUCTION

Allocations to alternative assets by pension funds around the world have been increasing over the past decades, and real estate plays a key role in that development. Figure 1 illustrates this trend. The global allocation to alternatives of pension funds reporting to CEM was about 10% in the 1990s and then started increasing to levels of about 20% in the last decade. Overall, allocations to real assets went up from levels of about 5% to 10% in the same period – a doubling of the allocation.

The big "alternatives" trend is still ongoing. For example, CalPERS, the largest pension fund in the U.S., recently announced its intention to increase the allocation to real assets (82% of which is real estate) from 13% to 15% by fiscal year 2023. But even as the numbers show an increased allocation to

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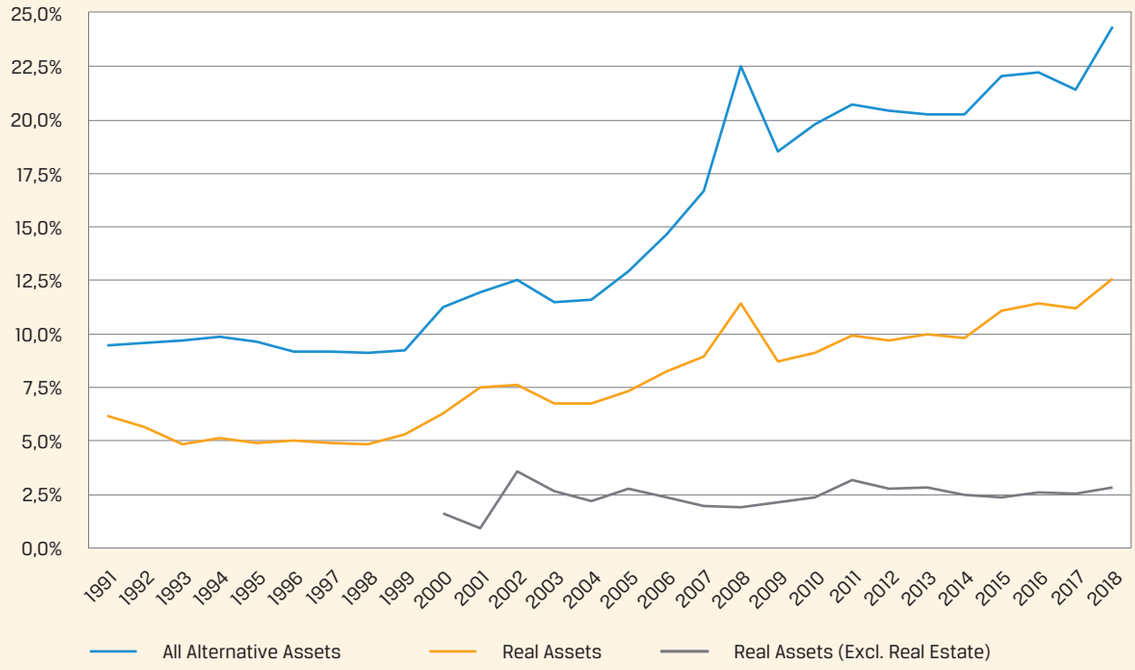
Figure 1



real estate over time, cross-sectional differences between pension funds are substantial. Many pension funds do not invest in the asset class at all, while the Pension Fund for the Dutch Construction Industry, for example, allocates some 20% of its portfolio to real estate. Little is known about the causes of the variation in pension fund real estate allocations, both in the cross-section and over time. This article aims sheds light on pension fund allocation decisions in real estate.
There is some literature regarding allocation decisions and fund flows, but typically not for pension funds, and neither specifically for real estate. Most papers on the subject study both how capital flows affect subsequent returns and how past returns affect fund flows. This has been studied for public equities (Froot et al, 2001), private equity (Gompers and Lerner, 2000; Kaplan and Shoar, 2005), mutual funds (Karceski, 2002), and public and private real estate (Ling and Naranjo, 2003; Fisher et al., 2009).

Froot et al. (2001) show that flows into equities (i.e., stocks) depend on historical returns and find evidence of return chasing. Specifically for emerging equity markets, the authors also find that inflows are predictive of future returns. For private equity, Gompers and Lerner (2000) and Kaplan and Schoar (2005) show that capital flows into private equity funds are positively related to past performance as well. Ling and Naranjo (2003) find return chasing behavior for capital flows into real estate investment trusts (REITs), but only in the short term, but this appears to reverse for periods of two quarters and more. Fisher et al. (2009) study private real estate, both in the short and long run, and do not find that returns to private real estate are predictive of future capital flows into or out of private real estate, either at the national or regional level. In other words, they find no evidence of return-chasing behavior for private real estate.

However, these studies do not examine the source of fund flows. Pension funds are at the top of the investment chain, and their decisions ultimately determine the allocation to different asset classes and investment styles. To date, not much is known about the allocation decisions of pension funds when it comes to real estate. In fact, to our knowledge, there are no papers that study the determinants of pension fund asset allocation choices. The main contribution of our paper is to fill this gap, with a focus on real estate allocations.

THIS ARTICLE STUDIES THE DYNAMICS OF GLOBAL INSTITUTIONAL CAPITAL FLOWS INTO REAL ESTATE, USING INFORMATION ON MORE THAN 1,000 PENSION FUNDS IN THE CEM DATABASE

We use the database of CEM, a Toronto-based company that tracks the investment choices and portfolios of over 1,100 pension funds globally. This database is the richest of its kind and not only provides insights into how pension funds invest in different asset classes, but also provides information on the nature (i.e., public, corporate) and maturity of the fund, the performance benchmarks used, and their strategic allocation to asset classes. Within the real estate allocation, CEM includes both public and private equity investments in real estate, distinguishing between in-house, fund, and fund-of-fund allocation strategies. This database has been used before to study pension fund decision-making, for example by Andonov et al. (2015, 2017, 2022).

In the remainder of this paper, we will first present the data and provide sample statistics from our global pension fund dataset. We then present the statistical methods we use, followed by a section in which we present and comment on the results. We end the paper with conclusions and a discussion of practical implications.

2 DATA AND VARIABLES

For the empirical analysis, we use annual data from 1991 to 2018. The capital flows and return variables, among other pension fund data, are constructed and retrieved from the CEM database. In addition, we extract macroeconomic variables from FactSet as explanatory factors for capital flows into real estate.

THE CEM DATABASE

We use data provided by CEM Benchmarking, a firm providing investment benchmarking services to pension funds all over the world. CEM collects investment data from pension funds through a voluntary online reporting process. The CEM database is the broadest global database on pension fund investments, including plan-level data (e.g., fund size and percentage of retirees), strategic asset allocation goals, investment approaches, investment costs, benchmark choices, and performance data. For a review of other studies using the database, see Carlo, Eichholtz and Kok (2021). The database includes 1,131 unique pension funds across five regions over a 28-year period from 1991 to 2018. Most pension funds are from North America (871 funds). The coverage of European funds has increased substantially over the past two decades, with funds from the Netherlands and the United Kingdom accounting for 87% of the total European subsample. Since the number of European pension funds was very low at the beginning of the sample, we only include European pension funds from the year 2000 onwards.

REAL ESTATE ALLOCATIONS HAVE INCREASED FROM 5.6% TO 8.7% OVER THE PAST 20 YEARS, WHICH IS MOSTLY THE RESULT OF RETURN ON INVESTMENT RATHER THAN ADDITIONAL CAPITAL ALLOCATION

The total assets of all pension funds reporting to CEM increased from USD 612 billion in 1991 to USD 10.1 trillion in 2018. This represents a significant portion of total global pension fund assets, which were recently estimated at USD40 trillion worldwide in 2018. Over the entire sample period, the average size of pension funds was USD33.7 billion, with average real estate holdings of USD1.5 billion. The European pension funds reporting to CEM and investing in real estate are significantly larger than their North American counterparts, with an average size of USD46.3 billion and USD1.53 billion in real estate holdings (in 2018), compared to an average size of USD25.7 billion and average real estate holdings of USD1.3 billion for the North American funds. Pension funds from the "Rest of the World" region had an average size of USD129 billion in 2018, but this is driven by a small number of very large funds in the Middle East, China, and South Korea.

We exclude pension funds that do not invest in real estate (see Andonov et al. 2015 for an analysis of real estate allocations at the extensive margin, i.e., the binary choice of investing in real estate, or not). In total, we have 907 pension plans in our sample that invest in real estate, with 6,537 fund/year observations. This implies that the average pension plan investing in real estate remains in the CEM panel for about 7.6 years. For these funds, we collected net asset value for all asset classes and their respective returns net of fees, the strategic asset allocation targets, the percentage of retired members, the size of the fund, and the type of plan (i.e., public and corporate). Within the real estate allocation, we further distinguish between public (i.e., REIT) investments and private investments in real estate.

Table 1
The CEM Database

	U.S.	Canada	Europe	Rest of World	Overall
Panel A: CEM Coverage					
#Funds in data	611	260	227	33	1,131
#Funds in RE	482	183	212	30	907
#Observations	3,704	1,651	1,023	159	6,537
Avg. Size USD bn	27.4	22.3	46.3	129.4	33.7
Avg. RE Holdings USD bn	1.2	1.5	1.6	2.8	1.5
Panel B: Relative allocation to real estate					
Min	0.0%	0.0%	0.0%	0.0%	0.0%
Average	4.6%	5.5%	6.4%	5.3%	5.2%
Max	32.9%	23.9%	26.8%	28.4%	32.9%
Panel C: Fund level data					
% Public	49.2%	54.6%	25.0%	12.1%	37.2%
% Corporate	50.8%	45.4%	75.0%	87.9%	62.8%
% Retired Members	41.7%	40.9%	30.7%	19.7%	38.3%

Note: This table provides descriptive statistics of the pension fund data that we use in the CEM database. Panel A shows the coverage of the CEM database. *Avg. Size USD bn* and *Avg. RE Holdings USD bn* are both reported for the year 2018. Panel B shows the minimum, maximum and average relative allocation to real estate with respect to other asset classes. Panel C displays the percentage of funds that are public and corporate, together with the percentage of retired members in all pension funds for each region and for the entire sample.

FACTSET

From FactSet, we download several macro variables that we use as explanatory variables for capital flows into real estate, including the 1-year government yield, the 10-year government yield, and the 10-year corporate yield. We also incorporate the term structure by taking the difference between the 10-year and the 1-year government yield (Government Yield Curve). Finally, we create a credit spread (Credit Spread) variable, which is calculated as the difference between the 10-year corporate bond yield and the 10-year government bond yield. Table 2 provides

sample statistics. We observe substantial heterogeneity in the cross-section (i.e., across countries) and over time, which we will further examine in our analysis.

Table 2
FactSet Data

	U.S.	Canada	U.K.
Panel A: Pre-Global Financial Crisis			
10Y Government Yield	4.2%	4.0%	4.5%
1Y Government Yield	3.0%	3.4%	4.6%
Government Yield Curve	1.2%	0.0%	–0.2%
10Y Corporate Yield	6.3%	5.8%	5.6%
Credit Spread	2.0%	1.3%	1.1%
Panel B: Global Financial Crisis			
10Y Government Yield	2.9%	3.1%	3.7%
1Y Government Yield	0.4%	0.8%	0.5%
Government Yield Curve	2.6%	2.4%	3.2%
10Y Corporate Yield	6.9%	6.6%	7.2%
Credit Spread	4.0%	3.5%	3.5%
Panel C: Post-Global Financial Crisis			
10Y Government Yield	2.2%	1.9%	1.7%
1Y Government Yield	0.7%	1.0%	0.4%
Government Yield Curve	1.5%	0.8%	1.3%
10Y Corporate Yield	4.5%	4.1%	3.7%
Credit Spread	2.3%	2.2%	2.0%

CAPITAL FLOWS INTO REAL ESTATE

Figure 2 shows the evolution of the total allocation to real estate for pension funds reporting to CEM. The overall allocation has increased from USD28 billion in 1991 to approximately USD 820 billion in 2018.[1] This translates into an increase in allocation to real estate from 6.2% to 8.7%, relative to all other asset classes. This increase has been largely monotonic, except for a small decline during the global financial crisis in 2008 and 2009.

It is critical to note that the overall increase in allocation over time is not only the result of additional capital flows allocated to the asset class but is also a result of the net return earned on existing pension plan investments. Since it is our goal to model the dynamics of global institutional net capital flows *into* and *out of* real estate, it is important to distinguish between return and net capital flows as the two sources of change in real estate allocations. Therefore, we break down the change in the total real estate allocation into a return component and a capital flow component. First, we measure the annual total change in allocation as the change in the net asset value of the real estate mandates. Then we subtract the net return earned during the year from the total change in allocation. The remaining value is the change in allocation due to capital flows alone. Equation 1 shows the mathematical expression we use to obtain our capital flow variable:

$$CapitalFlow_{i,t} = NAV_{i,t} - NAV_{i,t-1} - [NR_{i,t} * NAV_{i,t-1}] \quad (1)$$

with NAV denoting the intrinsic value and NR the net return, for pension fund i in year t. Generally, when pension funds set their strategic asset allocation target, they commit capital that is not necessarily deployed immediately. In our analysis, we cannot distinguish between capital pledged by a pension fund to a private equity fund (i.e., committed capital) and deployed capital. As a result, in our paper, we assume that the NAV primarily captures the deployed capital.

Panel A of Figure 3 shows the annual capital flows to real estate. In the years before the global financial crisis (hereafter "GFC"),

Figure 2

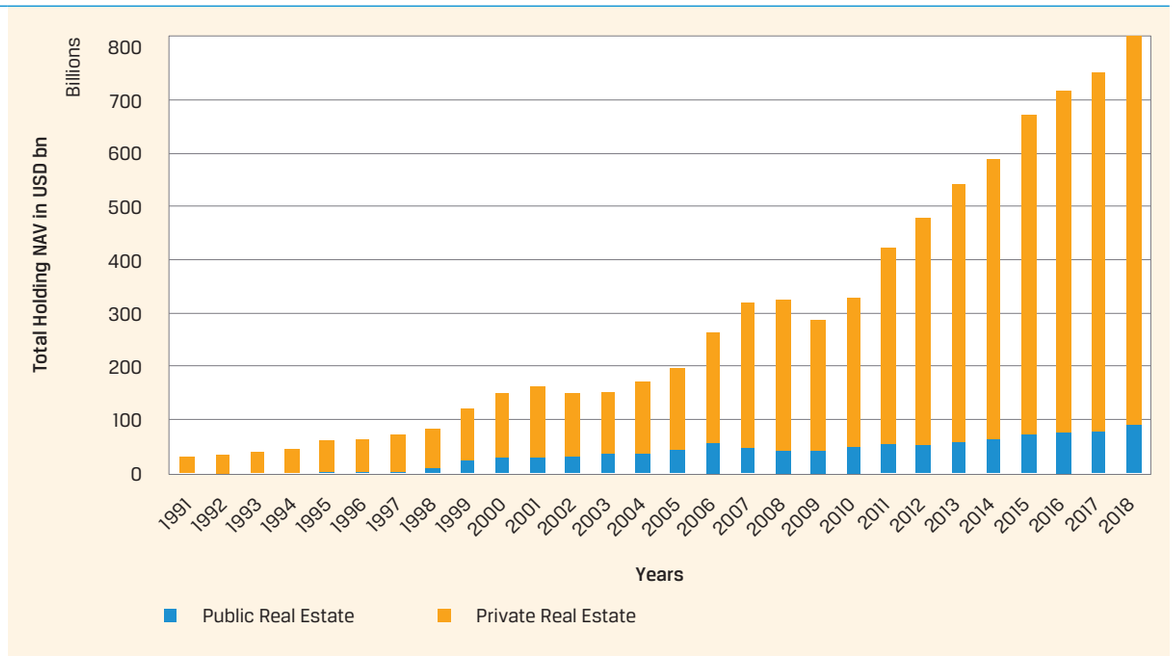
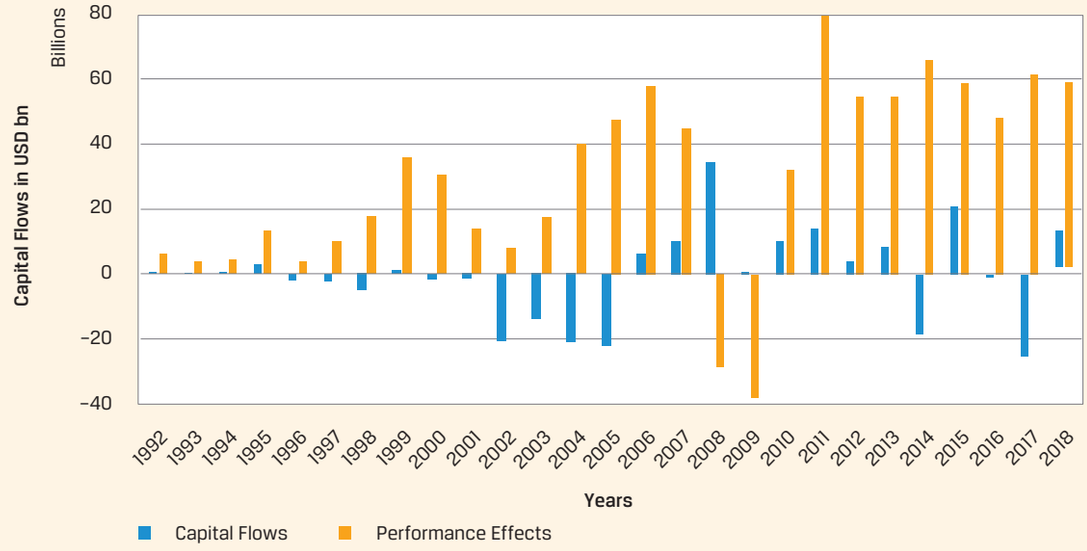
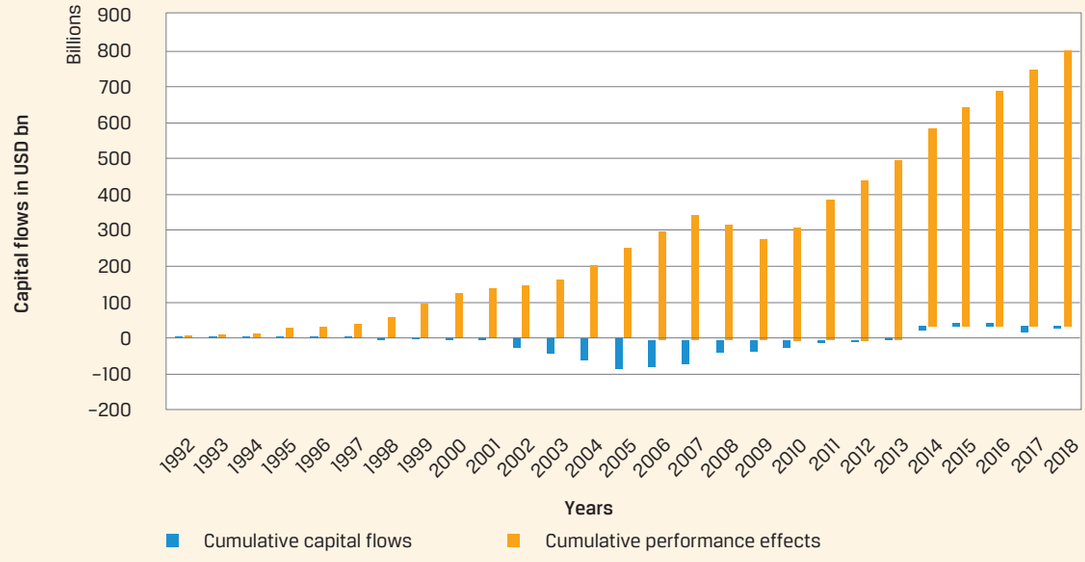


Figure 3

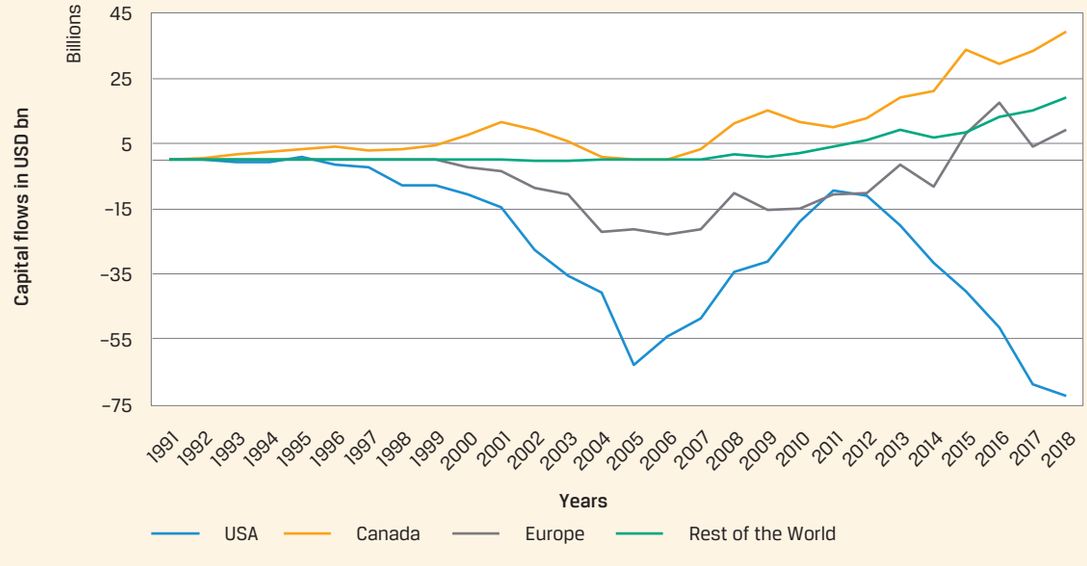
Panel A



Panel B



Panel C



the increase in allocation to real estate was primarily due to the positive returns achieved on existing investments. In total, the cumulative absolute real estate returns achieved by the pension funds in our sample up to the year 2007 amounted to about USD356 billion, while about USD67 billion was taken out of real estate mandates during this period (see Panel B of Figure 3). So, the strong returns on real estate allowed pension funds to take capital out of the asset class, while still maintaining their targeted allocation weight to the asset class. One reason could be that pension funds are pulling capital flows out to meet their pension obligations. Another reason could be that pension funds take money out of the asset class to strictly adhere to their strategic asset allocation target. We explore these possibilities later in the article.

We observe the opposite trend during and just after the GFC. When returns turned negative in 2008 and 2009, capital flows to real estate amounted to USD 35 billion and USD 850 million, respectively. It is noteworthy that when the asset class recovered from the crisis and started to post positive returns, net capital flows to the asset class remained positive until the year 2014. One possible reason for this observation is that pension funds aimed to adjust their real estate allocation to pre-crisis period levels, compensating for losses during the crisis (or, of course, to time the market).

WE FIND NO EVIDENCE OF "RETURN CHASING" FOR THE ALLOCATION TO REAL ESTATE BY PENSION FUNDS, WITH PENSION FUNDS RATHER TAKING MONEY OFF THE TABLE AFTER PERIODS OF STRONG PERFORMANCE (AND VICE VERSA)

Figure 3C shows the cumulative sum of capital flows from 1992 to 2018 for each region in the database. Interestingly, Panel C shows considerable heterogeneity across regions. Most notable is the position of pension funds from the U.S. relative to funds from the other regions. Across the sample, U.S. pension funds cumulatively withdrew more capital than they contributed to real estate (i.e., $72.6 billion). Pension funds in the other three regions cumulatively made net contributions to the asset class. In 2018, net cumulative capital flows for Canada, Europe, and the rest of the world were USD39 billion, USD9 billion, and USD19 billion, respectively. Overall, we find that total capital flows into real estate have fluctuated substantially over the past decades, with substantial regional heterogeneity.

THE INTERACTION BETWEEN FLOWS AND RETURNS

Figure 4A shows global annual capital flows into real estate, measured in billions of U.S. dollars, and the value-weighted net returns over the same period. Panel B shows capital flows for private real estate, and panel C for public real estate. In all three panels, we see a clear negative correlation between asset class returns and capital flows. This is especially evident in the years before the global financial crisis. Between 1991 and 2005, the weighted net return of all real estate was positive every year, while capital flows were negative.

For both private and public real estate, money was taken off the table before the GFC because of the positive returns achieved during that period, but during the global financial crisis, when real estate mandates produced negative returns, capital flows were positive. This is mainly due to the capital flow into private real estate, which has been positive for all years from 1992 to 2014, even though returns had already turned positive by 2010. As stated earlier, a possible reason for this is that pension funds want to increase the allocation back to their strategic goals and add capital to offset the losses incurred.

3 EMPIRICAL APPROACH

The previous section showed some nonparametric insights into the dynamics of capital flows into real estate relative to net returns. However, there are likely more factors that influence capital flows into real estate over time and across pension funds. Using the constructed capital flows variable from equation (1) we perform the following pooled OLS panel regression:

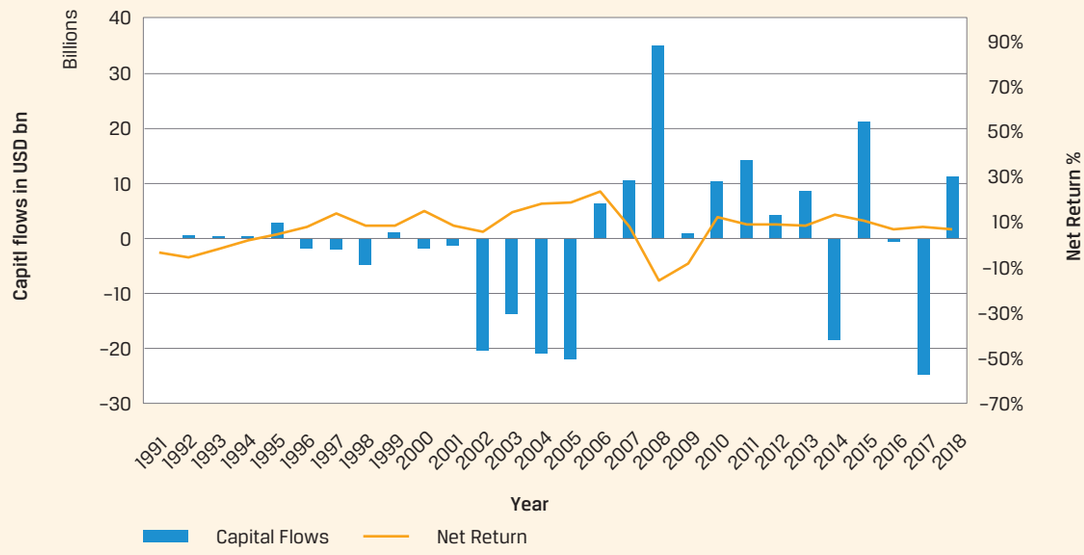
$$
\begin{aligned}
&CapitalFlow_{i,t} \\
&\quad = \beta_0 + \beta_1 RE_{i,t-1} + \beta_2 FI_{i,t-1} + \beta_3 S_{i,t-1} + \beta_4 OtherAlter_{i,t-1} \\
&\quad + \beta_5 BM_Outperformance_{i,t-1} + \beta_6 DiffAll_{i,t-1} \\
&\quad + \beta_7 \%RetiredMembers_{i,t} + \beta_8 Gov10Y_{i,t} + \beta_9 YieldCurve_{i,t} \\
&\quad + \beta_{10} CreditSpread_{i,t} + \beta_{11} Public_i + \beta_{12} SizeQuintiles_{i,t} + YD_t \\
&\quad + Region_i + \mu_{i,t}
\end{aligned}
$$

HISTORICAL PERFORMANCE VARIABLES

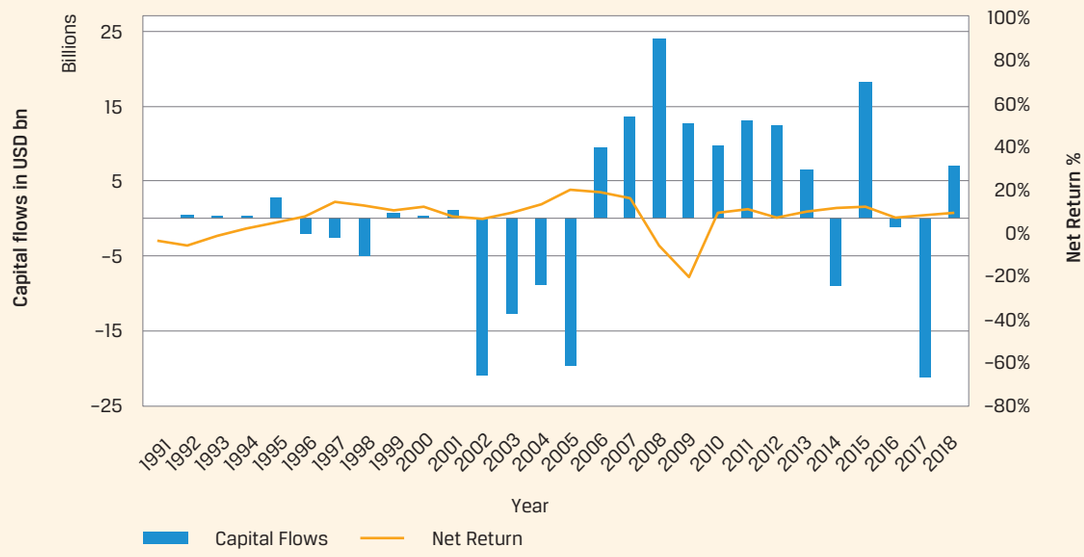
$CapitalFlow_{i,t}$ refers to the composite capital flows variable. We first look at returns to real estate and the other major asset classes as explanatory variables. $RE_{i,t-1}$, $FI_{i,t-1}$, $S_{i,t-1}$, and $OtherAlter_{i,t-1}$ are the NAV-weighted lagged net returns for the real estate, fixed income, equity, and "other alternatives" asset classes of pension fund i. $FI_{i,t-1}$ is added to control for possible "search-for-yield" behavior, which would be reflected in a negative coefficient. $S_{i,t-1}$ and $OtherAlter_{i,t-1}$ are added to control for possible different dynamics between the returns of these respective asset classes and the capital flows into real estate. Under $OtherAlter_{i,t-1}$ we group private equity, hedge funds and the other real asset classes: infrastructure and natural resource mandates. $RE_{i,t-1}$ is added to test for possible "return chasing" behavior by pension funds (in the spirit of Ling and Naranjo, 2003). Furthermore, we add interaction variables between historical performance and a pre-GFC and GFC period. The pre-GFC dummy is equal to 1 for the years before 2008, while the GFC dummy is equal to 1 for the years 2008 and 2009. $Region_i$ represents the region fixed effects, YD_t are the year dummies, and $\mu_{i,t}$ are the idiosyncratic errors. We perform this model specification for both private and public real estate and cluster the standard errors at the fund and year level to control for potentially correlated performance shocks within pension funds and across years.

Figure 4
Note: The bar charts represent the capital flows in USD bn to real estate, while the line graphs represent the net returns earned on the respective real estate portfolios.

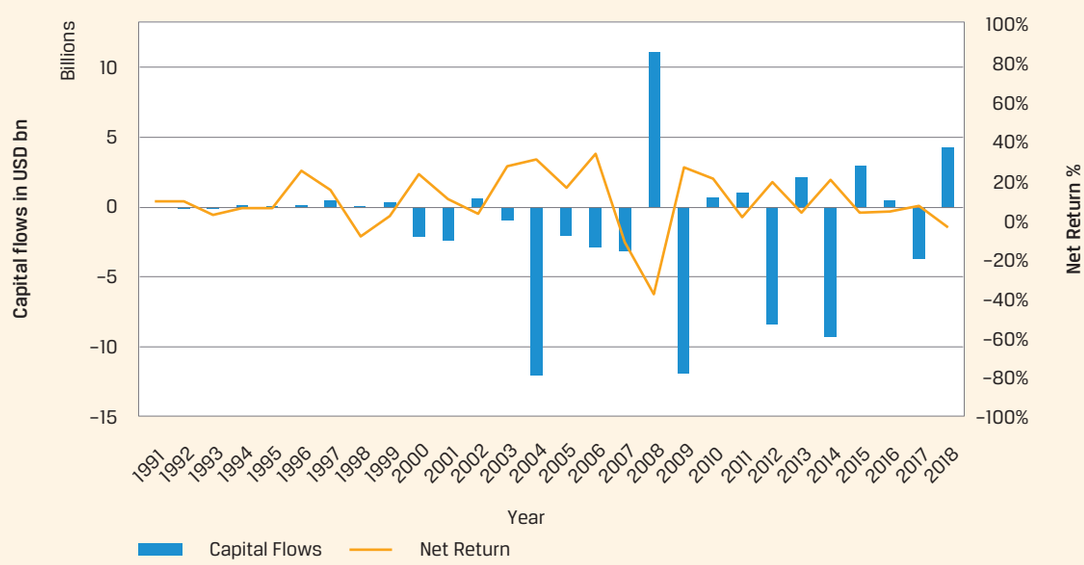
Panel A
All Real Estate



Panel B
Private Real Estate



Panel C
REITs



STRATEGIC ASSET ALLOCATION OBJECTIVE

One possible reason for the link between capital flows and real estate returns is that pension funds strictly follow their predetermined strategic asset allocation target. Thus, capital flows into and out of real estate could partially reflect the mechanism behind how pension funds adjust their actual allocation toward the target allocation. This is measured by including the control variable $DiffAll_{i,t-1}$, which is constructed as the difference between the target allocation (as reported by the pension fund) and the actual relative allocation. In other words, when the variable is positive, it means that pension funds have an allocation to real estate that is too low relative to the target weight, and vice versa.

LIQUIDITY ISSUES

We include the percentage of retirees in the pension plan to control for pension plan liquidity requirements. A high percentage of retirees relative to the total number of participants could indicate the need for asset classes with higher cash returns, which could make real estate investments more attractive. Thus, we would expect a positive regression coefficient for this variable.

MACROECONOMIC INDICATORS

We further add three macroeconomic indicators as explanatory variables. First, the yield on 10-year government bonds (*Gov10Y*) as a measure of general investment sentiment and the extent to which investors are "searching for yield." We also incorporate the term structure by taking the difference between the 10-year and 1-year government bond yields (*Yield Curve*). This is a measure of investors' time preference, which can influence their choice of long-term and private assets over more liquid assets. A larger time spread implies that investors are less interested in long-term cash flows, which would make real estate less attractive. Finally, we incorporate risk preferences into the market by adding a credit spread (*CreditSpread*) variable, which we construct as the difference between the 10-year corporate bond yield and the 10-year government bond yield.

4 RESULTS

We show the results for allocations to private real estate in Table 3 (results on REIT allocations are reported separately). Column (1) presents the results of the basic specification, in which the main explanatory variable is the one-period lagged return to private real estate mandates. This shows a negative and significant relationship between lagged returns and capital flows to real estate. A one-percentage point increase in the net return on private real estate mandates leads to a negative capital flow from the asset class of $561 million in the following period. Interestingly, we find that the interaction coefficient with the GFC dummy is positive and statistically significant at the 10% level. This means that during the GFC the relationship changed from negative to positive, for a total effect of USD256.6 million for the average pension fund (-560.2+816.8). During the depths of the financial crisis, pension funds did not take advantage of market dislocations, but rather liquidated (more) positions, taking money out of real estate.

Table 3
Capital flow to private real estate – (one-year lag)

	1	2	3	4
RE_t-1	-561.2**	-623.5**	-641.6*	-587.3**
	(208.3)	(239.4)	(258.0)	(190.0)
lagRet_Rre x D_PreGFC	494.5	570.5	587.6	115.7
	(299.8)	(383.1)	(388.1)	(1,102.2)
lagRet_Rre x D_GFC	814.8*	908.6*	921.5*	888.2*
	(361.8)	(369.3)	(375.8)	(421.8)
FI_t-1		-379.5*	-377.5*	-73.77
		(171.8)	(170.3)	(172.3)
S_t-1		326.5*	331.1	187.5
		(200.6)	(199.6)	(173.6)
Alter_t-1		6.988	5.463	20.98
		(72.79)	(73.06)	(111.1)
BM_OutPerformance			-0.1636	8.382
			(22.73)	(31.00)
Diff_All				1,744.7*
				(816.6)
% Retirement Members				-161.8*
				(79.82)
Gov10Y				-51.19
				(46.24)
Yield Curve				-41.52
				(34.85)
Credit Spread				12.24
				(71.04)
Public	47.89**	49.23*	51.96*	25.45
	(17.81)	(23.34)	(22.72)	(21.17)
Size_quintile 2	5.649	6.719	6.478	7.583
	(10.43)	(14.26)	(13.94)	(13.46)
Size_quintile 3	14.62	13.43	12.59	2.012
	(12.29)	(15.33)	(15.14)	(16.16)
Size_quintile 4	16.83	14.78	16.12	-2.632
	(17.10)	(19.21)	(18.10)	(18.55)
Size_quintile 5	36.74	0.4476	1.959	-120.0
	(67.33)	(60.89)	(58.23)	(76.77)
YD	Yes	Yes	Yes	Yes
#Obs	4,040	3,077	3,072	1,835
R^2	0.029	0.046	0.0467	0.054

Note: Standard errors are shown in brackets and the significance levels are reported with *, **, ***, which match with 0.10, 0.05, and 0.01 respectively.

The second specification, shown in Column (2), adds the lagged returns on other major asset classes to the model, which yields two interesting observations. First, the coefficients for the lagged returns on fixed income are negative and statistically significant. This could indicate a possible search for returns. If the returns on low-risk assets, such as bonds, fall too much, pension funds may search for yield by moving higher up the risk ladder, possibly leading to a higher allocation to real estate. Korevaar (2022) gives a discussion and analysis of this phenomenon. On the other hand, the coefficient on the lagged return of the government equity portfolio is positive and statistically significant at the 5% level. This may be because high returns increase the allocation to government stocks, forcing

pension funds to increase the flow of capital to real estate to maintain their strategic asset allocation target.
In Column (3), we also control for the possible outperformance of the pension fund's benchmark in the previous period, but we find no statistically significant effect for this variable.
Finally, in Column (4), we add the variable "*Diff All*" to the macroeconomic indicators. For "*Diff All*", we find a negative and significant coefficient, implying that the strategic objective of asset allocation to real estate seems to matter for the actual allocation. For the macroeconomic indicators, we find relationships in the expected direction, but no statistical significance. First, we see that the coefficient on the 10-year government interest rate is negative, as we would expect.
This could be a reflecting of a search for yield by pension funds. We see that the coefficient for the yield curve is also negative, which is to be expected because a steeper yield curve implies lower investor demand for long-term cash flow, which likely includes real estate. Finally, the coefficient for the credit spread is positive, but not statistically significant.

PENSION FUNDS DO SEEM TO ENGAGE IN A "SEARCH FOR YIELD," INCREASING REAL ESTATE ALLOCATIONS WHEN YIELDS ON FIXED INCOME ASSETS ARE LOW.

Overall, the results reported in Table 3 for all four specifications indicate a negative relationship between lagged returns and capital flows to private real estate. The fourth specification shows that a one percent increase in the net return results in a total of USD587.3 million taken off the table for the combined sample of pension funds. This negative relationship is even more evident when we look at the coefficients of the interaction of lagged returns with the pre-crisis and crisis dummies. Interestingly, the coefficients on the lagged return on the fixed income portfolio are negative and statistically significant for three out of four specifications. The coefficient on the interest rate variable points in the same direction, suggesting that pension funds are for searching yield. The results for the macroeconomic indicators all move in the right direction but are not statistically significant for our sample of pension funds.

PUBLIC REAL ESTATE ALLOCATIONS

For private real estate, it is relatively difficult to change the allocation quickly, given its illiquidity. Therefore, we also study the public real estate holdings by pension funds. The regression results for the model that explains capital flows to listed real estate are shown in Table 4, which has the same structure as before. In Column (1) we see that, in contrast to the results for private real estate, the coefficient on lagged returns to real estate mandates is positive, albeit statistically insignificant. We see that the relationship between capital flows and lagged returns on the REIT portfolio is positive, but never statistically significant in any of our model specifications. This is surprising given that it is much easier to adjust the public real estate portfolio than the private real estate portfolio. In Column (2), we see that the coefficient on fixed income portfolio returns is positive, but statistically non-significant, while the coefficient on equities is negative and statistically non-significant. Neither the public market sentiment nor the performance of fixed income portfolios seems to affect the capital allocation to REITs.

In the most complete specification, shown in Column (4), we find that all variables are still statistically insignificant, except for "Diff All." In other words, as the "underallocation" to public real estate increases by 1 percentage point, capital flows to publicly listed real estate increase by $1.3 billion. This result is statistically significant at the 5 percent level. Overall, the results

Table 4
Capital flow to public real estate – (one-year lag)

	1	2	3	4
RE_t-1	1.644	11.47	42.95	110.7
	(44.66)	(49.97)	(60.03)	(71.65)
lagRet_Rreit x D_PreGFC	-82.27	-64.72	-81.30	63.43
	(148.2)	(189.1)	(192.5)	(396.8)
lagRet_Rreit x D_GFC	-29.49	-51.90	-68.81	-228.2
	(60.78)	(83.16)	(84.89)	(126.0)
FI_t-1		59.42	69.92	174.0
		(81.24)	(82.27)	(119.5)
S_t-1		-179.9	-201.6	-114.3
		(106.1)	(109.8)	(165.0)
OtherAlter_t-1		-33.43	-40.03	69.09
		(70.60)	(72.17)	(65.65)
BM_OutPerformance			-12.56	-11.51
			(14.49)	(17.10)
Diff_All			1,131.0*	1,301.8*
			(453.8)	(572.3)
% Retirement Members				115.0
				(97.74)
Gov10Y				20.02
				(41.77)
Yield Curve				-1.367
				(25.64)
Credit Spread				36.97
				(81.71)
Public	19.55	20.64	22.50	19.14
	(13.31)	(14.29)	(14.81)	(13.09)
Size_quintile 2	5.624	9.886	13.17.	15.81
	(7.592)	(8.712)	(7.957)	(13.09)
Size_quintile 3	-2.120	1.980	5.854	8.553
	(6.264)	(7.905)	(8.057)	(11.49)
Size_quintile 4	-18.63	-12.10	-8.846	-8.340
	(11.45)	(11.44)	(10.59)	(11.86)
Size_quintile 5	-65.41*	-72.31**	-69.79**	-74.50*
	(25.84)	(26.13)	(25.21)	(25.83)
YD	Yes	Yes	Yes	Yes
#Obs	1,017	850	846	638
R^2	0.052	0.065	0.073	0.085

Note: Standard errors are shown in brackets and the significance levels are reported with *, **, ***, which match with 0.10, 0.05, and 0.01 respectively.

in Table 4 show that capital flows to REITs depend primarily on the under or over-allocation of the public real estate portfolio relative to the target and not on the historical performance of the public real estate portfolio or any of the other asset classes.

5 CONCLUSION

Pension funds stand at the top of the institutional investment pyramid. Pension fund allocation decisions largely determine capital scarcity or capital excess for various asset classes, including private and public real estate. Yet, we know little about these allocation decisions. This article aimed to shed light on the dynamics of global institutional capital flows into real estate. We look at the universe of pension funds reporting to CEM, which represents about a quarter of total global pension fund assets. Over the past 25 years, these pension funds have gradually increased their allocation to real estate, in absolute and in relative terms. The average allocation to the asset class was 8.7% in 2018, the last year of our sample period, compared to 5.6% in 1998. However, some funds are not investing in the asset class at all, and other funds structurally allocate more than 20% to real estate. We use a panel regression to examine both the dynamics over time and the spread across pension funds. We first explore whether past returns to real estate and other asset classes affect pension funds' capital flows into and out of real estate. A key question is whether investors engage in return chasing: the extent to which capital flows into an asset class are influenced by past returns of that asset class. We find no evidence of return chasing for the allocation to real estate by pension funds. On the contrary, pension funds reduce their holdings after achieving positive returns on their real estate investments, and increase their holdings after bad returns, presumably to stay in line with their strategic asset allocation. We also find evidence of pension funds increasing their real estate investments after periods when their fixed-income investments have delivered weak returns. This could be a sign of a "search for yield," with pension funds moving up the risk ladder after experiencing poor returns on their lowest-risk assets. This is consistent with the risk behavior observed in U.S. pension plans due to low funding levels and high return expectations (Andonov et al., 2017). Liquidity considerations do not seem to play an important role in the decision to invest in real estate, as we find no significant difference in real estate allocation between funds with different ratios of retired to active members.

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Note

1 The increase in capital flows towards real estate is still observable when correcting for the increase in the number of pension funds reporting to the CEM database over the sample period.

Not yet over: 2008

I had only just started as editor in chief of VBA Journaal when the credit crisis ('the global financial crisis') erupted. This event had a huge impact on both my professional life and my personal life. The investment funds that I oversaw were at risk of collapsing, banks were being held afloat with all sorts of buoyancy aids and the media were asking me to explain all this. My children, who were still very young at the time, wondered whether cash machines would continue to dispense money and whether their grandparents' pensions were safe. My own portfolio halved in value. Through robust government intervention, the problems were controlled relatively quickly.

The most common explanation for the credit crisis is that the neoliberal market system failed. The fact that the markets – and especially the financial sector – were given a free rein, made it possible for lending to grow unconstrained. US families in particular, took on huge amounts of debt in order to maintain their spending behaviour. The mortgages that were granted – including sub-prime loans – were converted into tradable bonds. When the crisis erupted the risks were not clear – how large they were and who was exposed to them. Everyone – investors, supervisory authorities and the man in the street – was in the dark. As a result, the market collapsed and in a number of countries there were long queues of people outside closed bank branches and empty ATMs. If you would like to relive all this, just watch *Boom Bust Boom*.

Advancing insight

As time went on, my view on this crisis and its causes changed. I have come to the conclusion that the one-sided view on those causes needs to be revised. Is the neoliberal market system indeed the only cause, or were there more complex underlying reasons?

The1980 structure break

The credit crisis happened almost 30 years, after the big change in course that took place in the early 1980s, when the central banks in the Western world, led by Paul Volcker, took unprecedently tough measures to end the stagflation of the 1970s. By means of draconic interest rate hikes they forced a deep recession, which caused unemployment to rise sharply. This shock therapy proved remarkably effective. The power of the labour unions was broken, and consequently wage rises did not keep up with inflation. The lower rate of inflation allowed bond yields to come down, also in real terms. This allowed companies to start investing in their businesses again. The modest wage trend led to a recovery of corporate profits, which caused share prices to rise. All this resulted in an exuberant development of financial sector: the value of financial assets rose sharply. No price inflation, but asset inflation.

But that was not the only change. In many Western countries, governments withdrew from various sectors. Several sectors, including telecommunications, airlines and also banking, were liberalised. Meanwhile we also saw far-reaching global integration of the real sector ('main street'). Companies in the Western world transferred their production activities to emerging countries. This enabled them to control wages even more effectively and indirectly also eroded the power of the labour unions even further. The internationalisation of the corporate sector – particularly the financial sector – further weakened the grip that governments and regulatory authorities had on companies with international operations. This had various consequences. One example is the emergence of large platform companies, that operate worldwide and are very good at reducing their effective tax rate by means of fiscal arbitrage. The banking sector also got better and better at arbitraging against the supervisory rules. The rapid growth of securitisation allowed a rapid expansion of lending, evading the pressure of solvency supervision. The national regulators increasingly lost their grip on financial institutions. A good example is that in early 2008, when the first large cracks in the financial system and also in the real world were already clearly visible, ING pressured DNB to allow it to repurchases shares. This would reduce the bank's solvency, which DNB had issues with. But because ING threatened to leave the Netherlands, DNB nevertheless agreed. A few months later, ING had to ask the Dutch government for support.

Due to the rapid growth of lending that preceded the credit crisis, combined with the rising value of financial assets, the financial sector came to represent an increasingly large section of the economy. In its assessment of the credit crisis, the Netherlands Scientific Council for Government Policy refers to the concept of 'too much finance'. In the Western world, a structural discrepancy in the balance between the real economy and the financial sector developed. Governments did little to address this. They did not impose stricter solvency requirements and neither did they take steps to address the tax benefits of taking on debt, and continued to facilitate

pension accrual. Every country, its government and its people, took pride in its growing and increasingly international financial system. Companies took full advantage of this competition between financial centres.

The mistakes of 2001 and what went before

In early 2001 several events occurred that culminated in the credit crisis. In the course of 2001 the Internet hype came to a painful end. Share prices fell over 50%. The share price falls were reinforced when news about a series of frauds at large companies emerged. But these problems faded into insignificance compared with the disastrous impact of events such as the destruction of the twin towers on September 11. The authorities had little choice but to cut interest rates. Especially in order to control short-term panic, they had to use the interest rate instrument to calm things down. This is what they had learned during the previous, brief, financial crisis at the time of the implosion of Long Term Capital Management in 1998. The so-called Greenspan put had become a 'magic tool'. Greenspan also saved the system after Black Monday in 1987.

Combined with other policy errors, the deployment of the interest rate weapon also had some very negative side effects. The low interest rate level resulted in a sharp increase in lending. This rapid expansion was possible because the sharp increase in credit demand could be met by means of tradable mortgages. This form of lending took place within a barely regulated circuit of shadow banks, relying on the risk models of the banks and those of rating agencies. Their effectiveness was not tested by the authorities and was based on limited historical data. In hindsight, these models were seriously flawed. For instance, the risk of a systemic crisis was not taken into account and neither were assessments adjusted for changes in economic conditions.

Especially the US government was a major contributor to the credit explosion. Owing to a generous system of credit guarantees, low income groups and borrowers with little security also got access to mortgages. This resulted in risky behaviour by all parties involved. Financial institutions generously provided loans, because the government would foot the bill. Borrowers took on huge loans, because in case they defaulted they would be able to transfer their asset to the bank. Society became the big loser.

The policy mistake of 2001 was that the authorities assumed that spending would recover if household expenditure was boosted by cutting interest rates. It would have been better if instead something had been done to address the eroded income position of households. The chosen policy option ignored the fact that families had little or no financial resistance. Quite the opposite in fact, as they were being seduced to take on even more risk. Of course bankers behaved reprehensibly by providing virtually unlimited credit, but it was the government that made that very easy for them.

The government keeps coming to the rescue

Even when in 2008 the crisis had become reality, the government played a remarkable part. In most Western countries large-scale bailouts took place. In the US as well as in Europe, central banks and governments threw the financial sector some costly lifelines. This was a classic case of 'Privatizing Profits and Socializing Losses'. Time and again, the government has acted as the ministering angel and even kept paying bankers' bonuses.

Whoever thought that after 2008 we would have learned our lessons, will be disappointed. After 2012 central bankers and governments again proved willing to come to the rescue the financial sector. Greece, despite years of deceit, was effectively bailed out. The ECB is prepared to add the debts of defaulting European countries to its balance sheet. This rewards the refusal of various countries to restructure their economies and once again we are saving the financial institutions. Even during the Covid crisis, the government stepped into the breach, although the nature of the crisis made this inevitable. But the current energy crisis again forces the government into its role of ministering angel. The cost of the shocks is largely being borne by society. Partly because in the wake of a crisis, a rapid rollback of the measures taken, including a rapid reduction of repurchase programmes, proved and is still proving difficult for political and institutional reasons. *If you press down hard on the accelerator, you must also be prepared to brake very quickly and very hard.*

Are the problems that we are currently facing really only due to the neoliberal policy model? This view is too one-sided, because there is more at play. The government applied too little counterforce 40 years ago, when it set out on the path of liberalisation. The position of workers was allowed to become increasingly marginalised. Not enough was done to stop fiscal arbitrage by multinational companies and the financial sector was given too much leeway. Taking on debt was and remains attractive and too little is done to address the risks of excessive debt.

Local governments do not provide counterforce

The lesson of the financial crisis that we have still not learned is that the government has insufficiently redefined its role. Liberalisation and stimulating a free market system do not mean that the market can do as it pleases. The government needs to set clear rules and, especially, enforce these. That is not happening now, which has left the government at the mercy of the market. Consequently, there is a growing need for governments to take coordinated action. This will need to be done with regard to financial sector policy, but also in the areas of climate and fiscal policy. Local governments are not able to effectively address the global problems. Global problems demand a global approach. It is time for society to reassume the position that it has lost.

My personal observation is that the great crisis has eroded society's trust even further. Despite all the support measures, voters mistrust institutions and polarisation is increasing. For 40 years, soulless and uninspired policy has been pursued. It is high time for a coherent view of our society. If not for ourselves, let's at least do this for our children.

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DeFi and the foundation of a new finance

Campbell R. Harvey[1]

Out with the old

Today's financial system is based on centralized processes that often date back more than 100 years. From banking to trading and insurance, financial services are frequently slow, expensive, and opaque. Fintech companies are challenging old incumbents, but they too rely on the old centralized systems. The emergence of decentralised finance (DeFi) is set to sweep all that away.

In with the new

DeFi is defined by peer to peer transactions based on algorithms or smart contracts. Using blockchain technology and open source code, it is free of the bureaucratic baggage and overheads of old financial institutions, which means costs are much lower. It is faster. Its apps are interoperable. And it is more transparent. DeFi is set to revolutionize finance.

In the last 12 months, how many times have you turned to the latest business or financial news – to find the media focused on bitcoin's price gyrations, or Elon Musk's latest tweet about dogecoin? Cyber currencies have dominated the discussion about the future of finance. But something else is happening, largely under the radar, which is more profound, and which is starting to change the shape of the entire financial system. It is the emergence of decentralized finance, or DeFi.

In the simplest possible terms, DeFi is about trading with an algorithm. I have Asset One, and I want to buy Asset Two. I send Asset One to the algorithm, and Asset Two comes back to me. It's simple – and powerful. It's not too difficult to imagine a future where we are trading with algorithms or doing business in general with algorithms – with the advantage of this is that you eliminate the middle person so there's no broker and there's no bank. It is effectively a peer to peer transaction, moderated by an algorithm.

DeFi is distinct from fintech, which has boomed in recent years. Fintech companies are challenging traditional financial services companies by lowering transaction costs and greatly improving the user experience. That's good for consumers and good for the economy. However, it has its limitations, because fintech uses the legacy centralized financial infrastructure. Costs can only be reduced so far with these centralized systems. So while traditional financial institutions are being challenged by the current wave of fintech firms, in time, fintech will be challenged by DeFi.

Defi is not about bitcoin or dogecoin. It is a structural change in the financial system, that will lead to a new system of exchange, savings, borrowing, tokenization and insurance.

STUCK IN THE PAST

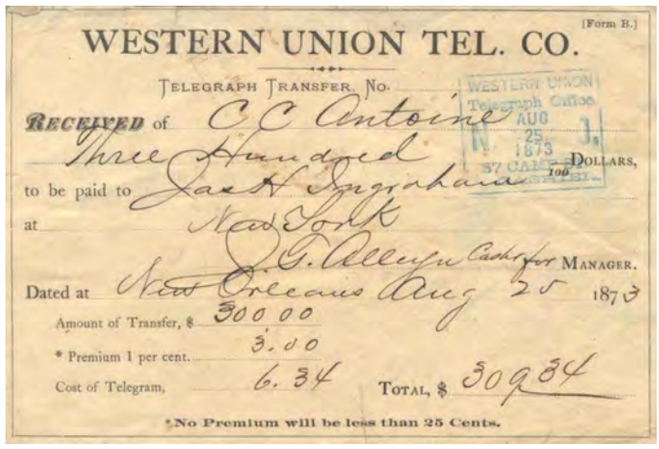
Our centralized financial system has not substantially changed over the past century. From insurance to banks, brokers and exchanges, as well as central monetary authorities, processes may have been digitized – but the basic infrastructure is substantially the same.

In my book, *DeFi and the Future of Finance*, I look at one of the first Western Union wire transfers from 1873. It is for $300. The total fee is $9.34 – or roughly 3%. Today – 149 years later – a 3% fee is still common for routine credit card transactions.

In fact, try sending a Western Union transfer today for $300; it will cost a lot more than $9.34. Sending within the U.S. and from a debit card, the fee for sending for cash pickup is $46.99. Sending to a bank account, "only" costs $19.99. Using a credit card as the source of funds is even more expensive.

Campbell R Harvey
Professor of finance at Duke University and former president of the American Finance Association. He is an author of DeFi and the Future of Finance as well as a Coursera decentralized finance specialization.

Exhibit 1
Western Union Wire Transfer 1873



[Form B.]

WESTERN UNION TEL. CO.

TELEGRAPH TRANSFER. No.

RECEIVED of C C Antoine

Three Hundred DOLLARS,

to be paid to Jas A Ingraham

at New York

J. G. Allen Cashier for MANAGER.

Dated at New Orleans Aug 25 1873

Amount of Transfer, $ 300 00

* Premium 1 per cent. 3.00

Cost of Telegram, 6.34 TOTAL, $ 309 34

*No Premium will be less than 25 Cents.

On many dimensions, our financial system is letting us down. Retailers, often operating on razor thin margins, not only face a 3% fee on credit card transactions but wait weeks for funding to show up in their accounts. Why is the transfer of money today so expensive, slow, and insecure?

There are other more general problems with the current financial system. Why are savings rates zero or negative? Why are borrowing rates so high? How is it possible, in the age of the internet, that it can take two days to transfer ownership after buying shares in a company? Why, during the global financial crisis, did we have to bail out the very institutions that caused the crisis? And why are 1.7 billion people in the world unbanked – and many more underbanked?

All these problems impose a cost – the financial frictions that have persisted over so many years take a toll on economic growth. Consider the economic cost of underbanking. An entrepreneur has a great idea with a target rate of return of 20% a year. She goes to her bank and asks for a loan. The bank agrees the idea is a good one, but the client is too small; the bank would prefer to deal with a single larger commercial customer than with 100 small customers. Instead, the bank offers to significantly increase the credit limit on the entrepreneur's credit card. Credit card debt, of course, comes with significant interest rates (currently more than 18%). The entrepreneur decides against pursuing her project given the cost of financing leaves too thin of a margin.

Yet this is exactly the type of project that boosts economic growth. The US economy has been stuck over the past decade in a 2%-annual-growth mode. At the same time, government debt has piled up. There are three ways to pay off that debt: to increase taxes, print money, and increase economic growth. Only one of them is attractive, the last.

DeFi is about reducing financial frictions and making finance more inclusive. It enables economic growth.

BENEFITS

DeFI offers three significant benefits. Firstly, the algorithms or smart contracts at the heart of DeFi do not carry the baggage of traditional finance – there are no layers of bureaucracy and back office staff. When peers interact, no middle person is making a large spread or commission.

> IN DEFI, PEERS INTERACT WITH PEERS VIA ALGORITHMS OR SMART CONTRACTS

Second, decentralized apps are interoperable. For example, in centralized finance, it might take days to send money from your broker to your bank or vice versa. No such delay exists in DeFi.

Finally, the DeFi makes everything transparent – a key characteristic of blockchain technology. The current centralized system is very opaque. We rely on government regulators to spot trouble in our financial sector, and history suggests a dubious track record in monitoring. Transparency addresses that problem – and it makes innovation rapid. If someone has an idea as to how to improve an algorithm, they can start with the open-source code and bolt on an improvement. The new protocol could be ready to launch in a few days.

RISKS

Any analysis of a new technology must clearly gauge the associated risks and challenges associated. Indeed, if all risk is eliminated, an investor may just as well invest in US Treasury bills.

Smart Contract risk A flaw in one of the algorithms. Contrary to our current system, all code is open source, so the exploiter does not need to 'hack in' to see the code. There are two types of smart contract risk: a logic error and an economic exploit. A logic error might be the algorithm doing some rounding up, i.e., 13.9999 to 14, and a command to withdraw 14 fails because of insufficient funds. Economic exploits are subtler and often take advantage of exchanges that are illiquid. For example, an exploiter could manipulate the price on the illiquid exchange – that is, for assets that cannot readily be traded or sold – and if that price feed was then used in another exchange, profits could easily be made.

Governance risk DeFi, by definition, is decentralized. A small group could take control of an algorithm.

Oracle risk All DeFi relies on blockchain technology, which is a closed system. It is important to get information from outside a blockchain into the blockchain; the link to the outside world is called an oracle. The source of the oracle's information can be manipulated (such as my example with the illiquid exchange). Or, the oracle could go offline: if it does, any DeFi protocol using that oracle also goes offline and all transactions will fail.

Scaling risk The current technology, which processes 15 transactions per second, cannot compete with centralized systems, such as Visa, which can process 65,000 transactions per second. To reduce scaling risk, a number of proposals are being made to increase the transactions per second in the Ethereum blockchain. These proposals, known as Ethereum 2.0, also greatly decrease transactions costs.

DEX risk DeFi also involves a new way to exchange assets, a decentralized exchange, or DEX. In contrast, popular cryptocurrency exchanges, such as Coinbase and Binance, are centralized exchanges. With DEX, the investor interacts with an algorithm not a broker, which leads to its own set of risks – DEX risk. This includes the possibility that liquidity providers are taken advantage of by arbitrageurs.

Custodial risk A cryptocurrency is identified by a private key – a long number that cannot be guessed. If the owner loses the key, they lose their cryptocurrency. This is a very real risk: the *New York Times* reported last year on a developer in California who decided to self-custody by adding all of his private keys to a special hardware wallet that was not connected to the internet. Unfortunately, he forgot his password. The hardware is designed such that 10 password misses in a row triggers the destruction of the hardware. The developer has failed eight times in a row and has two tries left. The value of the cryptocurrency in his wallet? $220 million. However, you don't need to self-custody. A number of solutions have been put forth to mitigate this risk, such as using a professional custodian.

Environmental risk This stems from the fact that most of the current cryptocurrencies use a very energy-intensive method to add to their blockchains. Many experts estimate cryptocurrencies' energy use as equal to the amount required to run a sizeable country such as Argentina. Ethereum (which hosts most of the DeFi applications) already has a plan to move to a vastly less energy-intensive method of consensus. Instead of tens of thousands of computers doing redundant work, the new method designates a single computer to do the work. The technique is called proof of stake. In this method, the miner must 'stake' collateral. If the miner approves an invalid transaction, any shortfall in funds is immediately deducted from their stake. Many Ethereum-compatible DeFi blockchains have already made that transition.

Regulatory risk When the Securities Act was passed in the United States in 1933, cryptocurrencies did not exist. Hence, regulators are only now trying to develop a framework for them. They need to be careful: if regulations are too harsh, then innovation is squashed or moves offshore. If it is too lax, many people will be taken advantage of. The regulator needs to find the middle ground, which is challenging for three reasons. First, the technology is complicated, so a considerable investment in time needs to be made to understand the new landscape. Second, the technology is evolving so quickly that it is hard to keep pace with the new protocols. Third, it is hard to attract employees that are well versed in this space because they have opportunities in the private sector. This means that there is presently considerable regulatory uncertainty. The DeFi space will benefit once that uncertainty is resolved.

WHERE NEXT?

I believe we are less than 1% into the DeFi disruption. We are seeing the scaffolding of a new city. This is not a renovation – it is a complete rebuild of our financial system.

In effect, we have come full circle. Our earliest market exchanges were done by barter, which was very inefficient. The introduction of money vastly increased efficiency. However, with DeFi, anything can be tokenized: goods, services, commodities, art, music, to name a few. As a result, in the future, you can choose how to pay. At the grocery store, perhaps you pay with a token backed by gold; perhaps you use on backed by Apple stock. It is your choice. If your choice does not match what the store wants, a decentralized exchange seamlessly exchanges your asset into something the store wants. This is barter – but an efficient form of barter. In this world, the central banks face competition. They lose their monopoly over money.

For those who choose to ignore the DeFi future, beware. I have heard many say "I am not interested in this space and do not hold any companies in my portfolio in this space." But those people and their portfolios are still exposed to DeFi because the very companies they hold could be put out of business by this new technology. To ignore DeFi is to be short DeFi. (See Harvey et al. 2022.)

DeFi is on its way, and it is revolutionizing the future of finance. Again, these are early days and there are many risks. However, DeFi holds the potential of solve many problems in our existing system.

DeFi is fundamentally a technology of financial democracy and financial inclusion. There are no clients, bankers, institutional or retail investors – everyone is a peer. DeFi has the potential to greatly reduce the financial frictions that plague our current system and to spur modern economies to much higher economic growth.

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- Harvey, Campbell R., Tarek Abou Zeid, Teun Draaisma, Martin Luk, Henry Neville, Andre Rzym, and Otto van Hemert, 2022. An Investor's Guide to Crypto Available at SSRN: https://ssrn.com/abstract=4124576

Note

1 I appreciate the help of my coauthors Ashwin Ramachandran and Joey Santoro. An early version appeared on the Duke website: https://www.dukece.com/insights/defi-and-the-future-of-finance/

A survey of the developments in quantitative finance

By Mark Geene, Roy Hoevenaars and Sander Nooij

Fast-speaking Koijen talks about the financial markets with great passion. His main focus is *why* financial markets fluctuate as much as they do. "*If on a given day the market rises or falls, you can usually come up with a few possible reasons. But no one really knows. Even when quarterly figures are published, we have a hard time explaining why share prices go up or down. That is one of the crucial questions that my collaborators and I are asking*", says the professor.

Before discussing the content of his research, we talk about the current schools of thought concerning financial markets. We consider issues such as factor investing and the famous Fama and French models, which has been a hot topic since the 1990s. We realise that a great deal is still unclear about the impact of ESG on the financial markets. We also discuss Koijen's views on the use of alternative data, which has become a frequent occurrence in the light of Big Data.

After discussing the recent research on factor investing, we continue our interview by discussing Koijen's research. With his research on inelastic markets, he tries to explain the dynamics of financial markets using holdings data to trace price fluctuations back to the demand of different investors. Holdings data for equities have been available in the US since the 1980s, but it is only now that we have methods and frameworks for to use these data in equilibrium asset pricing models. For fixed income markets, the availability of these data is quite good in the US for investment-grade credit market, but more limited for other parts of fixed income markets. And in the European Union the availability of holdings data for equities as well as for bonds is organised differently from that in the US, but detailed, high-quality data are available in recent years. With holdings data broadly available, these new frameworks and methods can be used to provide a new perspective on why prices move and how markets function.

SECULAR DEVELOPMENTS IN THE ACADEMIC AND THE INVESTMENT WORLDS

FACTOR INVESTING

Factor investing has become very popular in recent decades, both in academic research and in the asset management industry itself. However, the proliferation of factors poses some challenges according to Koijen. Just for equities, hundreds of factors have been proposed in the literature. Such factors are often based on company-level characteristics and may also use macroeconomic data. "There is an ongoing debate whether those are always real factors or whether data mining has sneaked in", Koijen remarks.

Prof. Dr. Ralph Koijen[1,2] is the Dutch-born AQR Capital Management[3] Distinguished Service Professor of Finance at the University of Chicago, Booth School of Business[4]. He studied econometrics at Tilburg University, where he received his Ph.D. in Finance in 2008. In 2019 he was awarded the Fischer Black Prize by the American Finance Association, given biennially to the top financial economics scholar under the age of 40. In 2021 he received the Bernacer prize[5] for the best European economist under the age of 40. Koijen's articles have been published in journals such as the American Economic Review, Econometrica, the Journal of Political Economy, the Quarterly Journal of Economics, the Journal of Finance, the Review of Financial Studies, and the Journal of Financial Economics. In addition, his research is frequently covered in international media such as the Financial Times, the Wall Street Journal, and the Economist.

"An active literature explores how to use machine learning methods to efficiently combine all this information. This is quite challenging and the connection to the underlying economic forces is not obvious. If it would be possible to limit the set of factors, then perhaps it would be easier to determine the relationship between these factors and the fundamental drivers, and thus gain a better insight into the economic dynamics. However, it has been challenging to reduce this large number of factors to a small set of economically-interpretable factors", Koijen continues.

> HOLDINGS DATA ARE OF IMPORTANT VALUE IN ADDITION TO PRICES AND FIRM CHARACTERISTICS TO UNDERSTAND FINANCIAL MARKETS

One concern is that the set of factors that investors may change over time. We have seen a variety of global financial market trends in recent years, including the 2008 credit crisis, the problems in Greece, the pandemic, and now we may be faced with stagflation. If the ambition of the multi-factor model is to adequately model the developments in the markets, then such a multi-factor model should be capable of explaining all those developments[6]. This may be challenging using current methods and modelling approaches.

Koijen and his collaborators decided to take a different approach to try to understand financial markets. At its core, any asset pricing model combines a model of investors' portfolio choice with market clearing to solve for asset prices. The main idea behind the new approach, which they label "demand system asset pricing," is to return to this core and model the demand of each investor. The new data that are used are then portfolio holdings and flows.

This modelling approach has four key advantages. First, a well-specified demand system is essential to obtain credible quantitative answers to questions that involve shifts in investors' demand. Examples include the impact on asset prices of (i) the growth of ESG investing, (ii) the transition from active to passive investing, (iii) quantitative easing and tightening, and (iv) global capital flows, just to name a few. Those key economic questions cannot be easily answered without modelling the demand of investors. Second, by modelling the demand of each investor, fluctuations in asset prices can be traced back to the demand of different investors. This makes markets more interpretable and shines a light on the dark matter of financial markets. Third, asset pricing models make strong predictions about the asset demand system. By directly estimating investors' demand, it provides a new way of testing and improving asset pricing theories. Fourth, by taking this granular perspective, it also provides a new way to explore return predictability. Instead of directly predicting returns using firm characteristics or macroeconomic variables, the demand system approach instead predicts the demand of investors and then aggregates these forecasts to a forecast for returns. We will revisit these themes below.

MUCH IS STILL UNCLEAR ABOUT THE IMPACT OF ESG

What are your views on the impact of ESG on the theory and science of investing?

Now that we have established the challenges for major new developments within the multi-factor framework, we move on to the promising subject of the recent developments in the field of ESG investing. We wonder what impact ESG investing is having on the theory and science of investing.

"Conceptually, the asset pricing models that incorporate ESG-conscious investors can be viewed as adjustments to asset pricing frameworks where investors have tastes for certain characteristics. This in and of itself is not radically different. One implication of these models is that as ESG investing becomes more popular, prices of highly-rated stocks increase and expected returns fall. However, during this transition period, average realized returns are a poor proxy for future expected returns. That said, there is an ongoing debate about how large the flows to ESG securities are, how to properly define these securities and measure the flows, and what the ultimate impact on prices is. At the end of the day, the real question is to what extent ESG investments are having an impact on what you are trying to achieve. Do they have an impact on decarbonisation and that sort of thing?" the skeptical professor explains.

Koijen refers to a recent conference, where it was argued that "brown" firms may actually be the main source of new developments in terms of important green patents. "The oil and gas sector is a major innovator in this area. But many ESG investors may no longer own oil and gas companies or reduce their allocations. A technology company, for instance, may already be quite green and it is relatively easy for them to come up with a transition plan that would make them net zero in modest amount of time. But if the real innovation in fact comes from the other group, then we may need to rethink the investment strategies. As measuring the effect on asset prices (and the passthrough to investment and green R&D) is challenging, the evidence is not yet conclusive, even though some investors and policymakers have strong opinions on these questions. There is clearly a lot of effort and focus on these questions, so hopefully we can make serious progress on these important issues", says Koijen.

More broadly, there is a concern that the passthrough from firms' cost of capital to real investment decisions and R&D is quite low. So if funding costs for ESG projects are lower, what is the additional investment in green projects? There is an ongoing debate whether engagement is more effective, and this may well be the case", Koijen notes.

ALTERNATIVE DATA AS A SHORT-TERM SOURCE OF FUNDAMENTALS

At the moment, alternative data are seen as the gateway to applying Big Data in financial markets and as a source of alpha. We wonder what Koijen's thoughts are on this subject. Koijen has a slightly different view but sees many interesting applications for Big Data technologies within the sector.

With alternative data you often try to make better predictions of a firm's short-term fundamentals compared to your peers. For instance, by scanning the parking lots at retail stores or by using credit card data to predict a company's upcoming quarterly results, expecting that prices will move when other investors learn these quarterly figure.

But in my view, there is already a wealth of data that we can use that is relatively unexplored, namely data on holdings and flows. By modelling and predicting the demand of different investors, we can predict prices using by predicting demand. Alternative data can be useful as another source of forecasting demand, yet I cannot yet tell how useful it as we have not explored this", says Koijen.

As the interview continued, we move on to the research area that Koijen is focused on. Holdings data are informative about a key element of his theory about why financial markets are not elastic and enable him to explain some of the effects that we are seeing. We now move on to a more detailed discussion of his research and his ideas about the future.

INELASTIC MARKETS

Together with Xavier Gabaix (Harvard University), Koijen has proposed a new model to explain fluctuations in the aggregate stock market. They jointly published a paper in which they show that certain investor groups, such as retail investors, can have a much greater impact on equity market returns than had previously been assumed. Six months after the GameStop circus[7], this conclusion fell on fertile ground. It received a lot of attention in the financial press worldwide.

The core focus of this research is the elasticity of markets. Previously, standard models assumed that markets were elastic. In the CAPM model, assets are very close substitutes and your portfolio weight is determined by a stock's beta and the amount of idiosyncratic risk. "If an investors wants to buy more shares of Apple, other investors quickly make way and rebalance to other technology stocks", Koijen explains. Prices therefore do not need to move much for markets to clear. This logic still applies, although to a lesser extent, at the level of the aggregate stock markets versus, for instance, bonds. Standard theories imply that investors' demand uis very sensitive to changes in expected returns.

According to the study by Gabaix and Koijen, markets are in fact *inelastic*. Stock market prices react more violently than should be the case for more elastic markets. For instance, if you buy 1% of the aggregate stock market, the market will rise by between 3% and 8%.

To understand why markets can be inelastic, Gabaix and Koijen look at the investment behavior of various market participants. We know that the investments of institutional investors far outweigh those of private investors, but they are typically restricted by mandates. Pension funds and insurance companies have an equity-to-bond ratio of, for instance, 60/40. If the market falls, they will very gradually bring their positions back to their target levels. Investment funds that already have 100% of their assets invested in equities are also unable to provide elasticity, because they are already fully invested in equities.

Koijen believes that hedge funds, too, do not have the room for manoeuvre that is necessary to make the market more elastic. When stock markets fall, hedge funds are also having to deal with an outflow of assets and risk constraints tighten. "You can consider all the various parties, but you won't be left with many likely candidates who can provide a lot of elasticity. This means that certain investor groups, such as retail investors, foreign investors, and classes of institutional investors, can have a greater impact than you would expect. Every euro that they invest on the stock market, has a five times greater impact, because the rest of the market does not react much", Koijen argues.

While there is a debate in the literature on the exact magnitude, but that misses the point. In fact, based on the assumption that markets are elastic, the price impact should be close to 0. Based on the evidence so far, markets appear to be inelastic and that means that suddenly many question that never used to be all that interesting become worth investigating", the professor notes.

> RETAIL INVESTORS CAN HAVE A SIGNIFICANT IMPACT ON PRICES

The paper also provides a conceptual clarification on how to measure the flow into the stock market. This is not entirely obvious as for every buyer there is a seller. "The theoretical framework shows that we need to first compute the flow into all asset class for each investor. Then those flows need to be aggregated using equity weights, that is, the fraction that they invest in equity markets. While this analysis provides conceptual clarity on how to measure the flow into the stock market (or into any other asset class), the data to measure these flows perfectly is not publicly available as you need to know the holdings and flows in all asset classes", says Koijen. However, as holdings data are increasingly available, the measurement of such flows will improve over time.

SHARE BUYBACKS AS A DEMAND SHOCK

So-called share buybacks are the media's darlings. Our model provides a potential mechanism how share buybacks can have an effect on asset prices. If you simply pay a dividend, you don't know what investors will do with that money. Will they reinvest it in the market or will they use it for consumption? When a company buys back shares, this creates a direct flow in the market and prices will rise. Not only is demand increasing, but supply will also diminish. That is why dividend payments and share buybacks may have a different effect," says Koijen. Quantifying those effects is challenging however, and these results are therefore best viewed as a theoretical possibility at this stage. It also opens up broader questions how firms can act as arbitrageurs by changing the supply of shares in response to price movements.

FLOW INFORMATION AS A STEERING INSTRUMENT FOR THE ECB AND FED

These insights are also relevant for central banks' purchasing policies. Central banks have been buying large quantities of government bonds, corporate bonds, mortgage securities and in Asia even equities. If you want to understand the impact of such actions or want to know how far prices need to rise before someone else will start selling their equities or bonds, you need a demand model.

ASSET DEMAND FOR THE CROSS-SECTION OF U.S. EQUITIES

Together with Motohiro Yogo (Princeton University), Koijen studies the cross-section of U.S. equity prices and returns using 13F data. Whenever possible, Koijen includes every single investor in his research. What BlackRock does, what Vanguard does, ABP: everybody. These data make it possible to monitor investors' behaviour. So for instance, if market participants start to follow the low volatility factor, that would be measurable.

Koijen and Yogo find that demand is inelastic across U.S. equities. The following figure illustrates this effect for US equities. The figure shows by what percentage the stock price moves in response to a 1% change in demand. This clearly indicates inelasticity. This effect is also reflected in well-known factors, such as value, and in other asset categories, such as bond markets.

His research suggests that the 13F holdings data allow a much more detailed analysis. For instance, if a stock gains 10% in value. then the model attributes this to, for instance, 1% due to a change in the demand of Vanguard, 2% for BlackRock, et cetera. With this information in hand, one can try to understand why investors bought or sold securities. "Were asset managers receiving inflows, or did they respond to changes in firms' fundamentals", is how Koijen outlines the potential underlying causes of market movements. The research so far is largely focused on developing frameworks to incorporate information in holdings data and flows, but these frameworks can be used to explore those new questions.

The research also aims to predict the future demand for equities for each investor. So if during a certain period the stock market or the volatility is higher or actually lower, some investors will be quicker to adjust their positions than others. "It is very much bottom-up compared to predicting returns directly," says the professor.

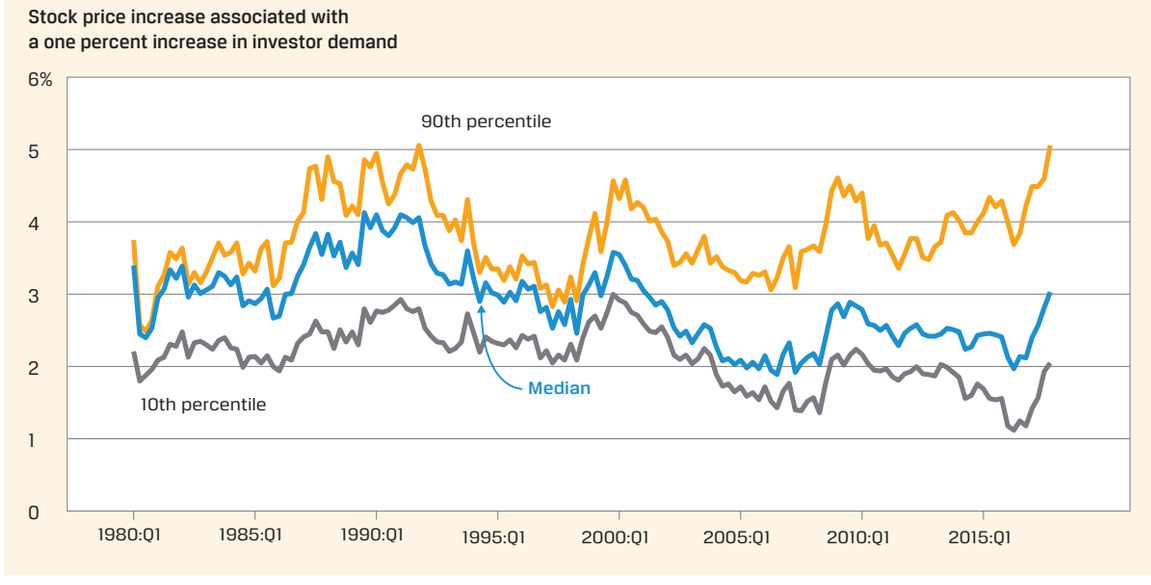
"Modelling the "demand shocks", as he calls them, that determine investors' demand is a different approach to using factor models. An advantage of this approach is that model quickly adjust to structural changes in the market, for instance due to an influx of retail investors" Koijen argues.

"The availability and timeliness of holdings data is not the same for every market. In the US, all institutional investors report their positions on a quarterly basis and that also applies to foreign investors. You can find these data on their 13F forms. The current threshold is 100 million in invested assets. This covers 70% of the total market capitalisation. And then of course you have the short sellers. Those data are also available, but the big unknown factor for us has been the private investor", says Koijen. In ongoing research, Koijen and his collaborators also have data on holdings of (ultra-) high-net-worth individuals.

Hence, a key new source of information are data on holdings and flows. These are usually not taken into account by factor models. In hindsight that may be surprising, because outside the field of finance it is rare to only focus on prices and not on quantities. This would be like asking labour market economists to study wage trends but ignore unemployment.

"The idea to estimate asset demand systems is not new. In 1960s and '70s, James Tobin and Benjamin Friedman (among others) tried to estimate financial that way. However, due to limitations in terms of available data, modelling approaches, and econometric methodologies, this literature ended in the eighties and factor models have been successful in the academic literature and asset management industry since then", the professor comments.

Figure
Price Impact of Positive Demand Shocks for US Stocks, 1980–2017



Source: Koijen R and Yogo M. NBER Working Paper 21749, and published as "A Demand System Approach to Asset Pricing," *Journal of Political Economy*, 127(4), 2019, pp 1475–1515

"Interestingly, the SEC data have already been available for 40 years. These data have been used, but not for equilibrium asset pricing models. So we can run analyses on a quarterly basis for a 40-year period. That is of tremendous interest to us, and we have discovered many new data sources in the process, both from public and private sources. New data are now emerging from all sorts of nooks and crannies."

EUROPEAN CREDIT SPREADS

Koijen and Yogo have developed a model for global equity and fixed income markets that can be used to shed light on the European sovereign debt crisis- not commissioned by the ECB, by the way. Their conclusion: the spread between Greek and German government bonds can be entirely explained based on fundamentals. This is not the case, however, for Italy and Portugal. Next, we can look at the demand shocks – because all investors in the world are covered – and which countries drive the spreads. This used to be referred to as contagion or spillover effects, but we know exactly which investors cause such spillovers. The ECB could perhaps put this information to good use. If spreads in Italy surge, we now know which market participants are causing this and this may in turn guide policy.

So for policymakers this could serve as a dashboard that would allow them to fathom the causes of price movements and their scale. But all this is still a work in progress; it will take us a few more years and there is still a great deal that we do not yet understand."

CAN COMPANIES PLAY AN IMPORTANT ROLE AS ARBITRAGEUR?

This transparency of holdings data is a prerequisite for such a dashboard. And that has not gone unnoticed by the ECB. With its securities holdings statistics, the ECB has taken a huge step towards greater transparency. Since the autumn of 2013, we know for each country and each sector exactly who holds what – for every security, such as every equity and bond.

They also have these data for the 26 biggest banking groups. So the ECB has already taken a huge step towards making the holdings data available now and using these for research.

And there is another dataset, the EMIR data, for derivatives. The ECB therefore has a good overview of both the cash market and the derivatives market. The next question is how to jointly model those markets. The data and frameworks often go together. That then allows you to start asking better questions.

BOND MARKETS

In the US we have fantastic data for equity holdings, through the 13F filings, but such data is more limited for Treasuries and parts of the corporate bond market. While that is typically something that you would want to have as a policymaker.

During the liquidity events in March 2020, the Fed intervened in the corporate bond markets. At a time like that you would want to have solid holdings data for Treasuries and corporate bonds.

From a policy perspective, it looks as if Europe has made bigger strides than the US. But these are great times, because we now have new frameworks and holdings data that we can use. We are witnessing an interest in this from within the sector because you can of course use this for predicting returns. And for policymakers it is relevant for dealing with stability issues.
What is key, is that we try to find out what the holdings data can tell us about demand, or rather demand systems. And one of the main outcomes of that study has been that based on that framework markets are inelastic.

THE DEMAND FOR TRANSPARENCY

Of course from a scientific point of view increased transparency is valuable. For policymakers, too, it is valuable to know who holds what positions. In March 2020 things went horribly wrong in the Treasury market. And there was limited transparency in positions. From the perspective of central banks, it is important also to know how investors substitute to other assets if the central bank buys Treasuries or corporate bonds", Koijen discusses.

The sector, too, advocates (more) transparency. Two years ago, one of the SEC commissioners proposed raising the reporting threshold for large investors from USD 100 million to USD 1 billion. That would have meant a huge reduction in the amount of 13F information[8]. Scholars started a petition to stop that from happening. And then many large investors also decided that it would be a bad idea, because they would have to report their positions while smaller investors would no longer have to do so. The SEC then found to its surprise that small hedge funds also believed it was a bad idea. Because they used the 13F data, literally everyone felt that raising the threshold would be a bad idea. And so it did not happen, Koijen explains enthusiastically.

Koijen ends the interview with the conclusion that by adding holdings data a huge new dynamic has emerged. If you consider Big Data and machine learning, then holdings data are a very logical application. Before, you would have 3,000 stocks and a number of characteristics. Now you have 3,000 stocks and thousands of investors. By adding the holdings data, a huge dimension is added (the countless investors that all have their own characteristics too). And then suddenly Big Data methods become highly relevant.

Notes

1 https://twitter.com/rkoijen
2 https://www.koijen.net/
3 https://www.aqr.com/
4 https://www.chicagobooth.edu/faculty/directory/k/ralph-koijen
5 http://bernacerprize.com/ralph-koijen/
6 https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html
7 https://www.scu.edu/ethics/focus-areas/business-ethics/resources/robinhood-reddit-and-gamestop-what-happened-and-what-should-happen-next/
8 https:/www.sec.gov/comments/s7-08-20/s70820.htm

Broadening our thinking as the basis for finance professionals

DAWN OF THE COMPLEXITY PARADIGM

Theo Kocken

INTRODUCTION

Through the various crises in recent decades, it has become clear that the world is fundamentally uncertain – and not stochastically uncertain. With the new insights based on, among other things, complexity theory, it starts to dawn in science and in practice, that we need a greater diversity of models and tools. From Agent Based Modeling and network theory to pre-mortems and scenario thinking. These will enhance financial risk management practices.

In addition, decades of cognitive research have taught us that there are very effective methodologies for extracting much more information from a group of professionals and mitigating the impact of human biases. The decision-making process itself is an important toolkit for improving risk-return decisions. Both within the financial world and beyond.

However, financial education as well as practice within financial institutions and rules used by supervisors are far from fully adopting these new insights. This article is a small tour through the past, the current state of education and practice and the expectations for the future of the finance profession. The present article argues that these insights, including those arising from behavioral research and complexity theory, lead to requirements for a broader and more diverse arsenal of competences for a financial professional 'fit for the future'.

DECADES OF OVERESTIMATING OUR ABILITIES

Since the 1990s, there has been a strong trend within risk and portfolio management towards steering financial institutions and markets based on well-established statistical methods, such as Value at Risk and associated stochastic modeling of the balance sheet risks of banks, insurers and pension funds. The reason for this is the underlying ideology of neoclassical equilibrium modeling based on the axioms of rational agents in a world that always tends towards equilibrium. The underlying worldview for managing risks seemed to be aimed at "being in control". A mechanical worldview in line with our Cartesian Newtonian school education from the 'hard' sciences like physics. The key assumption underlying this approach is that our economic and financial world is based on stable mechanical (stochastic) processes that we can measure and control. This is actually the case in many sectors. Aircraft can fly more safely, driving became safer and nuclear reactors can supply electricity more safely. These are top-down processes with stable cause-effect functions. We often categorize these types of processes as "complicated processes". It takes a lot of specialist knowledge to understand them, but we can measure and control the risks. For this category of processes, risk management entails the measurement and "bringing under control" of fatalities.

However, a large part of all the processes that we deal with within economics, especially finance, are of a fundamentally uncertain nature. This applies to most market risks, business risks, but also money laundering and various operational and cyber risks. We call this "complex processes". These are essentially different in nature from "complicated processes". The cause behind this lies in the fact that there are no clear causal top-down relationships in complex systems; instead, there are feedback loops and changing levels of connectivity between institutions, countries and so forth. Feedback loops arise in part because of what George Soros calls "reflexivity":

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the relationship between individuals and the market as a whole in which "behavior" plays a major role. A person who at one given moment considers buying a certain asset such as a house, with an x% probability, can (unconsciously) adjust preferences due to an increase in the market prices, whereby the probability of buying that asset changes to y% (y>x), thus influencing the market outcomes. As a result, the preferences of many other people change and so-called feedback loops arise because of these reflexive relations between the market and people. Small initial changes in, for example, buying behavior can bring about enormous changes at the macro level through various self-reinforcing (positive) feedback loops.[1]

> AS LONG AS CHANGING PREFERENCES AND RESULTING FEEDBACK MECHANISMS ARE NOT INCLUDED, ECONOMIC MODELS CONTINUE TO MISS THE ESSENCE OF REAL-LIFE ECONOMIC SYSTEM BEHAVIOR

In addition, market dynamics change because of changes in connectivity. For example, this can occur through new trade agreements, inter-bank loans, a reduction of trading activities by banks and mandatory Central Clearing Platforms. And dynamics change through innovations. Examples include less capital-intensive industries and growth in products such as Exchange Traded Funds. This set of feedback loops, innovations and connectivity changes leads to a continuous change in the dynamics of financial markets, resulting in fundamental uncertainty. This is a world where we cannot measure equilibria (because there are often none at all) nor estimate probability distributions. We do the latter, but they have little practical – and sometimes even very misleading – value in a complex world. Bernard Shaw's quote "Beware of false knowledge, it is more dangerous than ignorance" sums this up well.

COUNTERPRODUCTIVE WORLDVIEWS

A well-known example of the counter productiveness of modeling is the failure of financial models to measure bank stability prior to the 2007/2008 Global Financial Crisis (GFC). Due to the very low market volatility – and very low correlations – these models didn't signal that the risks had become very high. According to conventional academic reasoning and many financial professionals in the field, low market volatility had to imply low risk. Otherwise, the vast majority of the market would be irrational, which was inconceivable in the presumed world of the (predominantly) rational men. This arose despite the fact that people like Minsky (1986) warned about the existence of collective irrationality. The focus was also too much on the micro level: What is the risk per institution? However, risk can only be measured when it is connected to the environment: What are the relations between institutions and how do risks pass through a system? Indeed, reductionism oversimplified the world and a holistic system view was lacking.

A second example of the destructive effect of ideological models without any scientific foundations is the mean reversion interest rate model. This model assumes that interest rates have a strong tendency to revert to a kind of equilibrium level (the "mean"), which for decades attributed a nil chance to interest rates below 2%. This resulted in inertia from insurers and pension funds, many of whom misjudged their risks because of this ideology. Low interest rates fuel demand and discourage saving while driving up interest rates again through several clear causal relationships. This was the ideology of mainstream economists. With a complex world view, on the other hand, we know that the probability of very low interest rates cannot be quantified, but it is easy to imagine how behavior-driven feedback loops, changes in the environment and innovations could lead to very low interest rates. A little imagination teaches us that long-term low interest rates can create a realization in people that one must save more money if one's future income is to remain the same. The income effect, as it is called, slowly starts to dominate the substitution effect. Although initially, low interest rates breed more demand in the economy and result in fewer savings, this can reverse after a while. Central banks – in which the naive assumption that low interest rates should always lead to more spending – are going to shout even louder that interest rates should remain low; as a result, people start saving even more instead of less. The positive feedback loop is in full swing and interest rates are in a trap. This is not necessarily the (only) cause. Innovations that make companies less capital intensive, et cetera, could also be imagined. Many insurers and pension funds that adhered to the ideology of mean reversion were badly hit the last three decades because they had not taken protective measures against a disastrous fall in interest rates. This meant that inflation adjustments (indexation) were no longer possible and many pension funds had to close their funds all together.

RELEVANCE OF HUMAN BEHAVIOR RECOGNIZED

Complex processes do not have a simple cause-effect relationship while feedback loops very often cause systems to spiral out of balance. Endogenous (behavior-driven) processes lead to unstable situations, chaotic crises and – in between – temporary states of stability. Therefore, we can speak of navigating "between order and chaos". Endogenous processes within people's social networks are driven, among other things, by a combination of emotions and cognitive biases. Describing these combinations exceeds the scope of the current article, but the components, including overconfidence and confirmation bias, have been extensively studied since the 1970s by, among others, Kahneman (2000). Also, the so called "affect heuristic", in which feeling good about long-term positive markets reduces our perception of risk (Slovic, 2000) and fear-related emotions, such as loss aversion, which includes the fear of missing out, play a major role. Moreover, the human ability to collectively generate stories that gain traction through epidemic diffusion processes is an important part of endogenous imbalance. Scientific developments in this area have been described in particular by Shiller (2019).

These biases and heuristics have been acknowledged by almost all economists, but many of them are not yet ready to recognize that this can lead to unstable feedback loops. Or they do recognize this, but try to get a little closer to reality with small adjustments in their equilibrium models. This has been called the "shoehorn" approach: Try to force some refuted theory into something that looks more plausible, even if it does not fit. However, as long as changing preferences and resulting feedback mechanisms are not included, economic models continue to miss the essence of real-life economic system behavior.

COMPLEXITY THEORY MEETS BEHAVIORAL SCIENCE: DAWN OF A NEW PARADIGM

As Kuhn (1962) argued, paradigms that seem to be failing will only really succumb if there is a new paradigm to replace them. In economic science, especially in investment theory, the emergence of behavioral finance is not sufficient as a new workable paradigm. It is not a replacement framework for how the economy including financial markets works. It erodes the paramount assumption of Homo Economicus in conventional finance, but no new form of modeling the micro or macro economy has been proposed. However, the – coincidentally parallel – development of Complexity Theory over the past 30 years does provide the building blocks for a new paradigm[2]: of emergent processes, of connectivity and of interaction (feedback loops et cetera) which are more important than studying the static particles of the system itself. This theory is also increasingly applied to economics, as Arthur (2013) summarized in an overview.

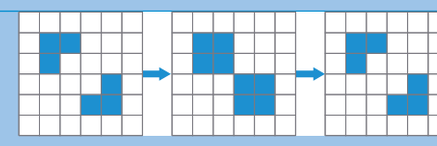
AGENT-BASED MODELS

Armed with the knowledge of behavioral finance, from the first decade of the twenty-first century, the first steps were taken to incorporate behavioral aspects into the modeling of the (financial) economy. For example, it was possible to incorporate into models how the behavior of groups of "agents" (institutions, households, etc.) adapts to certain developments in the economy and/or financial markets. A kind of "learning process" which does not necessarily have to be rational. For example, a sustained period of rising markets will make more people "learn" that markets will most likely continue to rise. A trend-following heuristic. As another example, an experience like persistent low interest rates might entail that the income effect gradually comes to dominate the substitution effect. In any case, learning is never "perfect". Our process of "learning" is based on simple heuristics that differ from person to person. As the economy changes, we adjust our heuristics. It follows from experiments that large groups follow these heuristics-based learning rules. This makes it possible to make models of heterogeneous groups of dynamic, adapting agents, and here, simulation provides a great deal of insight into the origin of market behavior. Unfortunately, a beautiful, closed form solution is infeasible as the output of complexity models. Examples of these simulation models are the dynamic macro-economic models by De Grauwe (2012) and Hommes (2019), among others, which provide us with a better understanding of endogenous instability and the resulting fat tails in macro-economics.

Box 1: Game of Life, a big step towards agent-based modelling

One of the first "agent-based models" was John Conway's Game of Life (1970). It is a two-dimensional plan with a grid of squares in which each square in the plane represents an "agent" that is alive (black) or dead (white). The squares (cells) evolve over time per time-step via three simple rules:

- Any live cell with two or three live neighbors survives.
- Any dead cell with three live neighbors becomes a live cell.
- All other live cells die in the next generation. Similarly, all other dead cells remain dead.



Example of the Game of Life. This process is called an oscillator

Though extremely simple in its rules, many initial situations generates an amazing set of "emerging" (and disappearing) phenomena. The approach appealed to many scientists including complexity theorists. It provides understanding around chaos theory, emergence, complexity and fundamental uncertainty.

Farmer (2009), one of the fathers of complexity economics, has created many agent-based models. One of these is a model in which hedge funds, banks, regulators and investors interact with each other. This model explains, among other things, how regulation can lead to unintended positive feedback loops and instability.

BROADER APPLICATION OF NETWORK THEORY WITHIN FINANCE

A variant that is somewhat related to agent-based modelling is the spectrum of network models. In this, agents are the nodes in the network. The relationships (loan volume between banks, derivative contracts between institutions, etc.) are represented by the connections (edges) between the nodes. Shocks in the market can be steered through such a network, providing insights into which players are the "central culprits" that can cause the system to collapse. A good example is the "DebtRank" network approach of Battiston (2012) which shows that, for example, two banks of the same size, can have totally different systematic impact on the system as a whole. This replaces the "micro" thinking of "too big to fail" with the "system" thinking of "too central to fail". Another illustrative approach is Borovkova's (2013) Central Clearing Platform (CCP) network model. This research reveals that a CCP is not more secure than a bilateral clearing approach for all institutions in the network, depending on where in the network an institution is located. This contrasts the "micro" approach in which the dynamic effects within the system are ignored and the sum of micro risks naively determines the macro risk.

CALL FOR MORE PLURALISTIC THINKING

It is not yet possible to say how quickly this more pluralist approach, applying a wider variety of models instead of relying on one ideology, in education and in practice will become commonplace. On the internet, we do see an increase in the word use of these new modelling approaches. However, not much can be concluded from this, because much of the terminology is also fairly new.[3] An increasing number of international research and training institutes related to complexity and complexity economics have emerged.[4] Institutes such as Rethinking Economics, which pushes for greater diversity in economic education worldwide, have examined the curricula of various universities. They found that in the Netherlands, for example, 86% of all education is still based on conventional "neoclassical" models. Unfortunately, they have only just started measuring in Europe, so they cannot show yet if progress is being made across the continent. So far it is clear that students worldwide are now also demanding much more pluralist real-world educational programs.

Asset managers, banks and regulators are also paying increasing attention to network models and other forms of risk modeling and are collaborating with the new complexity research institutes. However, most of the financial models that are used are still of the classical "equilibrium" type. Change is happening very slowly. Not in the least because these classical models are the prescribed supervisory models and they require an enormous time commitment within financial organizations.

PROGRESS: UNDERSTANDING AND CREATING RESILIENCE INSTEAD OF PREDICTING AND CONTROL

Scientific fields such as data science and artificial intelligence produce an enormous amount of new knowledge. And computers are still getting faster. All these developments give people hope that we will be able to model risks better.

These developments will certainly bring progress in several areas, such as better understanding of idiosyncratic aspects of consumer credit risk, security risks in various physical projects and cyber-attacks in which global data can recognize repetitive patterns.

However, the negative side of new knowledge, faster computers, better data when dealing with a complex environment such as the financial world, can largely be summarized in one word: overconfidence. Once we were able to solve long-term Stochastic Dynamic General Equilibrium (SDGE) models with modern computers, this led to the remark by Nobel Prize winner Robert Lucas in 2003 in his speech to the American Economic Society (Lucas, 2003): "The problem of depression prevention has been solved". This belief of "superior knowledge" came just a few years before the worst economic depression since 1929. The combination of modeling and computing power made the world so overconfident that it had created the most unstable economy since the 1920s.

SELF-ORGANIZED CRITICALITY AND THE THEORY OF UNPREDICTABILITY

However, even if complex processes would be much better understood by new models as discussed above, the predictability of a potentially high-risk event would still remain very low. This can be explained by the research on so called "self-organized criticality". Many processes in the natural sciences, ecology and social sciences, have the property that behavior around especially so-called tipping points (highly built-up tension) is very erratic, non-linear and unpredictable. This is despite the fact that the building blocks themselves are (often) very predictable in their behavior.

We can understand quite well how tension is built, for example instability in financial markets or the tension in tectonic plates preceding an earthquake. However, we do not know when this increased tension will lead to a meltdown. This process of inherent unpredictability, which is closely linked to Mandelbrot's Fractal Theory, is often explained in terms of sandpiles. If you build a pile of sand on a beach using grains of sand in your hand, that pile can collapse at a height of 20 centimeters, 40 centimeters or even as high as a meter or more. The difference in the number of grains of sand that come down in an "avalanche" is enormous. The timing is virtually unpredictable. Of course there is a smaller chance that a sandpile will make it to a very high altitude before it collapses, however, this decrease in probability follows a kind of power law distribution.[5] The probability of extreme outcomes is still significant under power law and does not converge quickly to 0 as it would with normal distributions.[6] It is these extreme outcomes with outsized, often negative, impact that should not be neglected by finance professionals and supervisors or classified as "too unlikely to occur".

However, if the self-organized criticality of a sandpile is unpredictable, even though the behavior of each grain itself is highly predictable, how large is the unpredictability of human-induced "sandpile phenomena" such as financial markets? Every person is subject to behavioral changes when a system changes. This often creates destabilizing (positive) feedback loops and subsequently greatly reduces predictability. Consequently, forecasting is impossible for most interactive economic situations. This is the notion of fundamental uncertainty. As Keynes (1937) noted: "There is no scientific basis to form any calculable probability whatever. We simply don't know". Despite a more than poor track record, many economists continue to see forecasting as a socially meaningful activity.[7]

So, we have to get used to using a diversity of models combined with broad perspectives to find a robust and adaptive solution that provides a reasonable outcome under different world views. Robust solutions ensure that one can survive shocks. For example, pension funds and insurers cannot gamble on the surmise that "mean reversion exists". They also need to survive if mean reversion doesn't exist and hedge some of their downside interest rate risk. They can also make risk hedging dependent on developments in interest rates, inflation and other variables.

This will allow them to develop conditional plans that are adaptive if the environment changes structurally. By having knowledge about a diversity of models and imaginary world views, including actions to be taken, it is possible to respond more quickly to a changing environment, changing connectivity, changing technology and emerging feedback loops. This is more effective than optimizing under just one worldview and seeing one's financial institution fail if their worldview is false.[8] [9]Allowing imaginable calamities to happen while being unprepared and then attributing them to "bad luck" is not a responsible policy.

RESILIENCE ENGINEERING: ORGANIZATIONAL DESIGN AND LEARNING CAPACITY

Thinking about complexity does not only lead to a different use of (a diversity of) models. Being aware of fundamental uncertainty and the relevance of the non-linear dynamics of a complex system also leads to a different view of, among other things, the design of organizations and learning within organizations. This is often summarized under the term "resilience engineering". Efficiency, optimization and centralization need to be less glorified as ultimate goals and more balanced with those elements that are more effective in a fundamentally uncertain world, such as redundancy, flexibility and diversity.

> EFFICIENCY, OPTIMIZATION AND CENTRALIZATION NEED TO BE MORE BALANCED WITH REDUNDANCY, FLEXIBILITY AND DIVERSITY

If we know exactly how the world works, we can steer institutions with minimum inventory, minimum capital, minimum waiting times. However, in a complex world, a lack of redundancy often proves to destabilize the entire system. Bank capital shortages during a financial crisis and intensive care capacity shortages during a pandemic are examples of poor redundancy management in a complex environment.

Unfortunately, redundancy alone is not the (only) solution in a complex world. It is hard to say how much redundancy is enough in a fundamentally uncertain world. This implies that one must use other design tools as well. Instead of having an infinite amount of equity capital, a bank can also deal flexibly with its loan capital (convertibles) and make solid agreements about how other debt securities are written off in the event of a (near) default. In a complex system, the default of a financial institution is in most cases favorable to the (still common) practice of keeping them alive with lots of government support. Bankruptcies are part of a healthy economy. Setting up a tense system to prevent bankruptcies at all costs will make all institutions become increasingly homogeneous in their structure and behavior because of very strict, unambiguous regulations. Identical balance sheet construction and "exit" strategies in case of a crisis ensure that the connectedness of the system becomes extremely high. Reducing risks at the micro level leads to increasing system risks at the macro level. This applies to regulations, to CCPs, to monetary policy worldwide and so on. Centralization and lack of diversity create dangerous unstable systems because of a "control" tendency. Therefore, diversity in the strategies of institutions is a great asset if systemic risk is to be kept low. More principle-based and less rule-based regulations fit in with this, among other things. The publications by De Haan (2019) and Broeders (2018) have shown that regulators are increasingly aware of this. However, so far it is often only a few people within these institutions who really have this micro-macro paradox on their minds.

Learning is also different in a "complex" world than in a "complicated" world. A complicated worldview assumes stable processes and when mistakes are made, it is often investigated who made the mistake. Dismissal or better training are logical actions from the perspective of this worldview. In a complex world, people think more in terms of understanding changing systems, where the system must be (re-)organized in such a way that human errors have limited consequences. The studies by Hollnagel (2006) and Dekker (2017) have shown that the root cause of most disasters does not lie in individual human errors, these are just symptoms. Instead, they lie in a complex system that, through a drive for "optimization" and at the same time a quest for "zero -risk" (of the known, small risks) makes itself more fragile and more sensitive to calamities. "Drift into failure", is how Dekker (2017) described the endogenous processes that make complex systems such as companies less safe. In a complex worldview, from the bottom up, people play a major role in helping to realize a better design. A lack of learning in a financial organization about the system as a whole and too much focus on managing from the top-down and preventing small local risks, here hoping that large risks will not materialize, often have the opposite effect.

Thus, complexity thinking is not only useful for understanding complex financial markets, but also for understanding complex adaptive financial institutions and companies that operate in an equally complex external environment.

By analyzing complex processes in financial institutions, risk management and compliance can better understand how certain rules may reduce risks at the micro (silo) level, but lead to increased risks at a macro (company) level. For example via the impact on other departments (workload, lead time, pressure on customer service) leading to fraud or other forms of "rule insubordination". With all the associated feedback loops. There are several known cases – without going into the names – of signature forgeries as a result of compliance-related long lead times and customer burden that employees found embarrassing and unacceptable. Unfortunately, the solution was often to fire these people instead of changing the system. Viewing a company as separate departments and not as a system is just as

dangerous as an equilibrium model in the economy that ignores endogenous change.

Again, supervisors should also embrace a system approach. Currently they contribute strongly to a silo approach, imposing rules per risk factor without a system view and, with their many rules, ensure a homogeneous landscape of financial institutions and a fragile ecosystem.

A GOOD DECISION-MAKING PROCESS DOMINATES A GOOD ANALYSIS

The influence of the growing insights in the cognitive field of behavioral finance and behavioral economics on the finance professional goes beyond including human behavior in agent based and other models. Human behavior is not only observed to better understand how the world works. The knowledge about pitfalls and noise in our decision-making process – both at the individual level and group level – can also be directly incorporated into improving the way we make decisions in those organizations operating under fundamental uncertainty.

We have realized that our risk perception and the entire decision-making process suffers too much from a large set of biases. Extensive research by, among others, Tetlock (2015) and Lovallo (2010) has revealed that groups of amateurs who follow a thorough process make better estimates of the expected outcomes and better decisions than individual top specialists (the so-called 'experts'). Lovallo (2010) even concluded that the quality of the process has a six times greater effect on the quality of a decision than the quality of the analysis. Broader thinking by individuals and balanced group processes can, when combined, lead to significantly better decision-making processes.

The most effective approach is to use tools that prevent individual and group biases. Thus, the process of working towards a decision is structurally an important instrument in producing sound decisions in the context of the company's objectives and risk appetite.

Tools to assist individuals and the group think more broadly and not to fall into pitfalls such as overconfidence, confirmation bias, affect heuristics and Groupthink include:

- Scenario thinking in the broad sense of the word (Van der Heijden, 2004),
- The Delphi method, Triangulation (Dalio, 2019),
- Premortem (Klein, 2007) and
- Pre-commitment.

This is far from an exhaustive list. An increasing stream of the literature, including Grant (2021), Johnson (2018), Heath (2013) and Kahneman (2021) has provided scientifically sound but very practical procedures and checklists to reduce various biases and unnecessary noise in our decisions.

The (financial) business community is also slowly but surely starting to use these techniques more and more. This is apparent from, among other things, the increasing flow of publications in this area by banks and asset managers, as well as the increasing number of behavioral researchers and behavioral risk managers at financial institutions and regulatory and supervisory bodies.

HOW WILL THE FINANCE PROFESSIONAL OF THE FUTURE WORK?

Among other things, the above implies that the finance professional must be very critical of assumptions and be well aware of how relevant the incorrectness of the assumptions can be for the results of the model. The standard models that make extensive use of statistics, such as Value at Risk and Asset and Liability Models, can provide insights into changes in a risk profile over time. However, these models provide little insight into the absolute risks. We can only imagine extreme risks in a dynamic system and not express them in probabilities. This makes embracing different models relevant in understanding under which circumstances certain regulations, centralization of activities and so forth can be counterproductive. Different models will also better prepare financial institutions for the next major crisis. Various scenario tools including stress testing, long-term worldviews, pre-mortem and gaming tools, are part of the diverse group of models that should be applied. When applied in a structured way, these tools make companies more adaptive to change. We need to focus on consequences of scenarios and related actions: both in terms of actions now and pre-commitments, conditionally on certain deeply conceptualized scenarios. Imagination is key. It's not a surprise that the saying goes that the root cause of any crisis is a failure of imagination.

> WE NEED TO FOCUS ON CONSEQUENCES OF SCENARIOS AND RELATED ACTIONS, BOTH ACTIONS NOW AND PRE-COMMITMENTS, CONDITIONALLY ON CERTAIN DEEPLY CONCEPTUALIZED SCENARIOS

An important competence of the risk managers, portfolio managers and supervisors of the future is the ability to deal with ambiguity that is simply part of fundamental uncertainty. This will enable a multidisciplinary thinker to function well in a world that embraces complexity. Certainly at a senior level, it is a crucial quality to be able to lead a group process well and – instead of dominating it – to get the right information to the surface via various de-biasing processes. A company like Bridgewater has been selecting its people for this characteristic for decades.

In summary, the more conventional finance approach and the emerging complexity approach can be contrasted as shown in Table 1. However, it should be noted that the table is an exaggeration, and both approaches regularly (partly) embrace aspects of the other paradigm.

Table 1:
Differences in thinking between conventional finance and complexity finance

Conventional finance	Complexity finance
Risk is measurable	Fundamental uncertainty
One (dominating) worldview	Diversity of worldviews
Stochastic (equilibrium) risk model	complexity models, scenario models
Preferences fixed	Preferences change; feedback loops
Equilibrium plus external shocks	Endogenous instability; between order and chaos
Efficiency and specialization	Redundancy and flexibility
Rule based homogeneity	Principle based diversity
Focus on probabilities	Focus on consequences
Analysis is key	Process of de-biasing is key
Top-down mechanical control	Bottom-up system resilience

A FUNDAMENTALLY UNCERTAIN PARADIGM SHIFT

Of course, the future perspectives discussed above are not the only changes that are imminent in the field of finance. For example, much attention will be paid to the better integration of climate change, geopolitical developments and demographic changes in risk management. In addition, improved data analytics and artificial intelligence will play a greater role in more "complicated" risk areas such as (parts of) credit risk and insurance.

However, the claim in the current article is that the complexity theory approach and related areas will become more dominant. Whether and how quickly the transition to a different way of working, one that is based on more pluralist models, less rule-based regulations and better decision-making processes, will take place within education, financial institutions and regulators is also an unpredictable social phenomenon of a paradigm shift. Any assertion here would contradict the previous analysis about the unpredictability of critical tipping points in complex systems.

Twenty years ago, physicist Stephen Hawkins suggested that the twenty-first century could well be the century of complexity theory. It would be great if this new paradigm could soon find its way into the practice of the risk and finance professional. This does not magically lead our institutions to be "in control", but it will make them more resilient and adaptive. And that is exactly what is needed in a complex world.

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Notes

1 A positive feedback loop is a feedback mechanism in which the factors reinforce each other, so there is no stabilization but instead destabilization with often negative consequences. A negative feedback loop is stabilizing. The terms "positive" and "negative" are often confusing here.

2 Complexity Theory seems to have been "born" when the Santa Fe Institute (see www.santafe.edu) was founded in 1984. Especially starting in 1990s, a large group of top scientists (including several Nobel Prize winners, among others the economist Kenneth Arrow) from various disciplines started to work together with successful results. They conducted research into emergent properties of complex adaptive systems in biology, physics, economics and so forth.

3 Google Books Ngram Viewer shows that the use of words like Agent Based Modelling, Complexity Economics and Network Theory shows a growth of 300% to 1000% from roughly the beginning of the millennium. The use of words such as Neo-Classical Theory and Equilibrium models has been structurally declining since the beginning of this century. Value at Risk, introduced in the 1990s, has gradually declined since the 2007 crisis.

4 Examples include the Institute for New Economic Thinking (INET) at the Oxford Martin School, London School of Economics (LSE) Complexity Group, University of Amsterdam Center for Non-Linear Dynamics in Economics and Finance (CENDEF) and the University of Groningen Center for Social Complexity Studies (GCCS). An example of a multiform economics curriculum is CORE (Curriculum Open-access Resources in Economics www.core-econ.org). The co-founder is Sam Bowles of the Santa Fe Institute.

5 In a distribution that follows a power law, a relative change in one quantity implies a proportional relative change in the other quantity.

6 In practice, a power law probability distribution does not even have a finite standard deviation, which makes it difficult for financial professionals to work with it. In addition, the parameters are difficult to estimate, because it requires many observations in the "tail". This requires data going back decades into the past. However, the system has changed so much over time that these data no longer represent the system.

7 See for example (IMF Working Paper WP/18/39 "How Well Do Economists Forecast Recessions?" Z. An, Tovar Jalles, J., Loungani P., March 2018. See further analysis on the predictive qualities of "experts" in Tetlock (2015).

8 In this context, it is strange that economists advise not to put all your wealth in the stock of one company, but to entrust all your wealth to one world view.

9 Optimization takes place in many stochastic models – so with one single world view – which makes the outcome fragile for that world view. There are, however, models for "robust optimization". Klerkx (2022) showed that by including different world views (scenario sets) and by performing a mini-max optimization (with a kind of game-theoretical concept that the "opponent" is allowed to determine which scenario is used), the resulting solutions are more robust to different worldviews.

Unfortunately people are not donkeys

I was editor-in-chief of VBA Journaal from 2001 until 2008. We had just emerged from a period when most of the articles that we received were written by academics. Quite often, this meant that the content of the magazine and the requirements and interests of our readers were not properly aligned. From 2001 onwards it was mainly authors who actually worked in the financial sector that provided us with articles. In the beginning, this took some effort on our part, but the process became easier as time went on – especially because as editors we actively tried to come up with interesting themes and looked for authors to match.

The dominant theme in the 2001 – 2008 period was pensions. Articles were written about subjects such as performance measurement at pension funds, the introduction of the Financial Assessment Framework and the investment policies of pension funds. In that respect, not much has changed yet in the financial sector. Pension funds are still very much in the spotlight, although currently the focus is on the introduction of a new pension system. The strong focus on pension investing is not just a reflection of the substantial size of pension assets in the Netherlands (around € 1,500 billion), but also of the amount of knowledge regarding pension policies that is available in the Netherlands. Another subject that was much discussed during this period is alternative investments, including hedge funds, infrastructure, commodities and private equity. During those years, many institutional investors in the Netherlands made room in their investment portfolios for alternative investments. That has not changed over time, although the composition of these investments has. Most institutional investors in the Netherlands do not (any longer) own hedge funds or commodities.

Interestingly, around 2008 the first articles about factor investing and socially responsible investing began to appear. We had no idea then that these forms of investment were destined to become so prevalent. They also remained important themes in VBA Journaal after 2008.

When I joined as editor-in-chief, we were still dealing with the aftermath of the TNT crisis. The value of the S&P 500 had almost halved and the economy was in the throes of a recession. At the end of the 1990s all of us briefly believed that this time everything would be different, that a new era had begun, characterised by strong economic growth owing to presumed productivity gains that would be realised due to all sorts of new technological applications. In 2000 we came to the conclusion that we had been wrong. Again, we had let ourselves get carried away by unbridled optimism. And yes, if you are optimistic you are also prepared to take more risk. And that is exactly what happened. Of course we would never let this happen again. Because, as a Dutch saying goes, a donkey generally does not trip over the same stone twice! But unfortunately, people are not donkeys

When I retired as editor-in-chief in 2008, we were once again in midst of a crisis. This time it was a credit crisis linked to the US housing market. The factors that contributed to this crisis are diverse. For a start, there were the aggressive interest rate cuts by the Fed, which responded to the economic contraction by cutting its official rate from 6.5% to 1% in the space of one year. The accommodative monetary policy caused lending the soar. This was also reflected in house prices, as between

2002 and 2006 house prices rose at an average annual rate of 13% – 14%. And there was another problem. The quality of mortgagors deteriorated over time. These mortgagors not only included house buyers with a precarious financial position, but also financially healthy but excessively leveraged house buyers. Normally you would expect banks, as gatekeepers, to ensure that the risks remain limited, but unfortunately that is not how it works. Because they neatly repackaged those mortgages as structured products, had S&P and Moody's give them attractive ratings and subsequently sold those mortgages on to institutional investors. These transactions generally made the banks money. In order to arrive at their ratings, the rating agencies only used their rearview mirrors and as a result, many subprime mortgages had high ratings. For institutional investors a high rating was sufficient guarantee that all was in order. In the end, the whole house of cards collapsed, causing sharp price falls on the equity and bond markets, as well as another economic recession.

The common ground between the crisis of 2000/2001 and the 2008 crisis is human behaviour. In the years that preceded the credit crisis we also saw unbridled optimism. Taking on a huge amount of debt to buy a house was not a problem, because house prices would continue to go up. And on top of that, interest rates were very low, so that also meant that being highly leveraged was not a problem. Banks also had no problem with this. Of course there are always doomsayers who tell us that things cannot go on as they are, but you always get those. Things were fine in recent years, weren't they? Why would everything suddenly change. Right? The collapse of Lehman was the event that set off a financial avalanche and thus put paid to all the fantasies about eternal prosperity and good things never coming to an end. The most important lesson that 2001/2002 and 2008 have taught us is that people are incorrigible and have a flat learning curve and short memories. The longing for a positive narrative is so great that this blots out negative memories from the past. The positive take on this, is that it produces an interesting and dynamic market environment. A more important conclusion that we must draw, is that for financial market participants, effective behavioural supervision is essential, backed up by effective nudges and incentives. I doubt that this will prevent financial crises in the future, but let's hope that it will contribute to some damage limitation.

Hans de Ruiter
CIO Pensionfund TNO (former editor-in-chief VBA Journaal spring 2001 up to and including fall 2008)

Signals are green for quant investing

David Blitz and Pim van Vliet

In this article we will reflect on the developments in the field of quant investing and argue that the future looks bright. With decades worth of experience at actively navigating multiple investment cycles we have learned that a long-term winning formula can sometimes feel like riding a rollercoaster in the short run. Due to this cyclical nature quant investing is often more a test of character than a test of intelligence and 'strong hands' are a necessary condition for success.

The swift analysis of vast amounts of data is an obvious characteristic of quant investing that sets it apart from its fundamental sibling. But its key strength is its rules-based and systematic nature that results in objective outputs that strip out human emotions. Quant investing has become more relevant since more investors can get access to quant based mutual funds, ETFs, or direct indexing solutions. In this piece we primarily focus on the developments going on in research as well as what is needed to translate high quality research into excellent investment results. The main scope is equity market strategies, but we also discuss our view on quant fixed income, multi asset quant and other possible market applications.

As we have dedicated our careers to quant investing, we have had front-row seats to witness how effective it has been for investors over the long term. We discuss the move beyond traditional 'Fama-French' type factors to more innovative signals. We explore the opportunities next-gen quant techniques like machine learning and alternative data sources offer to predict not only risk and return, but also characteristics such as the sustainability of a firm. Quant investing has become increasingly a team play, which means culture will also be more important in the future.

DIGGING INTO THE ARCHIVES

First we will take a few steps back to provide a bit more context. The empirical foundations for equity factor investing were laid over 40 years ago. Sanjoy Basu outlined the value effect in 1977,[1] followed by the size anomaly discovered by Rolf Banz in 1981.[2] The three-factor model developed by Nobel prize laureate Eugene Fama and fellow researcher Kenneth French in 1992 provided the catalyst for increased attention and research on

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factors.[3] Hot on the heels of the seminal Fama and French paper, Narasimhan Jegadeesh and Sheridan Titman documented the momentum factor in 1993.[4]

This bevy of academic research helped to form the basis of our own personal education and inspired us to become early proponents of factor-based investing. We thought to ourselves, "could it be so easy to beat the market?", while reading the academic literature in the 1990s. And as young and ambitious practitioners, we made our own contribution by helping to establish the low volatility effect within equities in the mid-2000s.[5] Interestingly, this defensive factor has been largely ignored by academics, despite the abundant empirical evidence and research in support of it. However, the low-volatility effect has remained strong post-publication, and its popularity among investors has grown steadily. From the outset we have also embraced the momentum factor, notwithstanding the skepticism from academics who questioned its profitability after transaction costs.

In 2015, Fama and French built on their earlier work as they included the investment and profitability factors in their new five-factor model.[6] The, by then empirically proven, low volatility and momentum factors remained conspicuously absent though. Industry practitioners typically bundle the two new factors into a single theme called quality, which also consists of other financial statement health metrics, such as earnings quality.

QUANT CYCLES REQUIRE STRONG HANDS

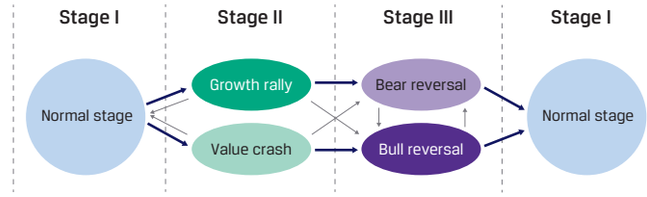
Through our experience as practitioners and researchers, we have observed that factors have offered a premium in the long term (pre and post publication), but tend to experience major bull and bear phases in the short run. The difficult quant bear phases come in different shapes, typically last 2-4 years and are driven by deeply entrenched cognitive biases that afflict investors.

That said, we have learnt that behavioral finance is not only a lens through which to view the world, but also a mirror to look at ourselves. Therefore in addition to employing a disciplined and systematic approach to keep emotions at bay and take advantage of market inefficiencies driven by human behavior, quant investors need to be stoic and tenacious to weather the bumps and bruises along the way, as we too are human.

Moreover, timing quant cycles has proven to be extremely hard. For instance, if we had changed our quant models by lowering our exposure to the value factor in various strategies due to its publicized struggles in the late 2010s, then we would have partially missed the recent rebound in performance. Similarly, investors typically make withdrawals after a prolonged period of underperformance, thereby locking in the losses and missing out on the subsequent reversals.[7]

To contextualize the cyclicality in factor returns, we mapped out a quant cycle by qualitatively identifying peaks and troughs that correspond to bull and bear markets in factor returns.[8] Traditional business cycle indicators do not capture much of the large cyclical variation in factor returns. Instead, major turning points of factors seem to be caused by abrupt changes in investor sentiment. Thus a quant cycle can be inferred directly from factor returns, which consists of a normal stage that is interrupted by occasional severe drawdowns of the value factor and subsequent reversals as shown in Figure 1.

Figure 1
Conceptual illustration of the Quant Cycle



Source: Robeco Quantitative Research

The normal stage prevails around two-thirds of the time and factors typically perform well during this phase. Value drawdowns, which usually occur once every decade and last around two years, are caused either by growth rallies or value crashes. The model also identifies two types of reversals: bear and bull. Bear reversals are distinguished by large positive returns for value due to a growth crash. By contrast, bull reversals are characterized by large negative returns for momentum.

Overall, we believe a better understanding of the quant cycle can help investors contextualize the behavioral dynamics of factors. This provides a basis to formulate a multi-year outlook by providing insight into how the cycle could potentially unfold based on the prevalent market environment. Moreover, our research highlights the benefits of perseverance during periods of weak factor performance.

More philosophically, the quant cycle plays a role in the persistence of factor premiums. As history shows, it is possible for factors to underperform for an interval as long as 10 years (a la value in the 1930s and 2010s). This leads some investors to give up in such instances as the waiting period is too long. Indeed, the occasional drawdowns that we witness often engender disillusion in the quant approach among investors.

This makes factor premiums difficult to arbitrage, because in the short run they are anything but risk free. As such, quant investing is ultimately more a test of character than a test of intelligence. In light of all this, we are confident that factor investing will remain alive and healthy for the foreseeable future.

FACTOR PREMIUMS ARE PERVASIVE

Our strong conviction is also supported by our finding that the low volatility, value and momentum factors have been effective since the mid-19th century, based on a proprietary US stock database that dates back to 1866.[9] This underlines that

these factor premiums do not depend on specific historical market structures. The deep 155-year sample also allows us to study infrequent macro events, from which we can infer that low-risk stocks generally exhibit resilience in times of recession, expansion, peace, war, deflation or inflation.

Most of the studies on quant investing revolve around the US, but the opportunity set is much broader. For example, factors also turn out to be highly effective in emerging markets.[10] It even seems that the grass is greener in emerging markets, perhaps because of the presence of many private, non-professional investors. The recent opening up of the Chinese A market to international investors offered a rare opportunity for true out-of-sample testing. It turns out that factors also thrive in this market which is known to attract many speculative investors.[11]

Beyond equities, quant investing can be applied to fixed income. In government bond markets, various signals can be used for duration timing.[12] In corporate bond markets, similar factors as in the stock market turn out to be rewarded.[13] As a result, the concept of multi-factor investing seems equally appealing for credits as for stocks.[14] Quant fixed income investing has the potential for enormous growth, but, in all fairness, we would probably have said the same thing ten years ago. Progress has been slow, similar to how Brazil has for a long time been recognized as the land of the future, but having a hard time living up to the high expectations.

In fact, some asset managers who had ventured into the quant fixed income space have since pulled out due to a lack of traction. This serves as yet another illustration that quant investing really requires the long view. In addition to stocks and bonds factors can also be harvested in other asset classes such as commodity markets and currencies, where they are commonly referred to as alternative risk premia.[15] The next step could be the application of quant strategies to cryptocurrencies and tokens on illiquid assets.

THE VERSATILE NATURE OF QUANT INVESTING IS ONE OF ITS KEY FEATURES

As mentioned earlier, one of the unique elements of quant investing is that it can be used to systematically analyze vast amounts of data. But what investors plan to achieve with the use of data is an important consideration. Anecdotally, we have noticed that people instinctually focus on returns when they think about the use of data in the context of quant investing. For example, academic papers on the use of machine learning in quant investing virtually all examine alpha generation. We believe it is important to consider not only on return, but also risk, sustainability and other important characteristics.

Risk can have an impact on how clients experience their investment journey, especially in volatile environments. Moreover, risk also plays a vital role in performance. For instance, avoiding investments in companies that subsequently experience financial distress can be helpful for investors.

While sustainability integration is by no means limited to any particular investment approach, quant strategies are especially suitable for this. Their rules-based nature makes it easy to integrate additional quantifiable variables in the security selection and portfolio construction processes. This enables quant investors to create a portfolio that strikes the right balance between sustainability preferences and risk-return expectations.

A quant approach also offers the flexibility to adapt to ever-evolving views. A decade ago, sustainability was all about exclusions and integrating ESG. Nowadays, the market focuses on SDGs, carbon footprints, calculating Scope 3 trajectories, measuring real-world impact in portfolios, etc. And for certain, we have not seen the last of these changes. Examples of upcoming topics are biodiversity and human rights.

Good quality data is required to address these issues. On the one hand, there is an increasing standardization of sustainability data for reporting purposes and to manage portfolio restrictions. While this data is being commoditized, it is not cheap. However, commercial data vendors could be disrupted if asset owners/managers make this data publicly available and free of charge.

Aside from the issue of data access, top-class technical skills are crucial for the development of proprietary sustainability data that is more effective than generic data and can also help generate alpha. This data 'arms race' will be an increasing hurdle for smaller quant houses with limited resources, whereas their larger peers could effectively harness their quant platforms to adequately satisfy evolving sustainability preferences.

Meanwhile, clients have differing beliefs and values, which can also evolve over time due to social developments. As such, we foresee increased demand for customized and flexible solutions that cater to client-specific financial and sustainability goals. The execution of such portfolios will likely require state-of-the-art infrastructure to facilitate the construction of customized strategies. This uniquely positions quant investing to benefit from these trends.

NEXT-GENERATION QUANT

Quant investing has traditionally relied primarily on price data and financial statement information. However, exciting new opportunities are opening up due to the big data revolution and advanced in computing power. This forms the basis for next-generation quant strategies, that use alternative data and machine learning techniques.

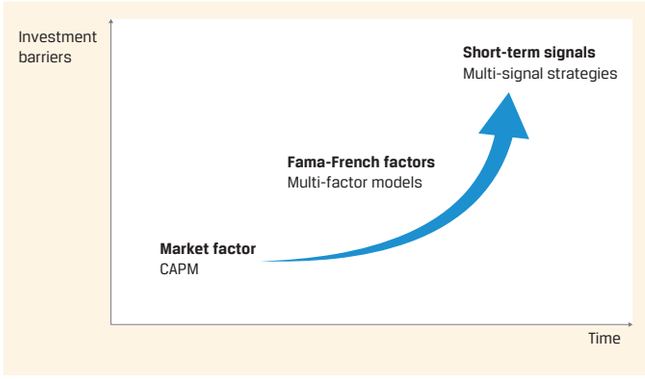
In our research, we outline how machine learning can help to predict the risk that a firm becomes financially distressed.[16] Risk is often non-linear. For instance, leverage levels might be fine up to a certain threshold, but risk could rise disproportionally beyond this level. Next-generation models can identify such patterns to better forecast stock crashes. As return databases grow in breadth and depth, the likelihood of successfully exploiting non-standard patterns should increase. Moreover, machine learning techniques can help us to better

understand how factors work and interact with each other. This can reveal some of the shortcomings of quant investing and risks associated with factors.

Next-generation models may also better cluster similar securities beyond traditional industry classifications. This could allow for more effective tracking error control, thereby improving the accuracy of relative risk forecasts which could lead to more stable outperformance. As mentioned, advanced methods can also be used to create new sustainability data. For example, this can be achieved by analyzing audio transcripts, decomposing capital expenditure and R&D data, or web scraping.

In addition, next-generation quant strategies can be designed to target sources of alpha that are orthogonal to existing factors. For instance, short-term signals are uncorrelated with traditional Fama-French factors because they change frequently. In a recent paper we show that these alpha signals can be captured and exploited when multiple signals are integrated and an efficient trading approach is used.[17] In Figure 2 we show conceptually how short-term signals may enable investors to go beyond the standard Fama-French framework. It shows the move from passive to factors and on to signals over time, but also increasing investment barriers which need to be overcome to translate these new signals into positive net alpha.

Figure 2
Beyond Fama-French factors



Source: 'Beyond Fama-French: alpha from short term signals' SSRN working paper 2022.

CULTURE EATS QUANT STRATEGIES FOR BREAKFAST

Peter Drucker supposedly said "culture eats strategy for breakfast".[18] Relatedly, quant investing has increasingly become a 'team sport' over time. Staying ahead of the curve with cutting-edge research calls for investing in state-of-the-art infrastructure and employing smart people. As the saying goes, the bamboo that bends is stronger than the oak that resists. In other words, failure to take into account the future needs of investors and evolve will likely result in asset managers being left behind.

However, it is more important than ever to carefully look for genuine signals in this era of burgeoning data sources and modeling techniques. With more data, there is increased risk of data mining or uncovering spurious results. The issue here is that some patterns may come out as statistically significant, when in fact there is no real underlying phenomenon. Within academia the problem of 'p-hacking' is now much more acknowledged than say 10 years ago.[19]

Thus, we believe in a cautious approach to innovation. Our investment philosophy of evidence-based research, economic rationale and prudent investing also applies to new variables or methods. Although some new signals might not have long histories, the coverage should at least be sufficient and preferably span across multiple markets worldwide. The quality of the data should also be sufficiently high, while variables have to pass our stringent falsification tests. We often find that many new promising variables fail at this stage of testing.

This should be underpinned by a strong culture that rewards high-quality research. Meritocracy is central to this, as the best ideas should always win, regardless of who proposes them. For this to happen, a flat structure and direct communication that offers everyone an opportunity to engage and speak up is key. In other words, a culture where junior members can safely challenge their seniors and contribute to discussions. This competition of ideas helps to shape an innovative research agenda.

A team-based approach is important as the problems that need to be solved in quant investing have become increasingly complex, and often call for cooperation across disciplines. In this sense, quant investing is very much a 'team sport'. In terms of actual research, a strong research protocol is required to separate sheep from goat factors in an ever-expanding zoo of factors.

Remaining ahead of the curve requires awareness of the innovator's dilemma, meaning the willingness to disrupt or falsify one's established approach, beliefs or solutions. This is a tough concept to follow since many biases need to be overcome. That said, it is a great method to stay honest and to future-proof the investment process.

Innovation is not a goal in itself and must be conducted with a long-term horizon. This means prioritizing sustainable innovation that will endure the test of time, which in turn requires strategic investments in infrastructure and people over time. A collaborative approach is also crucial to this. For example, encouraging all researchers to improve the shared code base which helps to guard against complexities that can stifle innovation down the line.

QUANT INVESTING IS MORE A VOCATION THAN AN OCCUPATION

Ten years ago we might have said that most research questions would be answered by 2022. Instead, we probably have more questions today than we had a decade ago. We have experienced that quant investing is easy and difficult at the same time. We have also learnt to maintain 'strong hands' when we encounter challenging phases of the quant cycle. Now, we are facing a fast-developing world in which data and computing power is swiftly increasing, giving rise to next-generation quant.

Asset managers have been entrusted by their clients with their savings. Asset managers who are responsible stewards of capital can help clients to achieve their financial and sustainability goals. This means exercising prudence in the decision-making and alignment of objectives by also investing one's own capital in the same strategies. We derive great pleasure and purpose from our jobs as we continuously undertake sustainable innovation to deliver quality results for our clients.

From an asset owner perspective we believe that quant investing will become an even more important part of the investment toolbox. More specifically not only helping them to deliver high returns over the full investment horizon, but also in an increasingly sustainable manner. Quant premia are often uncorrelated or even negatively correlated with the classical equity and bond market premiums. After a 10+ years long bull market in which equities and bonds were strongly supported by very loose monetary policy we are now probably entering a new macro regime. A world with lower growth, higher macro uncertainty and lower real returns. Since most asset owners have horizons of more than 5 or even 10 years quant investing is ideally suited to help them grow and preserve capital.

Therefore in our humble and admittedly biased opinion, we firmly believe the signals are green for quant investing!

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VBA Journaal
is a publication of CFA Society VBA Netherlands.
CFA Society VBA Netherlands is the trade name of CFA Society Netherlands.
The VBA Journal is published four times a year.

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Subscription rate 2022:
€ 53 including vat and postage costs

Layout and realization
az grafisch serviceburo bv,
Den Haag. www.az-gsb.nl

Cover design
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ISSN-number
0920-2269

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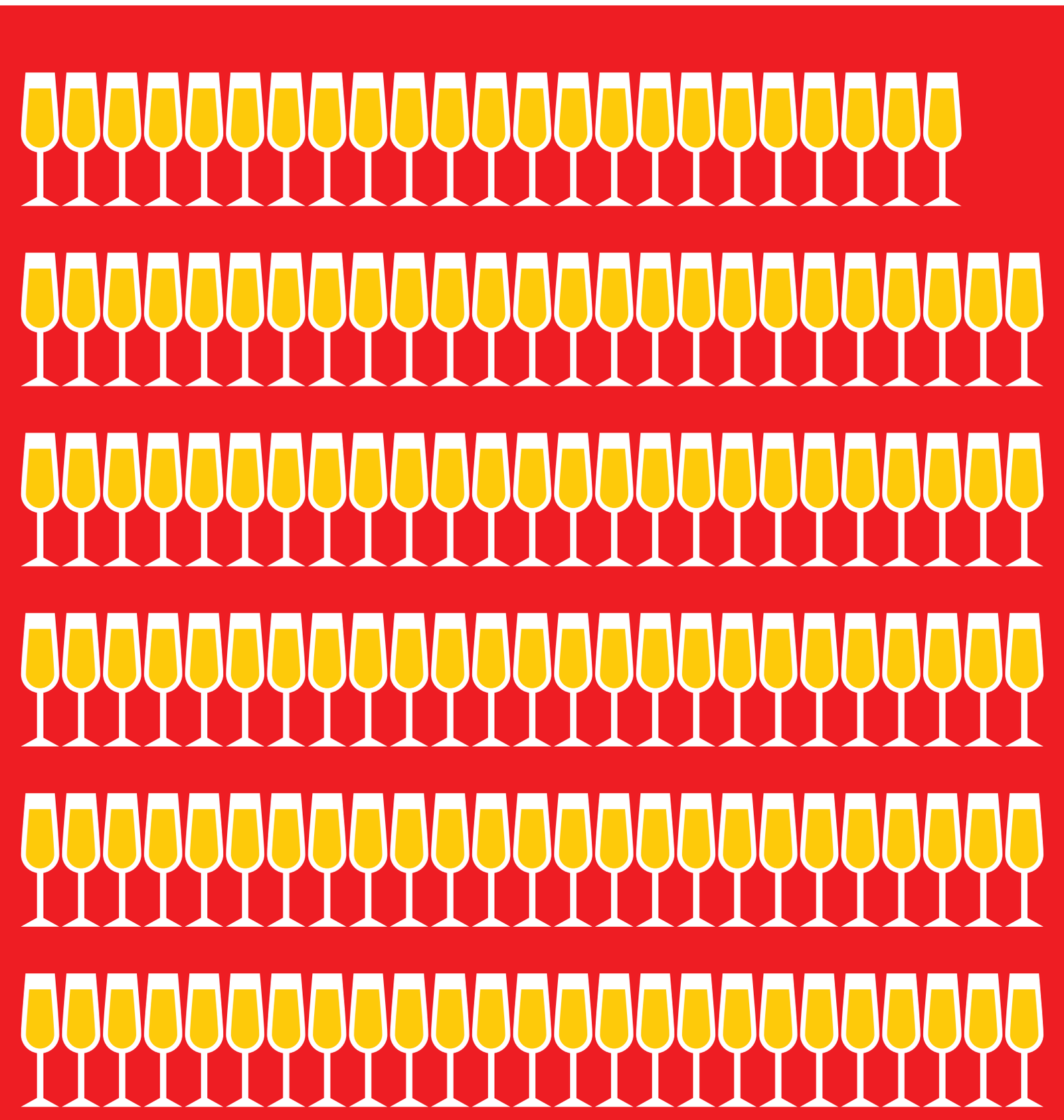
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