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>> **Triangle**
Dirck Bouwhuis

>> **Parents of the Board**
Emma & Dylan

>> **The Teacher**
Arthur van Soest

ASSET Econometrics

The Nekst Frontier

I grew up with science fiction, Star Wars, Blade Runner, The Matrix, universes filled to the brim with advanced technology, distant galaxies, characters finding themselves in dystopian futures and the struggle between humanity and machines. These stories spark imagination.

However, slowly but surely, these imaginations are becoming reality. Science fiction has long dreamt up technologies like artificial intelligence, space travel, and virtual reality, always placing them far into the future. Yet, nowadays, AI plays a role in our daily lives through voice assistants, self-driving cars and making our homework assignments with ChatGPT. Space exploration is no longer just government agencies sending satellites into space, now companies are shooting for an inhabitable Mars. Virtual and augmented reality, once only seen in movies, are now shaping gaming, education, and healthcare. Even genetic engineering, explored in sci-fi, is advancing with tools like CRISPR. The line between science fiction and reality continues to become thinner and thinner, bringing the future ever closer to our doorstep.

So you should check out articles like the Special about the tech leaders who are increasingly drawing inspiration from science fiction to shape future technologies. Also, check out: the Healthy Habits, which goes in depth on the impact that predictive modelling might have on healthcare.

Do not forget to take a look at the non-sci-fi themed articles as well, read about "The Bankruptcy Problem" in the Triangle or the Company Interview with the NS about their current work that is interesting to our field, and there is still much more to uncover as well!

Happy reading!

Kind regards,

Hedser van der Wel
Editor-in-Chief

Table of Contents

COLOPHON

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Event: Europe Trip

Meet the Board: Dylan Koenders

Company Interview: NS

Teacher: Arthur van Soest

Advertisements

Articles

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Anne Verbeek

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Johan Graafland
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Irene de Jong
Carlo Koenders
Liane Koenders
Mattijs Kroesen
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Tilburg University

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Dear Members,

For us econometricians, sci-fi is not such a far-off genre at all, as our field is already somewhat futuristic. We work with algorithms, simulate worlds that do not yet exist, and try to predict the future using data from the past. In this Dear Members, I want to take you on a journey through the recent adventures of our association, both on campus and beyond the stars.

These past few months, a lot has happened for Asset | Econometrics. Not only have we moved ships (or actually, moved across the hallway), our association also switched board members. After a year full of dedication, Jeroen and Rein have said their goodbyes, and Wouter and Amy have joined our team as the new Vice-Chairman and External Affairs Officer. This came with many fun events, like the Board Announcement Drink after the Christmas Dinner, the Department Member Meeting, and the Constitution Drink. We were delighted to see so many members come celebrate these big events with us!

In February, the students who are members of the constellation that is made up of the six econometrics study associations of the Netherlands gathered at the NBC for the annual National Econometrics Day, also known as the LED. We worked on interesting cases, had good conversations during the speed dates, and met plenty of new companies during the company fair. We also got to enjoy an opening and closing speaker.

The LED was not the only mission that we traveled for this year. This April, we entered a ship (airplane) and made our way to Sofia! Our crew swapped data sheets for city maps as we launched into a guided tour through the different layers of the city, from the Soviet time to the democracy it is now. We also got to observe a game of Rocket League (soccer) and participated in a competitive pub quiz!

Sci-fi remains a very interesting topic, not only for entertainment purposes but also for the future of econometrics and operations research. With the work of EOR researchers, hopefully, soon we will have robots solving OLS regressions faster than you can say “heteroskedasticity.” But for now, I am thankful that in this universe, I get to work on fun tasks like writing the Dear Members with silly sci-fi jokes. I am sure that in another, I am still working on debugging a Python code, where the only mistake turns out to be a missing comma…

On behalf of the board,

Emma Wieringa
Chairman Asset | Econometrics 2024-2025

Meet the Crew

Nick Drost - Consigliere

Hi everyone, my name is Nick, I am 23 years old and I am from the beautiful village of Putten on the edge of the Veluwe. I am currently in my seventh year of studying in Tilburg and I am finishing up my Masters EME and BAOR. I have been active at Asset | Econometrics for quite some time already, for example in the Active Members Weekend and Lustrum Trip committees. I still enjoy going to some events every now and then. Next to this, I am also a member of T.S.T.V. Lacoste and I am currently doing a board year as chairman at T.S.G.V. Under Par. If I am not in Boeka spinning the wheel or on the golf course playing a round of golf, you can find me in a nice restaurant.

Political Power of the Rich Heralds the Decline of the US

With the inauguration of Donal Trump as president of the US, Western capitalism is entering a new phase. An important element of Trump's economic policy is high tariffs on imports from other countries. This is at odds with the years-long policy of free international trade and is in conflict with economic freedom, which has always been a top priority in America.

Not only free trade is at stake, but also the rule of law and democratic principles. Because in the Trump government, many people from the business world participate in political power. The most striking example is Elon Musk, who has filled Trump's campaign with no less than 250 million dollars and has thus bought great political influence. The democratic principle that all citizens should have equal influence is therefore hopelessly lost.

Money as a means of power

With Trump, a government has taken office where money is becoming the language of power. This leads to a style of working that shows similarities with Putin's language of power. The only difference is the means of power that distinguishes the eastern and western Putins: while the Putin in the east uses military and inhuman violence to achieve his goals, the western Putin still relies on the somewhat softer coercion of big money. But the difference is relative, because Trump also incited physical violence at the Capitol in 2021 and now threatens to use military force against another NATO country if he does not get his way (getting possession of Greenland or natural resources of Ukraine).

Concentration of power and economic decline in historical perspective

The economic outcome of these unprecedented changes is uncertain. It must be said that the American economy has shown greater economic vitality so far than the European economy. But will this remain the case?

In this context, I am reminded of Bas van Bavel's book, entitled "The Invisible Hand: How Market Economies have Emerged and Declined since AD 500." In this book, van Bavel studies the economic development of Iraq, Italy, the Netherlands, the UK and the US in the past. He discovered a common pattern. Initially, markets developed in these societies with a relatively balanced socio-political structure. This balance ensured a more open and better functioning of land, labor and capital markets. But gradually the liberalization of these markets led to more inequality and the rise of new, powerful elites. These elites then used their wealth to increase their political power to strengthen their interests through the governance of the country. This exacerbated the growing inequality and hampered the economy. Markets began to collapse and, to maintain their power, elites increasingly used other forms of coercion to defend their interests. In all cases, the political power formation of the economic elite was an important cause for the onset of economic and social decline.

A similar pattern now seems to be emerging. While the Biden administration still focused on regulation to curb the great economic power of tech companies such as Meta, Google and Amazon, the Trump administration is preparing to abolish this type of regulation. This paves the way for further enrichment and concentration of power. But it also makes competition between companies more difficult, which will ultimately harm the economic dynamics in the US. ●

Johan Graafland

Prof. dr. Johan Graafland is a Full Professor at Tilburg University, specializing in Economics, Business, and Ethics. His research focuses on the intersection of economics, corporate social responsibility, and moral values. He has published extensively on topics such as sustainability, ethical behavior in business, and the relationship between religion and economic development.

Note: The views expressed in this piece are the author's own.

Emma's Parents: Mathematics, Music and More

written by **Stans Sonderkamp** and **Timo Klabbers**

On a Monday afternoon, we join on a Teams call with Emma's parents and, in just 45 minutes, get a fun and personal look into her family life. They share stories, laughs, and insights that help us understand where Emma gets her drive.

Irene studied at the conservatory and taught music until she had children. Combining work with family life was difficult, especially as a musician. She often had to work in the evenings, meaning she would be away when the children were home. So, when starting a family she quit and became a full-time mother. She did not only make music herself, but she also teaches. She enjoyed teaching, because it allowed her to build strong relationships with students. Although, all three children took lessons from her, they ultimately pursued other interests.

Rob studied mathematics in Eindhoven. When he was younger, he struggled a bit with languages, but the exact sciences were better. His math teacher also influenced his decision. During his studies, he balanced serious work with enjoying student life. His Master's program was more engaging since he had more freedom to choose courses and work closely with a professor. After studying, Rob worked in research at Philips for a while. He worked at the intersection of mathematics and computer science, focusing on formal logic in software. The 1980s software crisis led companies to adopt formal methods to reduce problems, but the complexity of large systems remained a challenge. In a big company, he often felt like a small cog in a machine. So, he moved to a smaller company with around fifteen employees. This was more rewarding, everyone knew each other, and his contributions felt valued. Now he is retired, which is a great time to take up his hobbies like ceramics, painting, and gardening.

Irene and Rob met through a relationship agency before the era of online dating. As Irene put it, "How you meet does not matter; it is what you make of it that counts."

They have three children, Emma is the youngest, after another daughter and a son. According to Emma's parents, Emma has always been emotional and expressive. As a child, when denied a cookie, she dramatically declared, "Papa, you have ruined my whole life!" She also had a strong sense of independence. Once, as a toddler, she packed a suitcase with stuffed animals and attempted to run away, making it only to the end of the street before returning home. Her adventurous spirit continued into her teenage years. At 15, she researched studying abroad and, after thorough planning all by herself, she convinced her parents. In her fifth year of high school, she spent half a year in California. While she enjoyed it, some expectations were shattered. She imagined grand Sweet 16 parties and exciting Halloween celebrations, but not everything matched the movies. On her 16th birthday, she invited classmates, but despite enthusiastic responses face to face, none of the American students showed up, an eye-opening cultural lesson.

In high school, Emma was good at math, but she also had a natural talent for languages, picking up English through online videos and music. In her later school years, she enjoyed small, interactive advanced mathematics classes, making the subject even more engaging. Choosing a study program was difficult. During university open days, she mostly ruled out what she did not want. Eventually, she settled on Online Culture, which she enjoyed, but by the end of her Bachelor's, she wanted a new challenge. Friends introduced her to econometrics, which intrigued her. Since she only had high school-level math, she had to complete a Pre-Master's program with nine courses within a year. To lighten the workload, she arranged to take some as electives during her Online Culture bachelor's. She finished in a year with her Pre-Master. After her board year, she only has her Master's thesis left.

When Emma decided to go to Tilburg, the next challenge was to find housing. Initially, she studied from home, traveling to the university by train. Unfortunately, Emma is cursed when it comes to trains, she had to face frequent train delays. Even to this day, when friends have to take the train, they ask what time Emma is leaving so that they can leave half an hour earlier. It is a good thing that she eventually found a place in Tilburg, living with other students. As the last of the three children to move out, her parents do miss her presence a bit, but fortunately they still see her regularly. Despite the distance, they stay in touch through calls and messages, which still remains even during her busy board year.
Her older brother Bram also did a board year, so she often turned to him for advice. Their conversations helped her navigate the challenges that came with the role. When the workload was high, Emma would call her parents to talk things through. These moments helped her regain perspective. Her parents, recognizing her dedication, reminded her of the importance of balance. While a board year is a valuable experience, Emma learned that knowing when to take a step back is just as important, a lesson she'll carry with her into the future.

Emma's parents always encouraged their children to explore their own paths. They never pushed them in a specific direction, but provided guidance when needed.

"Are You Really Going to do That?"

"At first, I thought: you are really not going to do that." Liane, Dylan's mother, had to get used to the idea that her son would be taking on a board position at Asset | Econometrics for a year. "You are doing so well in your studies, do you really want to do this?" But that feeling quickly changed: "You are still young, you can do it now, go for it!"

Dylan grew up in an active family. His parents, Liane and Carlo, met at a young age and have been together ever since. Sports play a big role in their lives, handball, cycling, skiing, even when things do not go entirely as planned, like Carlo's recent ski adventure. When they went, not only Carlo, but also their daughter Demi got hurt, so two victims.

While their own student years did not revolve around a vibrant social life, they see something different in Dylan. "He has really found his place, immediately moved into student housing, has an active group of friends, and now a board year. That was not the case for us back then." Still, they now fully understand his enthusiasm.

Dylan was always serious about his studies. "In high school, he did well with barely any effort, while his sister had to work really hard for her grades," his mother recalls. The transition to university took some getting used to, but he adapted quickly. Then came the board year. "He brought it up, and we thought: why would you interrupt your studies? But when he explained what he would gain from it, the experience, the network, we saw it differently. And everyone around us said: you have to do this!"

Now, Liane sees that it is more than just socializing. "At first, you think: a board year, how hard can it be? But you quickly realize there's a lot involved. Organizing, responsibilities, maintaining contacts, it is truly a full-time commitment."

Despite his busy schedule, Dylan stays involved with his family. His job as a package delivery driver on Saturday mornings ensures that he still comes home regularly. "He leaves again on Sunday afternoon by train, and sometimes we do not see him for three or four weeks. But we stay in touch, texting, sometimes calling."

Family remains important, even if he is not home often. "He has a strong bond with his grandmother and keeps in touch with his cousins. Even though he cannot be everywhere, he makes sure to maintain those relationships."

To outsiders, a board year might seem like a year full of parties and trips, but Dylan's parents see that it is much more than that. "You hear about the activities, the busy schedule, the responsibilities. Sometimes, during lunch, he really tells us how things are going, that is nice to hear." They have already visited his student housing once to see where he spends his time. "It gives you a much better idea of what it is like."

His mother remembers how, as a child, he was always calm and observant. "If something needed to be said, he would push his little sister forward and whisper to her what to say." He does not do that anymore, but the strategic mindset has remained.

His board year will undoubtedly stay with him for a long time, and Dylan's parents are proud of him. He has found a good balance: enjoying himself while also taking responsibility. And that is something to be happy about. ●

Negotiation in Bankruptcy Problems

Imagine a group of countries negotiating fishing quotas in international waters. To prevent overfishing, a total cap is imposed. Each country's claim is based on its historical fishing activity, but the total claims exceed the cap. Economists refer to such situations as *bankruptcy problems*, and they arise everywhere from vaccine allocation to debt relief. The central question: how to divide fairly when there is not enough to go around?

Bankruptcy problems and rules

A fascinating discussion of bankruptcy occurs in the Babylonian Talmud[1] (Kethubot 93a). In this ancient text, written nearly two thousand years ago, there is a parable about a man who dies, leaving behind three wives with different claims on the estate: 100, 200 and 300 respectively. The Talmud considers three scenarios, depending on the size of the estate (see Table 1). Despite its antiquity, the underlying logic behind the divisions remained elusive for centuries.Upon closer inspection, the **first row** reflects a principle of equality: the available amount is divided equally amongthe three persons, awarding each $33\frac{1}{3}$. In the **third row**, each person receives an amount proportional to their claim: person 1 receives 50 (which is half of 100), person 2 receives 100 (half of 200), and person 3 receives 150 (half of 300). However, the numbers in the **second row** at first sight look mysterious: they do not seem to correspond to any clear principle based on equality or proportionality. Moreover, an underlying principle governing all three cases does not seem to be present.

To better understand the nature of these divisions, we now introduce the formal notion of a bankruptcy problem. Let $N = \{1, \ldots, n\}$ be a finite set of players. Formally, a *bankruptcy problem* for N is a pair (E, c), where $E \in R_+$ denotes a positive *estate*, and $c \in R_+^N$ a vector of non-negative *claims*. A bankruptcy rule R assigns to every bankruptcy problem (E, c) an allocation $R(E, c) \in R^N$, such that $\sum_{i \in N} R_i(E, c) = E$ and $0 \leq R(E, c) \leq c$. In other words, a bankruptcy rule specifies for each bankruptcy problem a total division of the estate, where every player receives a non-negative amount, no more than their claim. The formal study of bankruptcy problems and rules began with O'Neill (1982). For an interesting survey, see Thomson (2019).

Estate	*Person 1 (100)*	*Person 2 (200)*	*Person 3 (300)*
100	$33\frac{1}{3}$	$33\frac{1}{3}$	$33\frac{1}{3}$
200	50	75	75
300	50	100	150

Table 1: The allocations prescribed by the Talmud for the bankruptcy problem with different estates.

The most well-known bankruptcy rule is the *proportional rule*, dating back to Aristotle. For every bankruptcy problem (E, c) the *proportional rule* allocates $PROP(E, c) = \left(E / \sum_{i \in N} c_i\right) c$, i.e. players all receive the same proportion with respect to their claims. Note that the third row of Table 1 corresponds to the allocations prescribed by the proportional rule. Another important bankruptcy rule, which corresponds to the first row, is the

[1] The Talmud is the textual record of generations of rabbinic debate about law, philosophy and theology, dating back to the 3rd century.

constrained equal awards rule. For every bankruptcy problem (E, c), the rule allocates to every player $i \in N$, $CEA_i(E, c) = \{\lambda, c_i\}$, where $\lambda \in R_+$ is such that $\sum_{i \in N} \{\lambda, c_i\} = E$. The constrained equal awards rule allocates every player as equally as possible, under the condition that no player receives more than their claim.

Both the constrained equal awards rule and the proportional rule offer natural ways to divide the estate. However, as we see in Table 1, neither alone fully explains all cases. It was only in the 1980s that a systematic principle underlying these allocations was uncovered. In the seminal work of Aumann & Maschler (1985), it is shown that all three cases of Table 1 can be described by the *Talmud rule*. For every bankruptcy problem (E, c), if $(1/2)\sum_{i \in N} c_i \geq E$ then the Talmud rule allocates $TAL(E, c) = CEA(E, c/2)$, and if $(1/2)\sum_{i \in N} c_i \leq E$ then $TAL(E, c) = c - CEA\left(\sum_{i \in N} c_i - E, c/2\right)$.

Are there reasons to prefer one rule to another? Theorists working on bankruptcy problems have been comparing different bankruptcy rules based on several properties that include monotonicity, order-preservation, symmetry, duality, consistency, and many more. The study of bankruptcy rules based on their fundamental properties is called the *axiomatic* approach. In many practical situations, however, no formal rule dictates how resources are divided. Instead, outcomes emerge through ad hoc negotiations. The research presented in this text focuses precisely on such situations, using tools from non-cooperative bargaining theory to analyze negotiation in bankruptcy problems. This work is based on joint research with Ruud Hendrickx and Jean-Jacques Herings.[2]

A bargaining approach to bankruptcy problems

In the non-cooperative approach to bankruptcy problems, a non-cooperative game is constructed based on the underlying bankruptcy problem. If the equilibrium outcomes of this game correspond to the outcomes prescribed by a certain bankruptcy rule, then it might be argued that this constitutes a *strategic justification* for this rule. In contrast to axiomatic approaches that assume fairness principles from the outset, the non-cooperative approach lets fairness *emerge* from strategic behavior. However, the axiomatic and non-cooperative approach are meant to complement each other and have been influencing research both ways.[3]

We build on the well-known Rubinstein bargaining model – a foundational framework where players alternate in making offers over time. Let (E, c) be a bankruptcy problem for N. In this model, all players have equal opportunities to make and respond to a proposal. Every round $t = 0, 1, \ldots$ a player $i \in N$ is recognized with probability $1/n$ as the *proposer*. The proposer selects a proposal p^i from the *feasible set* X, where

$$X = \{x \in R_+^N \mid \sum_{j \in N} x_j = E, x \leq c,$$

$$for\ all\ k, l \in N\colon\ c_k \leq c_l\ implies\ x_k \leq x_l\}.$$

In other words, proposals are efficient allocations of the estate which are bounded by the players' claims and respect the order of the claims.

[2] For the discussion paper, see: Bouwhuis et al. (2024).

[3] The bridge between non-cooperative and axiomatic analysis is studied in the *Nash program*: see Serrano (2005).

After player i has proposed $p^i \in X$, the other players vote to either accept or reject the proposal. The first voter, say player j, is selected out of $N\backslash\{i\}$ with uniform probability. If player j accepts, then the next voter is selected out of $N\backslash\{i,j\}$ with uniform probability, and so on. If any player in the voting stage rejects the offer, the bargaining procedure moves to period $t+1$, and the next proposer is selected out of N with uniform probability. We assume that the preferences of the players over the lotteries in the game can be represented by *von Neumann-Morgenstern* utility functions. If in period T every player has voted to accept a proposal $x \in X$ then, the utility of every player $i \in N$ is equal to $u^i(x,T) = \delta^T x_i$, where $\delta \in (0,1)$ is the *discount factor* of the players. This discount factor makes time costly – it pushes players to reach agreement and is crucial to ensure the model makes precise predictions.

Solution concepts: why refinements matter

One might wonder: what insights does game theory give into the outcome of this bargaining process? In what follows, I discuss why standard equilibrium concepts fall short, and introduce a refinement that selects a unique outcome converging to a well-known bankruptcy rule.

In this bargaining game, a *strategy* for a player is a complete plan of action that specifies what the player will do at every point where they might have to make a proposal or a voting decision. It tells the player what to choose in every possible situation they could face in the game, even if some of those situations never actually occur. Note that this game is an infinite extensive-form game, and there is an enormous amount of strategy combinations.

A natural starting point is the concept of **Nash equilibrium**, the standard solution concept in strategic games. A strategy profile is a Nash equilibrium if no player can gain by unilaterally deviating from their strategy, given the strategies of the others.
However, in dynamic bargaining models, Nash equilibrium is often too permissive: it allows players to make *non-credible threats*. For example, a player could threaten to reject any offer except for ones where this player is fully compensated. The best response for the others is to concede. As a result, almost *any* division of the resource can be sustained as a Nash equilibrium, making the concept too weak to give precise predictions.

To resolve this, economists use **subgame perfect equilibrium (SPE)**, which refines Nash equilibrium by requiring that also *in every subgame* the strategies constitute a Nash equilibrium. While this eliminates non-credible threats, it often still leaves us with many equilibria, especially when there are more than two players. Complex punishment strategies and other convoluted forms of strategic behavior – some quite unreasonable – may arise in equilibrium outcomes.

To regain predictive power, we focus on **stationary subgame perfect equilibria (SSPE)**. In these equilibria, strategies do not depend on the history of play but only on the payoff-relevant aspects of the game. SSPEs are particularly attractive in symmetric or repeated environments because they capture *stable, time-invariant behavior*. In our case this means that players always propose the same amount, regardless of the previous (rejected) proposals by other players, and base their acceptance decisions only on the proposal that is on the table at that moment. Stationarity assumes that players react only to the current offer, based on what they expect to receive if the offer is rejected, without keeping track of every twist in the negotiation.

For every player $i \in N$, a stationary strategy is a pair $\left(p^i, A^i\right)$ where $p^i \in X$ is the

proposal that player i makes when selected as the proposer, and $A^i \subset X$ is the set of proposals that player i is willing to accept.

Analysis of SSPEs

Given a strategy profile $(p, A) := \left(p^i, A^i\right)_{i \in N}$ of stationary strategies, we can define expected payoffs $y(p, A) \in X$ for the players. These are the ex-ante payoffs the players expect before a proposer is selected. Now, consider a situation where player $i \in N$ is selected to make a proposal. If a responder $j \in N \backslash \{i\}$ rejects the offer, their expected continuation payoff is $\delta y_j(p, A)$, where δ is the common discount factor. This continuation value is called player j's *reservation payoff* – the minimum amount j is willing to accept. Therefore, for a proposal $x \in X$ to be accepted it must hold that for every $j \in N \backslash \{i\}$, $x_j \geq \delta y_j(p, A)$. Among all such proposals, player i chooses one that maximizes x_i. For every combination of expected payoffs $y \in X$, let $\alpha^i(y)$ denote the set of such proposals. In the paper, we show that proposals $p^1, \ldots, p^n$ are part of an SSPE if and only if for every $i \in N$ it holds that $p^i \in \alpha^i\left((1/n) \sum_{j \in N} p^j\right)$. Using Kakutani's fixed point theorem[4] we show that there exist such proposals. Furthermore, we can show that, as the discount factor δ approaches 1, for every player $i \in N$ with $c_i \leq E/n$, it holds that $y_i \to c_i$. In other words, as the players get increasingly patient, the expected payoff of 'small claimants' converge to their claims.

Robust bargaining equilibrium

In many bargaining models, the refinement of SSPE leads to a unique outcome. A key property of our model is that the uniqueness of SSPE is in general not guaranteed. If a proposer is able to make an acceptable proposal in which this player is fully compensated, then often many such proposals are accepted – all of which this player is indifferent between. Moreover, as the players get increasingly patient ($\delta \to 1$), this indeterminacy does not disappear. To address this indeterminacy, we introduce a refinement called *robust bargaining equilibrium.* In a robust bargaining equilibrium, the proposer selects – among all proposals that will be accepted and between which this proposer is indifferent – the one that distributes the amount proposed over reservation payoffs of the responders as evenly as possible. This selection criterion provides a natural and systematic way to resolve indifference: it maximizes the minimum surplus above reservation payoffs, then the next smallest, and so on.

We show that for every $\delta \in (0, 1)$ there exists a unique robust bargaining equilibrium $p(\delta)$. The main result of our paper is that for every $i \in N$, we have that as $\delta \to 1$ it follows that $p^i(\delta) \to CEA(E, c)$. In other words, as the players get increasingly patient, every proposal in a robust bargaining equilibrium converges to the outcome prescribed by the constrained equal awards rule applied to the underlying bankruptcy problem.

If you are interested in how game theory can provide insights into fairness, negotiation, and resource allocation, feel free to reach out!

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Dirck Bouwhuis
PhD Candidate Econometrics

Why Your Train Departure Time Is Not Random

written by Timo van Oorschot and Maik Maas

A short transfer at a railway station, the lack of a direct train to your destination, or an inconvenient arrival time that doesn't align with your lecture. These are struggles many travelers face at some point. This might make you wonder: how are train schedules actually determined? Are these transfer times and arrivals coincidences, or is there a well-reasoned system behind them? To find out, we traveled (with a transfer) to the headquarters of the Dutch Railway Company (NS), where we spoke with Simone Griffioen and Marije Siemann to understand how train schedules are made.

Marije studied Applied Mathematics at the University of Twente, specializing in Operations Research during her Master's. She began her career at a bus company, where she used mathematical solvers to create bus and personnel schedules. However, she soon realized that she wanted to develop the solvers herself rather than just using them. This led her to join NS, where she now works in the "Solver Engineering" department.

Marije Siemann

Her role involves designing advanced solvers for complex planning problems, such as Mixed Integer Programming (MIP) solvers. These tools are used to optimize scheduling challenges across NS.

Simone studied Mathematics in Groningen and later completed a Master's in Logic in Amsterdam. After her studies, she realized that she enjoyed the programming aspect, which led her to apply for an IT traineeship at NS. She began her career at NS International as a Java developer but soon realized she missed working with mathematical frameworks. After completing her traineeship, she transitioned to the same department as Marije and eventually moved into her current role. As a Business Consultant, Simone ensures that the solvers developed by Marije's team are effectively implemented within NS. She serves as the crucial link between the users, researchers and the IT team, making sure that the tools being developed align with NS's needs while also ensuring their successful application. Beyond this, Simone plays an advisory role. Positioned between multiple departments, she has a broad perspective on processes that can be optimized. For example, she identifies how personnel planning and rolling stock planning influence each other since train schedules impact staffing needs. She then helps improve such interactions.

Since timetable design is one of the most crucial areas where NS uses optimization tools, we asked them how the timetable is ultimately developed.
The timetable is created in two steps. The first step involves determining train routes ("lijnvoering"). This means deciding which routes the trains will take and how frequently they will run. During this phase, planners determine how many passengers will need to transfer during their journey. This is an important factor since passengers dislike transfers. Customer research at NS has shown that passengers have a "transfer resistance" of about 15 to 20 minutes. This means that passengers prefer staying on a train for 15 extra minutes rather than arriving faster but having to transfer. This is one

Simone Griffioen

reason why NS is introducing more long train routes, such as a train starting in Dordrecht and traveling via Amsterdam and Utrecht to Venlo, Marije explains while pointing at the NS route map.

To optimize routes, NS uses a model that takes into account the generalized travel time of all passengers, combining travel time, transfer time and waiting time with different weights. The model relies on travel estimations and a large matrix containing data on how many passengers travel between different locations. The goal is to minimize the total generalized travel time. However, this model mainly serves as an inspiration for final decision-makers, as many constraints come into play when designing a timetable. Often, ideal scenarios cannot be implemented due to, for instance, capacity limitations. This means that timetables are not created by simply pressing a button but many factors must be considered. Nevertheless, this model provides the foundation for the final timetable.

The second step focuses on defining departure and arrival times and creating feasible transfers, a process called

"timetabling." NS uses an hourly pattern, meaning that departure times remain consistent every hour. To enhance efficiency, NS aims to spread departure times evenly. For instance, instead of two trains to Amsterdam leaving within minutes of each other, they are scheduled at 15-minute intervals to ensure a more even distribution of services.
Once the timetable is finalized, NS moves on to personnel and rolling stock planning. Every train requires a driver and a conductor. Scheduling staff shifts is a complex puzzle, so decision-support tools are used to optimize planning. A train driver, for instance, must take breaks and finish their shift at the same location where they started. This puzzle is further complicated by specific constraints, such as train drivers being certified to operate only on particular routes. At the time of the interview, one of Marije's projects was working on a solver that takes individual staff preferences into account.

Apart from timetables, rolling stock, and personnel planning, NS also deals with shunting yard planning, which involves all activities at a 'shunting yard'. This includes tasks such as parking, cleaning, and maintaining train units. Since trains have limited flexibility and their movements depend on track availability, station operations can be highly complex. This is known as the shunting yard problem. Proper planning is crucial to ensure that the correct train is accessible when needed. Marije explains that shunting operations take up so much time that NS train drivers spend 30% of their time shunting. At NS, a team of about ten people is continuously working on developing solvers to address these challenges.

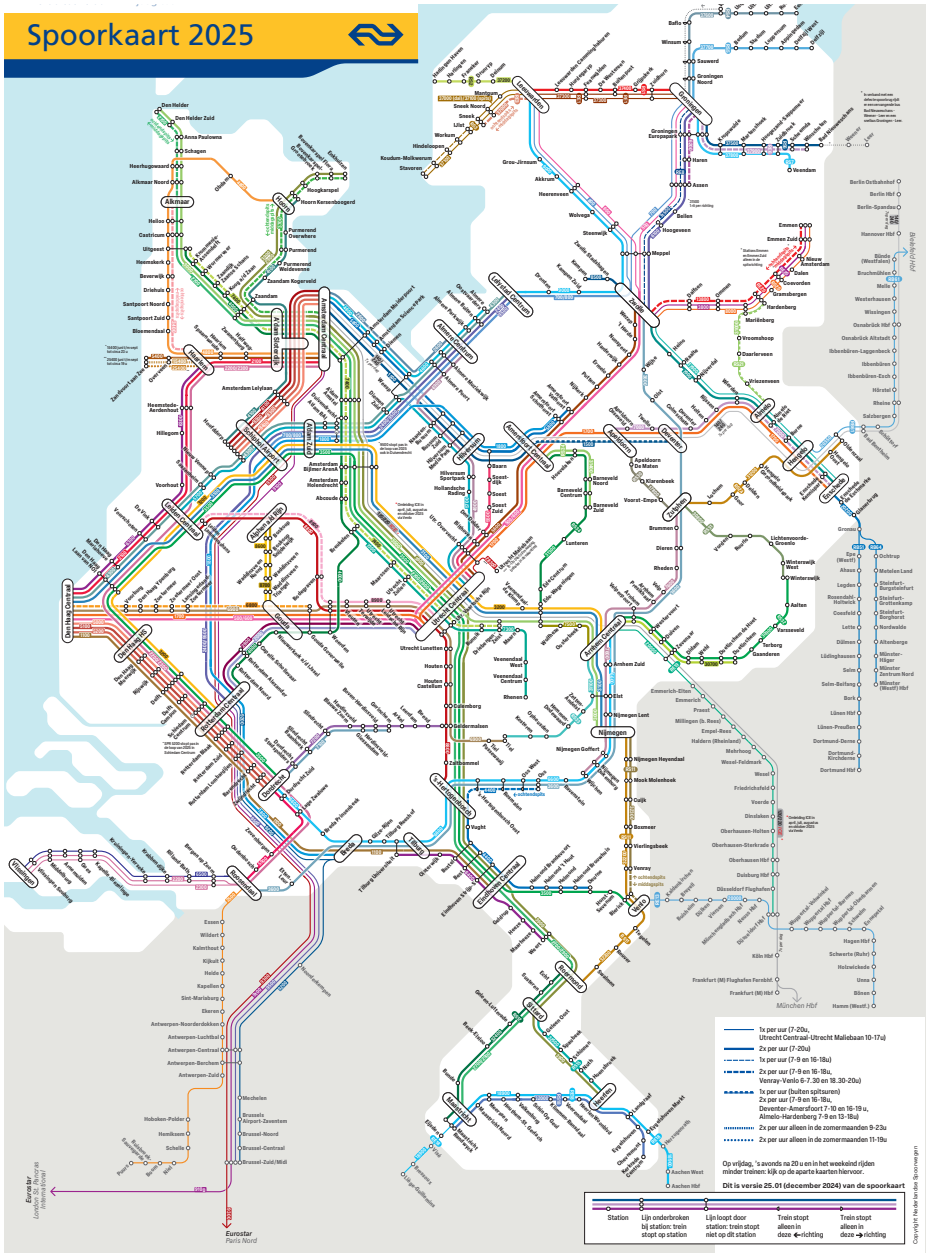
Beyond timetable planning, NS extensively uses data science. Several departments focus on AI and data analytics. For instance, NS has agreements with the Dutch government regarding the number of trains that must run on time and the availability of seats during peak hours. NS continuously monitors these metrics and, when performance falls short, teams analyze the data to find solutions.

Another key area where data science plays a role is train maintenance. Traditionally, trains are inspected at fixed intervals (e.g., every 30 days). However, NS is developing predictive maintenance models that analyze data from trains to anticipate component failures and adjust inspection schedules accordingly.

In the future, NS plans to implement more decision-support tools and solvers. In the past, employees often stayed with the company for their entire careers. Now, job switching is more common, even within NS, leading to employees building up less knowledge. This shift creates a growing need for automated support tools to assist employees. Moreover, the increasing crowds on the train platforms, as well as the growing amount of late planning adjustments due to maintenance on the track, makes planning by hand harder than ever. However, when it comes to planning, AI/Machine Learning tools are often not the best solution. ML requires extensive training and re-training when timetables change, making it impractical. Instead, operations research provides more effective solutions, as it allows planners to define clear criteria for an optimal schedule, such as maximizing passenger seating availability.

When asked about their hopes for future innovations, Marije highlighted the potential of circular train routes. In such a system, trains would continuously run in loops, eliminating the need to reverse direction at endpoints. This would save time, reduce staff transitions, and minimize transfers for passengers. Simone hopes that NS will be able to adjust schedules more quickly in response to capacity restrictions and other operational challenges.

Marije is enthusiastic about her role at NS, describing it as "challenging and intellectually stimulating." She enjoys working on complex operations research problems. Simone also finds her job rewarding, particularly in its real-world impact as her work directly affects train passengers, making the results tangible. Perhaps one day, these optimizations may improve your transfer or arrival time.



A Life in Econometrics, Retired but not Stopped

After a long and impressive academic career, Arthur van Soest has officially retired from his full-time position at Tilburg University (In the academic world you are then called an emeritus professor). However, he still teaches one day a week, a testament to his passion for education and econometrics. In this interview, we reflect on his career, his vision for the field, and the changes he has witnessed.

Arthur van Soest

From Mathematics to Econometrics

Van Soest originally started studying mathematics, a choice that often led to a career in education or academia at the time. His initial university studies focused on mathematical research. However, he soon realized that the abstraction of pure mathematics was not his strength, and he became more interested in its applications within econometrics. Therefore, he started with a new study in econometrics. This led him to research projects and his first experiences as a research assistant.

Throughout his career, Van Soest remained closely connected to Tilburg University, with only a brief interruption of a year and a half when he worked in the United States. There, he was involved in a research institute without teaching responsibilities, which presented a different dynamic. He observed how research in the U.S. is largely dependent on third-party funding, which influences financial security of researchers.

The Impact of Data and Technology

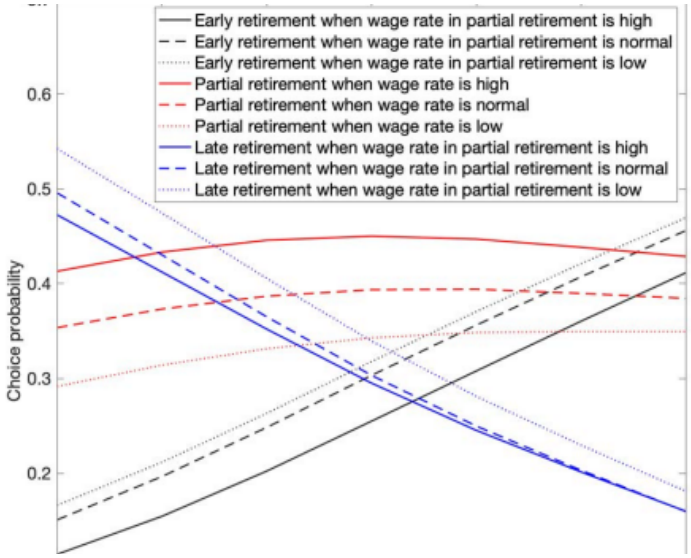
Van Soest has witnessed significant changes in academia and education throughout his career. Whereas he once taught using chalkboards and handwritten notes, students now expect digital materials and recorded lectures. According to him, this has both advantages and disadvantages: accessibility has improved, but expectations have also risen considerably.

One of the most significant shifts in his field is the availability of large datasets. Where researchers previously relied primarily on surveys, they can now access administrative datasets, such as those from pension funds and tax authorities. This offers unprecedented opportunities but also demands more from researchers in terms of technical expertise.

Pension and Labor Market Research

A substantial part of Van Soest's research has focused on pensions and the labor market, a topic that interests him both intellectually and socially. He was involved in projects such as SHARE and Netspar, where he studied the financial incentives needed to encourage people to retire later. One notable finding is that part-time retirement is an attractive option, yet employers have not fully embraced it. Ironically, Van Soest applies this principle to his own life by continuing to teach one day a week after his official retirement.

Although he believes that the new Dutch pension system is objectively better than the old one, he sees the transition as the greatest challenge. "With such a major change, there will always be people who end up worse off, and that is inevitable," he states realistically.



A Lasting Passion for Teaching

Despite his love for research, teaching remains Van Soest's most fulfilling activity. "It keeps you young," he says with a smile. He particularly values supervising PhD students, considering it one of his greatest achievements. He takes pride in seeing his former students find positions at prestigious institutions such as the Dutch Authority for the Financial Markets (AFM), pension funds or sometimes in more remarkable locations, such as in Abu Dhabi.

His advice to students is simple but effective: choose a direction that genuinely interests you. "You cannot spend forty years doing work that you do not enjoy," he emphasizes.

An Active Life

Outside his academic activities, Van Soest remains active in his free time. Sports play an important role in his life, whether it is jogging, cycling, or visiting the university sports center. He also has a billiard table at home and spends time gardening. His social involvement is evident in his work as a language tutor for people learning Dutch as a second language.

With a rich career behind him and an active role in both academia and society, Arthur van Soest demonstrates that retirement does not mean stopping contributions. With his passion for teaching he will help students for at least the next three years. ●

Meet the Board

Winter board of Asset | Econometrics 2024-2025

Vice-Chairman

Hi, my name is Wouter, I am 22 years old and I am originally from a village called Schijndel. About one and a half years ago, I moved to Tilburg to live in the fraternity house of 'Onafhankelijk Heerendispuut Excessive'. This fraternity keeps me quite busy, and I completely enjoy all the drinks, student festivals, and other parties it offers. I found some of my closest friends here, so I do my best to balance it with the responsibilities that come with being a board member. I am currently in the third year of my Bachelor's degree and plan on finishing it in four years. I enjoy having drinks with my friends, going to the gym, or playing any other sport. Before moving to Tilburg, I played soccer my entire life, and I will use any excuse I can find to occasionally play it again. Originally, I had no intention of becoming active at Asset | Econometrics, but after all the amazing parties and people I met, I went from an active member to a board member very quickly. I find that econometricians have certain character traits and that is something that I cherish and something that connects us so well. Before joining this beautiful association, I never thought I would have so much fun here.

External Affairs Officer

Hey everyone, I am Amy van den Tillaart, I am 20 years old and I am the External Affairs Officer of Asset | Econometrics alongside Dylan. I am from a small village near Eindhoven called Lieshout. I became active at Asset | Econometrics the second I started my studies, so I have been active for one and a half years. I started in the Active Members Weekend Committee and before joining the board I was part of the Europe Trip Committee. Since this year I am also an active member at T.S.R. Vidar, so I am also in a rowing team, with whom I will row many races in the coming weeks. Besides that, I play the trumpet in two bands and I enjoy going out with friends. In the upcoming half year, I will be coordinating Yearbook, Active Members Day, EOR Business Dinner and QIG, which is really exciting. I really look forward to this year and hope to see you at our activities!


ASSET
Econometrics

Unlocking the Secrets of Market Trends: How Hidden Markov Models Can Shape Pension Fund Strategies

1 Introduction: Investing at Pension Funds

Dutch pension funds manage enormous capital—over **€1.7 trillion**—and with the *Wet Toekomst Pensioenen (WTP)* reform shaking things up, it is the perfect time to reassess their investment strategies. Most pension funds currently base their investment strategies on Strategic Asset Allocation (SAA) studies grounded in Modern Portfolio Theory (MPT), a method that carries certain limitations (1). One of its biggest limitations is that the model assumes that historical return distributions are stable over time, an assumption that does not hold in practice given the cyclical nature of financial markets (2).

What if we could model the cyclical nature of the market more accurately and use that knowledge to optimize pension fund investment strategies? Enter Hidden Markov Models (HMMs)—a statistical tool that could transform how pension funds deal with market uncertainties (3). HMMs allow us to model asset returns as a system that transitions between different hidden states. Depending on the state the process is in, the model can apply different parameter values. In this way, HMMs provide a dynamic approach to risk management, with the potential to enhance returns while controlling downside risk.

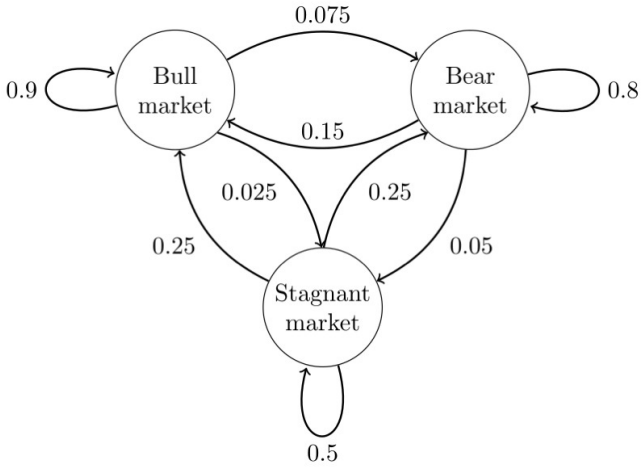


Figure 1: Possible states of the market.

2 The Math Behind the Model

At the heart of this research is the idea that financial markets operate in different regimes, much like how weather fluctuates between sunny and stormy days. HMMs assume that market conditions shift between these hidden states, and by analyzing historical returns, we can estimate transition probabilities.

A basic HMM follows this equation:

$$y_t = \mu_{s_t} + \phi_{s_t} y_{t-1} + \sigma_{s_t} \epsilon_t \tag{1}$$

where:

- y_t represents asset returns,
- s_t is the hidden market regime (bull or bear for example),
- μ_{s_t} is the mean return of that regime,
- ϕ_{s_t} accounts for autocorrelation,
- σ_{s_t} represents volatility,
- ϵ_t is a random shock.

The hidden states transition probabilistically according to:

$$P(s_t = j | s_{t-1} = i) = p_{ij} \tag{2}$$

which forms a Markov chain, meaning that tomorrow's market state depends only on today's market state, not yesterday's or last week's. This allows HMMs to capture stylized facts of financial markets, such as volatility clustering and fat-tailed return distributions, which traditional linear models struggle to incorporate.

3 Findings: A Statistical and Economic Perspective

Testing the model with real-world data revealed something intriguing: HMMs capture the time-varying nature of asset returns far better than traditional models. They outperform simple autoregressive models in identifying market regimes, in terms of their Area Under the Curve (AUC).

After establishing that HMMs offer superior performance in capturing the time-varying effects of asset

returns, the remaining question was whether this improved statistical accuracy translates into greater economic value. The answer is yes, but with caveats. Meaning that a strategy that dynamically shifts between a risk-on (bull market) and risk-off (bear market) allocation based on HMM forecasts **can** outperform traditional benchmarks in terms of risk-adjusted returns.

Key takeaways:

- HMM-based strategies generate higher Sharpe Ratios than static allocations, showing a better balance between risk and return. This finding is in line with previous work done by Guidolin (10).
- While transaction costs are taken into account, factors like governance remain a challenge for real-world implementation, as frequent rebalancing requires quick action from actors within the pension funds (9).

4 The Practical Hurdles

While the theoretical benefits of HMMs are clear, real-world implementation presents challenges. Dutch pension funds operate within strict regulatory frameworks, and major shifts in investment strategy require careful oversight and risk assessment. As a result, adjustments to the investment policy are only feasible with relative ease when they fall within the constraints of the stringent regulatory framework. Pension fund managers must also contend with fiduciary duties, ensuring that any new strategy aligns with the long-term security of participant benefits (8).

5 Conclusion: The Future of Pension Fund Investing

So, what did I learn from this research? First, I confirmed that financial markets go through distinct regimes and that Hidden Markov Models can help us detect these shifts. Second, I found that using HMMs to guide investment strategies can improve returns, but practical challenges remain. Ultimately, I realized that the biggest barrier isn't the mathematics itself, but rather the regulatory framework surrounding pension funds—and the challenge of gaining their trust to adopt and implement data-driven decision-making.

Overall, I believe that as technology advances and machine learning becomes increasingly integrated into finance, the pension sector may gradually shift away from traditional static models and begin to embrace approaches such as HMMs. While this transition may take time, my research offers a solid foundation for how these models can be applied to navigate uncertain financial markets. ●

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Wout Temmink
Graduated Master QFAS (2024)

Healthy Habits in a Not so Distant Future

written by **Marvin Priem**

In line with this edition of the Nekst, which explores the theme of science fiction, Healthy Habits turns to a futuristic world. What happens when the predictive models we use today evolve into fully integrated systems that not only track our behavior, but guide it? Picture a world where all of your healthy decisions, what you eat, how you move, when you rest, are not chosen by you but a result of a model that predicts what is best for you. In this future, the role of econometric modeling is not only for analysis but it could tell you what to do. So, we will explore how the tools we use to understand behavior might guide and control our behavior in the upcoming future.

The Rise of Predictive Models in Human Behavior

Recent years have shown a rise in the use of machine learning and data analysis to predict human behavior. Wearable devices, health trackers, and phone applications have changed the way in which we perform everyday tasks. These products do not only track information passively, but they actually provide feedback, monitor progress, and suggest adjustments. Already, algorithms are able to recommend the best time to exercise, eating patterns to optimize energy levels, or even psychiatric treatments to reduce stress.

Econometric models such as dynamic panel models and time series are being used more and more to analyze trends within this data. These models are based on history to forecast the future actions and understand that human behavior is often based on what has occurred before. For instance, the adoption of a healthy lifestyle can be depicted as a dynamic process wherein the decision on the present day is dependent on yesterday's behaviors, often utilizing lag structures to explain effects felt a while back. So these models are no longer just a passive forecast of health behavior, it is an active process with constant observation and adaptation.

When Prediction Becomes Prescription

While today's health apps only suggest potential improvements, imagine a future in which predictive models can go a step further, they know what is best for you next. In this future, algorithms would not just analyze data but actively shape daily routines to optimize health outcomes. Personalized AI systems could track real-time data on sleep, exercise, nutrition, and maybe even your mood, and then adjust your schedule to minimize risk and maximize well-being. It is a world where every action, from your choice of food to the time you spend exercising, is dictated by an algorithm designed to enhance your health in the most efficient way possible.

In this scenario, predictive models would be so accurate that they could offer individuals an optimized blueprint for health, a set of routines that, when followed, would ensure the best long-term outcomes. It is not hard to imagine a world where even minor fluctuations in health indicators trigger automatic adjustments, fine-tuning the individual's habits down to the last detail.

In such a world everyone would have a personalized utility function, one that takes health data and risk preferences into account, and optimized for long-term outcomes. This leads to an interesting question, if predictive models can determine optimal behavior, is there room left for personal choice?

Autonomy vs. Optimization

This question opens a critical debate: how much control over our own habits would we retain if all our decisions were based on predictions designed to maximize health outcomes? Due to us being able to make conscious choices we are able to form habits, often these choices are based on imperfect information and conflicting motivations. In a world where every choice is optimized, one can wonder, would we lose the ability to form habits, and thus lose a part of one's personality.

There are also some practical and ethical concerns to consider. What if predictive models fail to account for how complex human behavior is, or if they are driven by imperfect data? Then it may be possible that they advise or reinforce unhealthy patterns due to the input of inaccurate data. Just as we see that econometric models suffer from the risks of overfitting, or when we confuse correlation and causation, the predictive models of the future can also suffer these drawbacks.

Moreover, a central question remains, would people still be involved in their own well-being if they were constantly driven by a predictive model? Being in control is a crucial part of forming new habits. When choosing healthier habits, even when the new habits are more difficult or inconvenient, we get a sense of being in control. But, in a world where our actions are chosen for us, how much would we be in control? Would we still recognize our own decisions as our own?

Conclusion

There is a lot of science fiction that tells us we should be cautious about depending on technology too much, in these tales predictions and optimizations become instruments of control. It will probably be a long time to get close to such a reality, but we do see an increase in reliance on data-driven habits which are bringing us closer to such a future. If we allow algorithms to predict, and maybe even prescribe our routines, we may risk losing our personality and humanity. ●

Astrics Goes Balkan

Joost Verschueren

This spring, our association travelled to the Balkans. To be more precise, we went to the capital of Bulgaria: Sofia. The trip lasted from Wednesday, April 9 to Monday, April 14. We had to get up very early since our flight departed at 09.40 hours. Thankfully, no one overslept and everything went smoothly.

Upon arrival at the hostel and getting settled, the first thing everyone did was head to the local Lidl. Beers and bakery goods were the main items purchased. That evening, we had dinner together and kicked off the night with a pub crawl to see what the night life of the city was like.

The next morning, we had a city tour from a local guide who shared some historical insights and fun facts about Sofia. After the tour, we enjoyed some free time naturally accompanied by a few beers in the sun. In the evening, we returned to the hostel for the Europe Trip Pub Quiz. The quiz was won by Team Old, who were the first to guess the connection. Congrats to them! Many drinks were had during the quiz, so the night continued with a clubbing session in the city centre.

The day after, we experienced an all-time classic football match in the Vasil Levski National Stadium, where CSKA Sofia faced Lokomotiv Plovdiv. We had tickets in the ultra section, but shortly after sitting down, a rather intimidating Bulgarian man advised us to leave for our own safety. The atmosphere was intense, as you can imagine. The game itself was a thrill as CSKA won 2-0, with one of the goals being a spectacular bicycle kick.

Later that evening, we had dinner together at a local restaurant. As the trip neared its end, everyone was given free time. A group of twelve rented cars and drove to the Rila Mountains to hike the Seven Lakes Trail at 2,200 metres above sea level. Unfortunately, the chairlift was closed, so they had to climb an additional 500 metres on foot. Meanwhile, others spent the day relaxing in the sun with a cold beer in hand, enjoying the best weather of the trip; temperatures even hit 20°C!

Those who did the hike said it was absolutely beautiful and broke expectations, though everyone was thoroughly exhausted afterward it was definitely worthwhile!

On Monday, not much of note happened. Most people picked up some last-minute souvenirs for their parents or loved ones, and then we headed to the airport. Our flight left at 18.15 hours and landed in Eindhoven at 19.55 hours.

And that is where the trip ended. The committee thanked everyone for joining, it truly was an amazing trip and we hope everyone feels the same!

California Dreamin' and Viva Las Vegas

Matthijs Kroesen

The most exciting formal activity of Asset | Econometrics will be coming up next November: the International Business Tour (IBT). This year, the participants of the IBT will visit the finest places on the West Coast of the United States of America: San Francisco, Los Angeles, and Las Vegas. My committee and I have been planning this exciting trip since October last year. Organizing such a formal group trip may not be as trivial as one would imagine…

The IBT is one of the most comprehensive activities that Asset | Econometrics has to offer. It is a 15-day trip to a destination outside of Europe. Furthermore, the nature of the program is very diverse: it contains both formal and informal elements. Namely, the IBT usually visits the cultural landmarks of the chosen destination(s). Still, it also aims to visit universities to get a taste of the local academic life, and (multinational) companies and embassies are visited to compare the Dutch business culture with the local business culture. The International Business Tour 2025 committee is responsible for the organization of this trip: What is this 'organization process', and how did our committee handle this? Allow me to elaborate on all the facets of organizing an International Business Tour.

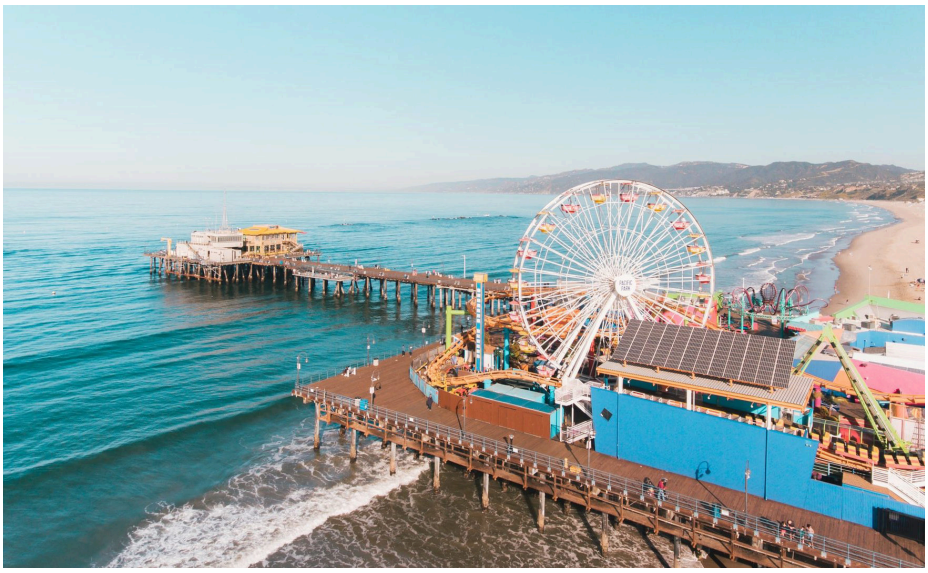
The first important task is finding an actual destination. Several meetings were organized, in which a wide range of destinations was considered. In some alternate universes, IBT 2025 would have gone to the city that never sleeps (New York), danced the samba in Rio de Janeiro, or eaten the best sushi in Tokyo's finest restaurants. All of that did not come to be: the appeal of the West Coast of the USA was too strong for all committee members. The sprawling economic hubs in Silicon Valley, the San Francisco Bay Area, the cultural landmarks in Los Angeles and Las Vegas, and the prominent universities or beautiful landscapes of the West Coast were too tempting to resist. Furthermore, we wanted to pick a refreshing new location, which the IBT had never visited in a previous edition. When the destination was set, the actual organization of the IBT could begin.

We immediately started with one of the most important tasks when organizing an IBT: the acquisition of formal activities. Namely, although organizing formal activities is hard enough as it is, it now needs to be done for a foreign country - of which no one in the committee knows the customs or unwritten rules. We split the tasks appropriately: our external affairs officers, Rein and Maik, went berserk on LinkedIn and tried to contact as many (Dutch) data scientists working on the West Coast. This effort went with great success: we can already confirm that we will visit Lineage Logistics, a market leader in logistics, and Ernst & Young in their Los Angeles office. Still, a lot more is in the works. I, the chairman, picked up contacting the local universities to visit, like the University of Nevada or UCLA. Lastly, our secretary Jarno contacted the consulate of the Netherlands in San Francisco. Needless to say, it helped us a lot in communication with stakeholders that the most commonly used language in the USA is English! The committee is positive that there will be a magnificent formal program during the IBT 2025.

Another important duty of the organization is to keep the costs of the trip under control. Luckily, our treasurer Daan is the man of the money. He makes sure that the rest of the committee does not become too enthusiastic and spends a lot without careful consideration. This happens quite often when we are setting up the informal program of the IBT! We are planning to do a wide range of unforgettable activities. Our supervisor Guus has managed to book quite some activities already: for example, in San Francisco, we will go to a roller disco avenue on Halloween, visit Alcatraz, and travel over the Golden Gate Bridge to the Muir Woods. In Los Angeles, we could not skip the Walk of Fame or a hike to the Hollywood sign, and in Las Vegas, we will discover the nightlife and visit the breathtaking South Rim of the Grand Canyon.

Naturally, our trip would not have generated any excitement without some participants. Therefore, the promotion of the IBT is another unmissable task. Our supervisor Wouter contacted a lot of lecturers, such that we could promote information sessions about the IBT directly at your lectures. Furthermore, our promotion officer Lina unleashed her creativity: for example, the information slides at our information sessions, the slides for the lecture talks and all the stories and posts you saw on the Asset | Econometrics' Instagram last period were all her designs. After giving all interested students an information session about joining the IBT, the registrations could finally open: very exciting!

This trip will cost a significant amount of cash. Fortunately for us, we will get some additional funding through the subsidy fund of Studium Generale. As a reciprocal service, we are meant to perform empirical research at our destination. As such, our committee thought it would be interesting to research whether tourists at our destinations have a different budget for the trip and different investment goals. One would expect that to be so: a tourist in Las Vegas would be driven more recreationally, while a tourist in Los Angeles is expected to be more culturally driven. The participants of the IBT will gather the data for the committee members, such that we can use our skills obtained in the EOR program to do a quantitative analysis of our research question. Make sure to check out future Nekst editions: we are planning to publish our results in the Nekst after the conclusion of the IBT 2025.



However, there is still a lot to organize by the committee. The subsidy deadline is coming up, we need to make an information booklet, acquisition needs to be finalized… major stress comes up just by thinking about it. I need to finish up this article and get back to work. Luckily, we will have a lot of time to catch up soon… we will see you on the West Coast at the International Business Tour in November!

With West Coast's sunshine-laced regards,

The International Business Tour 2025 committee.

Choose What Excites You

Right now I am doing my Master's Business Analytics at Católica Lisbon School of Business & Economics, but if you had asked me a few years ago what Master's I would do, it would have been one of the three econometric masters of Tilburg University. I will explain how I got to where I am now and the differences between Tilburg University and Católica.

At the time I completed my Bachelor's, COVID-19 was still a hot topic and studying at that time meant motivating yourself alone. That was a reason for me to start working after my Bachelor's. I found a nice job as an IT consultant doing software testing, using not much of my studies except for programming and the analytical mindset. At the time, I thought that I would not do a Master's at all since it was not necessary for the job market and my salary would increase to the level of a Master's graduate in the time it takes to complete a Master's. But [illegible] two years of working that changed. [illegible]ced to miss the challenge of studying and learning new things. Given my age it felt like a now or never moment (but you are never too old).

Jasmijn Aartsen

Most of my friends continued their studies by doing a Master's at Tilburg University. But if I were to quit my job for something uncertain, it had to really excite me. That is when I started looking at Master's abroad. The direction of the Bachelor's, especially data analytics, was what still interested me. So I used that in a google research to find different Masters in countries that excited me. I ended up applying to Master's in Spain and Portugal. I eventually chose courses and location, selecting the masters Business Analytics at Católica in Lisbon.
The Master's is probably different from the Master's BAOR in Tilburg, but they are related. In my program there are students from all kinds of backgrounds, and since Econometrics is the best fitting background it meant some repetition of statistics and programming in the beginning. For me that was quite nice since I had not seen any statistics for two and a half years. But quickly new courses and theories were presented. A glimpse into the subjects of my studies includes predictive analytics, forecasting, data visualization, AI and fairness, database management but also ethics and managing people. In (almost) all courses we use Python or R together with mathematical models. But compared to Bachelors the mathematics is only there to give background information and not needed to be understood completely or proven.

The structure of the Master's is different. In the first year you only have courses, and in the second year you can choose to do only your thesis and finish the masters in one and a half years. Or, you can choose to do an exchange semester in between and finish your Masters in two years. That is what I am going to do, to extend my student life and explore a different country again. My next destination is Bangkok. We do not have many opportunities for electives or specializations, and since we are with only 40

students we feel like a high school class. Every day with the same people, lectures, lunch and group meetings. In our program, 30% are Portuguese and 50% are Germans, and then individuals from other countries.

I am studying at a business school and you notice that through the projects, which are practical and often with real and relevant data. This is what I was searching for after the theoretical Bachelor's. I finally learned how to apply the theoretical concepts of our Bachelor's in a job. Our university promotes business relevance in every project, and not the research oriented approach I was used to. We also have mandatory career events, which we can choose from throughout the year. Companies from all over Europe come to visit.

I do not know about others but I failed several courses during my Bachelor's. But here that is almost impossible. The professors are here to teach you new things and attending lectures is highly recommended. If you later show on the exam that you paid attention you will pass. Also half of the grade consists of group projects which are also graded generously. While the level might be lower than in the Netherlands, the pace is high. We have lectures every day and group project deadlines weekly make it a more demanding study than I was used to.

In terms of job prospects, I would say that a Master's in Tilburg or another place in the Netherlands would look better on your CV. Dutch universities consistently rank higher and the quality is probably better. But I believe that having a Master's is still better than having none and most employees also value international experience.

I am really happy with the path I chose, if I had started my Master's with less motivation I would probably struggle finishing it. While right now I am actually sad that my Master's is only one year of courses. I enjoy learning, working vtogether with my fellow students and exploring the country. I would recommend everyone to look further than the standard options and look if there is something that makes you feel happy and excited.

Science Fiction, Reimagined by Its Most Powerful Fans

written by **Floris van de Moosdijk**

At Tesla's We Robot event on October 10, 2024, Elon Musk repeated a phrase he had posted a year earlier on X: 'The future should look like the future.' This statement captures a trend among tech leaders. They do not just love science fiction, they try to bring it to life, sometimes in ways its authors never intended.

The connection between fiction and innovation is not a new concept. In 1865, Jules Verne's From the Earth to the Moon imagined space travel long before rockets left the ground. A century later, handheld communicators from Star Trek helped inspire the development of the first mobile phones, as Motorola engineer Martin Cooper later confirmed. Science fiction has repeatedly shaped real technology, sometimes long before such inventions seemed possible. Today, that influence is stronger than ever. Technologies like Artificial Intelligence, virtual reality, and space exploration are no longer distant dreams; they are being built today, often by people who grew up on science fiction.

Notably, the stories that spark these new technologies often carry different messages than the ones tech billionaires seem to take from them. A novel intended as satire can turn into a blueprint. A utopia born from one political philosophy can be reimagined by someone with a very different ideological outlook. In an era of rapid AI breakthroughs and accelerating innovation, how these stories are interpreted matters more than ever.

Elon Musk often cites Iain M. Banks' Culture series as a personal favorite. SpaceX drone ships are named after the AI ships in the books, and Musk has praised the world Banks imagined: a highly advanced society where money is no longer needed, and intelligent machines run everything in the background. Yet the Culture series was not written to promote a perfect world. Banks, who openly held left-wing views, used the series as a thought experiment to explore what a society beyond capitalism and scarcity might look like. The novels describe many freedoms but also reveal the dilemmas and tensions that accompany such a system. Musk's admiration for the series is striking, given how far his techno-libertarian vision stands from Culture's society.

Musk's admiration may come from the Culture's vision of boundless technological achievement. The novels envision a society where space travel and artificial intelligence have advanced to heights far beyond today's technological capabilities. This aligns with Musk's ambitions to expand human civilization into space and integrate AI deeply into human life. Yet the political values at the heart of the Culture, focused on collective welfare and the careful distribution of power, stand in sharp contrast to Musk's techno-libertarian ideas.

Mark Zuckerberg has cited Snow Crash, Neal Stephenson's 1992 cyberpunk novel, as a key influence on his vision for the Metaverse. The term "Metaverse" itself originates from Snow Crash, which portrays a virtual world owned and shaped by powerful corporations, where inequality is built into the architecture of the digital space. While Stephenson wrote a satire of capitalism and digital escapism, Zuckerberg seems to have read it as a business plan.

These examples do not just show minor reinterpretations. When science fiction is treated as a product vision, its original intent can slip away. Many of the science fiction stories that inspire today's technology warned against the very dynamics now driving innovation: unchecked ambition, private power, and technological escape.

Science fiction not only explores what could be built, but more importantly, what should be questioned. By stretching the boundaries of what is technologically possible, it opens space to think about what is ethically acceptable, socially desirable, or potentially dangerous. These settings allow for thought-provoking storytelling. Even when a writer's ethical stance is clear, these stories tend to lead the audience to one key question: where should the moral boundary lie?

Dystopian worlds often push a technological concept to its most extreme form, not only to show what could go wrong, but to confront readers and viewers with realities they may never have considered. In

doing so, they invite audiences to decide for themselves how far is too far. TV series like Black Mirror and Severance are especially effective in this: even when their settings are dystopian, they spark a debate on where the ethical boundaries of new technologies should be drawn.

While fiction creates space to ask difficult questions, the real-world development of technology often happens without that same openness. Private tech companies and investors are playing a growing role in shaping innovation and defining what the future looks like. Recent policy changes in the United States reinforce this trend. For example, the Trump administration announced a private-sector initiative of up to $500 billion to support AI development, aimed at strengthening the country's global position in artificial intelligence.

Meanwhile, the current administration has significantly reduced federal research funding for universities, cancelling billions in grants and threatening further cuts. These reductions have already made it more difficult for universities to sustain research programs and support new students, including those in fields such as AI. At the same time, the administration has portrayed universities as politically biased and dominated by progressive agendas. This political framing further weakens the role of academic institutions in shaping the direction of new technologies.

This shift raises concerns about the direction of technological progress. When private and strategic interests lead the way, ethical questions and the public good can be pushed aside. The warnings presented in science fiction become even more critical, reminding readers and viewers of the importance of engaging in broader public debate to shape the future of technology.

In contrast to the United States, Europe is following a different path in guiding the development of artificial intelligence. In

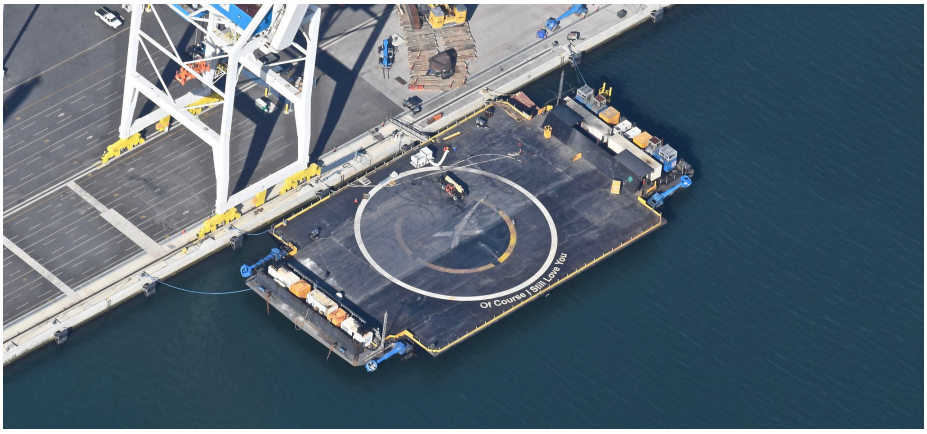


Figure 1: One of SpaceX's autonomous drone ships, named after the AI ships in Iain M. Banks' Culture series.

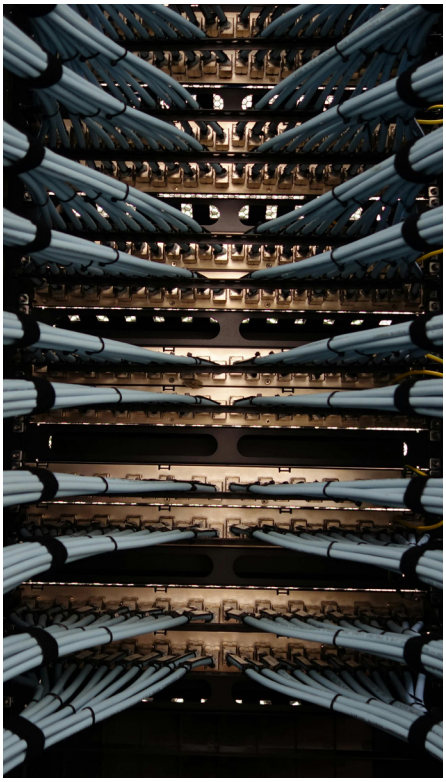
2024, the European Union introduced new laws that regulate AI use based on varying levels of risk. Some applications, such as government social scoring, are banned entirely, while others face strict conditions before deployment.

While these rules aim to protect human rights and public safety, the EU has recently begun working to simplify their implementation. In response to concerns from the tech industry, the European Commission is taking steps to reduce the regulatory burden, particularly for start-ups and smaller companies, while maintaining key protections. This shows the EU's effort to strike a balance between strong oversight and room for innovation.

Alongside regulation, the EU has also launched a major plan to support AI development, backed by a total of €200 billion in public and private investment. While private companies remain important players, the EU's approach gives governments more influence over how AI evolves.

Still, much of Europe's digital infrastructure depends on American companies. The new rules and investments could help strengthen Europe's position, but they also raise a question: can Europe keep pace with global innovation while holding onto stricter ethical standards? While the U.S. emphasizes accelerating AI development, Europe's approach may leave more room for discussion about what kind of progress is needed.

Science fiction was never meant to be a to-do list. Many of its stories were written to challenge our thinking, not to be turned into reality. The flawed and often ethically complex futures they imagined have nonetheless inspired some of the most powerful figures in tech. These stories are not blueprints; they are perspectives. Dreaming big is not the problem. The future can look like the future. But it is worth asking which fictional futures we are borrowing from, and whether we still understand the message behind those stories. ●



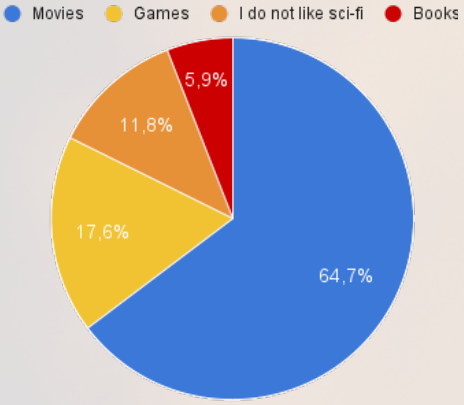
Let's Talk!

Science fiction is a genre that explores ideas beyond our current understanding of technology, society, and the world around us. It's all about imagining what could happen in the future, or in worlds completely different from ours.

written by **Stans Sonderkamp**

How Do You Experience Sci-Fi?

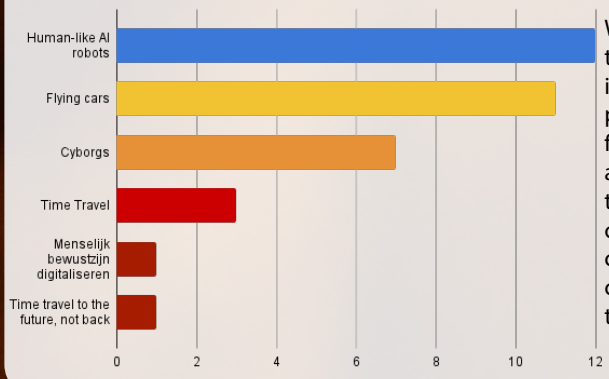
From books to movies and games, there are many ways to experience science fiction. But what is the most popular way? Do you prefer sci-fi movies, or do you enjoy reading a good book instead?



The most popular way to experience science fiction is through movies. Some films that were frequently mentioned as the best sci-fi movies include Inception and Interstellar.

Sci-Fi Dreams: What Would You Want to See Become Real?

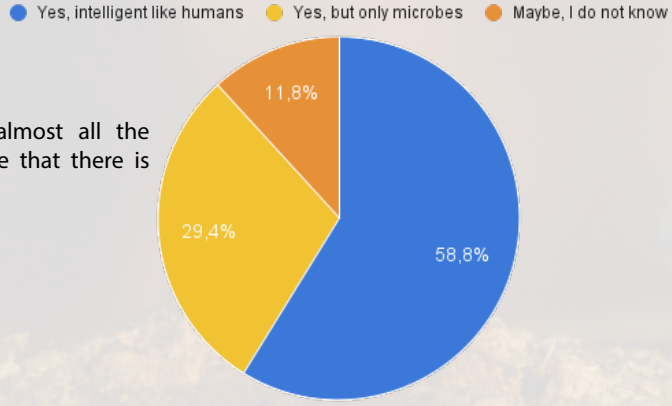
From flying cars to human-like robots, sci-fi is filled with futuristic technologies that sometimes seem closer than we think. A lot of these things are hard to imagine in real life, but also a lot is possible in the future. With a little imagination these are the things that we believe might be possible someday.



While time travel was mentioned a few times, according to someone, it is already possible to travel into the future. The most common answer to what we truly want to see in the future was flying cars. Although, as one person cleverly pointed out, "Flying cars already exist; we call them airplanes."

Are We Alone?

One of the biggest mysteries of the universe: does life exist outside of Earth? What do we think? Is there other life out there, or are we alone in the universe?

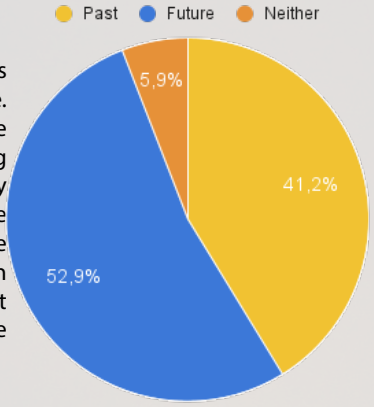


As you can see, almost all the respondents believe that there is life out there.

Time Travel: Future or Past?

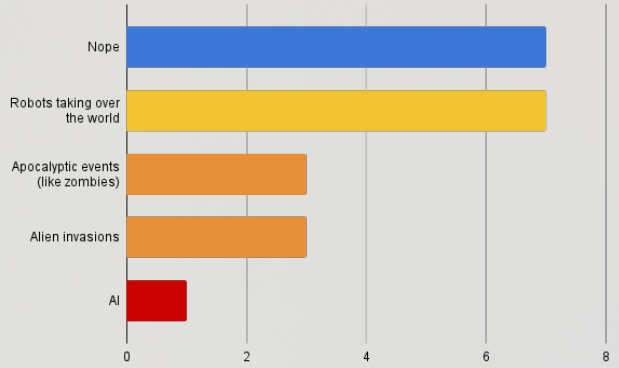
The questionnaire also showed that if we could meet one sci-fi character, the most popular one was someone from the future. So, as a follow-up question, if you had the chance to time travel, would you go to the future or the past? And what would you do there?

There were many creative ideas for both the past and the future. Of course, as econometricians, the most mentioned idea was making money by buying stocks or lottery tickets. But there were also some people who just wanted to observe the future and the technologies. In the past people wanted to meet people that passed away or taste a dodo.



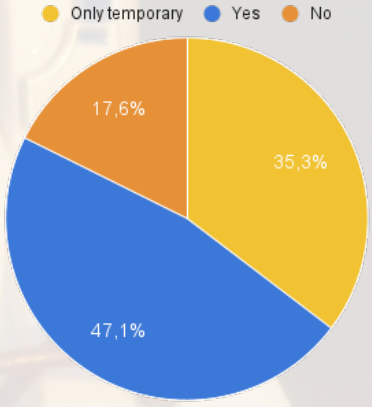
Sci-Fi Fears: What Scares You Most?

But we do not want everything to be real. While sci-fi can achieve great things in future; it can also be terrifying. From robots taking over to apocalyptic scenarios, some sci-fi themes make us think about what could go wrong if technology gets out of control. While not everyone was scared, some people did worry about some concepts.



Space Travel: Will We Live on Other Planets?

The idea of living on another planet is something that is featured in many sci-fi stories. But is it possible? Will we ever colonize other planets, or will Earth remain our only home?



Final Thoughts

Sci-fi presents a world of possibilities, but also of concerns. While some sci-fi ideas are becoming reality sooner than we expected, others remain far beyond our reach. Whatever the future holds, one thing is clear: we will keep dreaming and wondering what is possible. ●

Quatsch!

¯_(ツ)_/¯

Quatsch?

Over the past few months, the editorial staff of Nekst received many quotes that relate to the study of Econometrics and to the activities organized by Asset | Econometrics.
Hereby, we present to you a selection of some striking and funny quotes!

Julia
"Ik heb gisteren m'n haar gewassen met Dreft."

Rebecca
"Ik kijk echt uit naar samenwonen, dan kan ik al m'n spullen op 1 plek hebben."

Emma
"En dan je telefoon in Frankrijk."

Mattijs
"Los Angeles ken ik echt als mijn broekzak, van GTA."

Peter
"Hij legde in woorden een paar zinnen uit."

Ralph *(op de skipiste)*
"Hedser, zullen we daar straks een wedstrijdje doen?"

Hedser
"Ik kan nog geen bochten maken, dus ik denk wel dat ik sneller ben."

Julia
"Kan je naar Waalwijk fietsen?"

Selina
"Wat betekent fictief?"

Bertha
"Die heeft een IQ van 80."

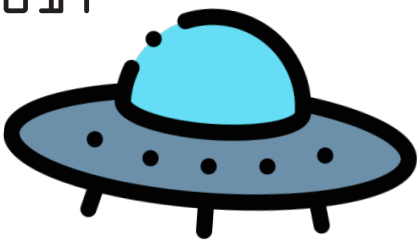
Selina
"80 van de honderd?"

Nienke
"Woont Bob hier nog steeds? Hij is toch bijna 30?"

Puzzle Time

written by **Mattijs Vernooij**

Signal Fragment #0017



In the year 4032, deep within the ruins of an abandoned Earth colony on Kepler-186f, a team of data-archeologists stumbled upon a sealed chamber. What they found inside was not machinery or weapons but only words.

Etched into stone and glowing faintly with residual solar energy, a wall was covered in dense symbols structured, intentional, and unmistakably human.

One phrase appeared again and again:

With help from ancient linguistics databases, the researchers determined this was a primitive human cipher, a code where each letter was shifted a fixed number of positions in the alphabet. After a few minutes of analysis, they unlocked the translation:

"The Nekst must remain protected."

Excited by the breakthrough, they identified the cipher as a Caesar shift, an encryption method once used for simple but effective secrecy. The principle was elegant: assign each letter a number, add a constant value, and translate back into letters.

How the Cipher Works

For example, using a Caesar shift of +5:

A $\xrightarrow{+5}$ F
B $\xrightarrow{+5}$ G
C $\xrightarrow{+5}$ H

…and so on.

To decode, one simply shifts each letter backward by the same amount.
But the team quickly realized that the true message did not stop at the cipher. There were patterns within the text, repetitions, structures and subtle signals that something deeper was encoded.

Their final discovery included two other encrypted inscriptions carved in separate corners of the chamber, which they could not decrypt with normal Cipher. Can you help the data-archeologists by decrypting the Ciphers?

Hint: start with the left phrase

Asset | Econometrics congratulates...

Name **Laurens van den Bogert**
Title The Class Assignment Problem (CAP): Mathematical Modeling and Development of an Optimization Algorithm for a Solution
MSc EME
Supervisors Prof.dr. H.W. Norde, Dr. R.L.P. Hendrickx

Name **Roland van Beerendonk**
Title Analyzing endogenous educational decisions in a life cycle framework containing biometric risk.
MSc QFAS
Supervisors Dr. C. Hambel, Dr. N.F.F. Schweizer

Name **Rick van Rijn**
Title Forecasting cash flow with machine learning techniques
MSc BAOR
Supervisors Prof.dr.ir. H.A.M. Daniels, Dr. C. Dobre

Name **Max Gerards**
Title Envy-freeness, Stability and Pareto Efficiency in the House Allocation Problem
MSc BAOR
Supervisors Prof.dr. P.J.J. Herings, Prof.dr. P.E.M. Borm

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Name **Ody van de Brug**
Title Cyclic Capacitated Vehicle Routing Problems with "unlimited" truck capacity
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Name **Djep Doreleijers**
Title An Analysis of the Long-Run Risk Model
MSc EME
Supervisors Dr. C. Hambel, Dr. N.F.F. Schweizer

Name **Admir Mujezinovic**
Title Analyzing Risk Preferences in Pension Fund Members: The Impact of Survey-Elicited Willingness to Take Risks, Ability to Handle Pension Risks, and Understanding of Investment Risks
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Supervisors Prof.dr. A.M.B. De Waegenaere, Prof.dr. B.J.M. Werker

Name **Paul de Moor**
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Supervisors Dr. N.F.F. Schweizer, Dr. A.G. Balter

Name **Kelt Coolen**
Title Creating an optimal sampling plan for Kenya
MSc BAOR
Supervisors Dr. F.C.A.M. Cruijssen, Dr. J.C. Wagenaar

Name **Koen van der Lee**
Title An agent's consumption-portfolio problem during times of economic normality and recession
MSc QFAS
Supervisors Dr. C. Hambel, Prof.dr. B.J.M. Werker

...on obtaining their Master's degree

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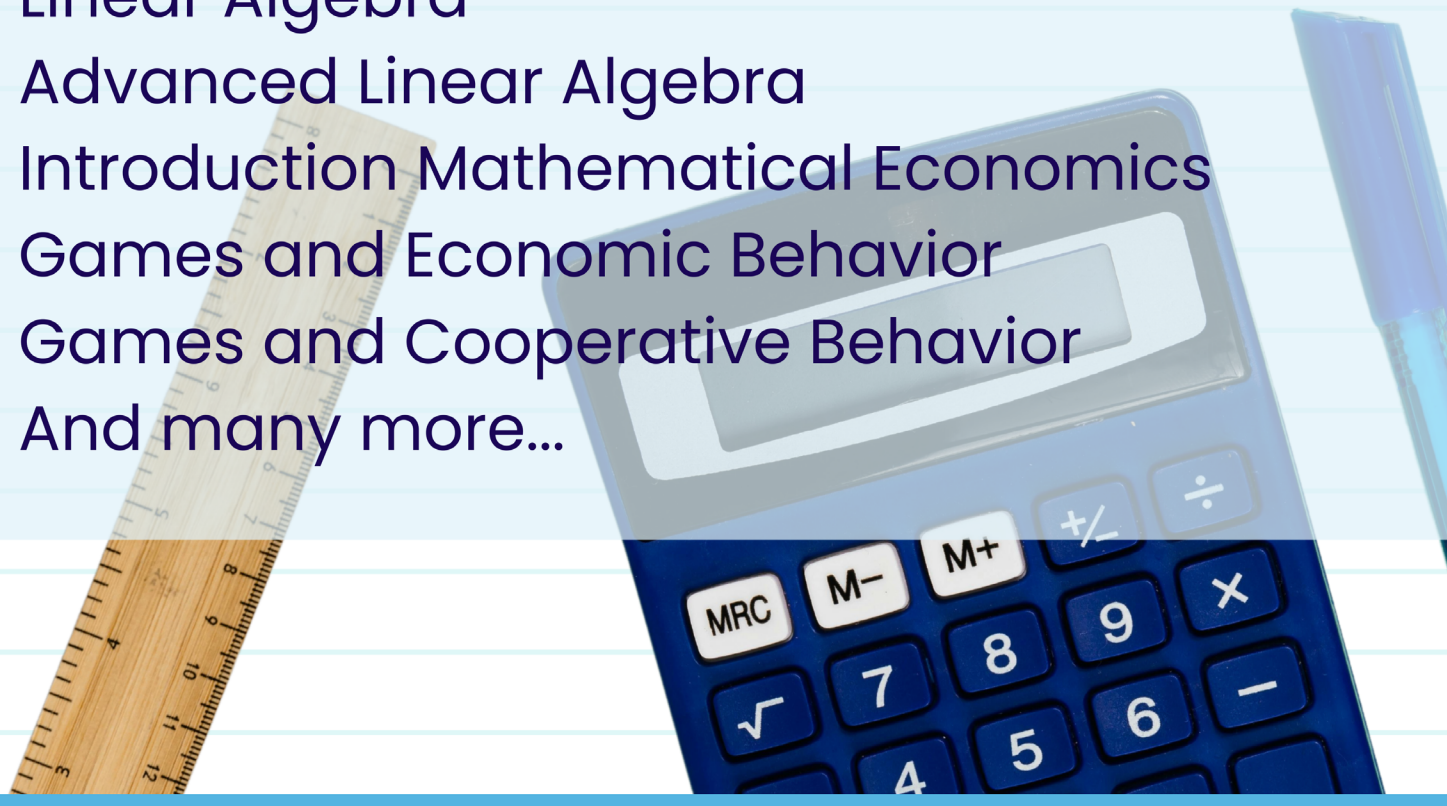
- Linear Algebra
- Advanced Linear Algebra
- Introduction Mathematical Economics
- Games and Economic Behavior
- Games and Cooperative Behavior
- And many more...



www.Asset-Econometrics.nl/Students/Study/Guidelines

Agenda

SAD 17 MAY

KOALA Activity

It is time for this year's Former Active Members activity, this time on the water. Think chill vibes, good chats, and lots of laughs while we cruise around in a boat with drinks and snacks included. Just bring yourself and get ready for a good time with familiar faces.
Hope to see you there!

TUE 20 MAY

Monthly Afternoon / Lecture of the Year Awards

The end of the academic year is approaching, and that means that it is time again for the Lecturer of the Year Awards, where our lecturers or tutorial instructors can get prizes within different categories, voted by our own students. Let us grade our teachers for once!

THU 22 MAY

Sports Activity

Join the Padel tournament to smash out some stress before the exams start. The tournament will only be from 14:00 - 17:00, and is a 9-minute bicycle ride from the Library away ;)

TUE 03 JUN

Study Break

Exams are back and so is the well-known Study Break! Join us for a nice lunch with a sandwich, juice, and a piece of fruit.

FRI 13 JUN

Pipple Boat BBQ

On Friday, June 13, we will join Pipple on a boat in 's-Hertogenbosch. On this boat ride you will enjoy an amazing BBQ whilst touring through the canals of s'Hertogenbosch. Drinks are included and the activity is entirely free!

THU 19 JUN

Board Announcement

As the academic year is ending, it is time to announce our board of 2025-2026! Find out who will become the successors of Emma, Rebecca, Guus, Dylan en Amy during the entertaining announcement video. The first drinks are on us!

THU 26 JUN

Asset Champions League

The ASSET Champions League is back! This exciting 7v7 football tournament is the perfect opportunity to showcase your skills, compete against fellow students, and enjoy a fun day on the pitch. This year, we are welcoming teams from other student associations in Tilburg, so grab your friends and sign up!

Register and find more information about our events at
www.Asset-Econometrics.nl/students/events

Do you see opportunities to get ahead?

The future calls for econometricians who look further.

Every day you will contribute to income for now, soon and later. To the income of your generation, your parents' and grandparents' generation and even your children's and grandchildren's generations. And you do it in the way that suits you.

As data scientist or actuary, because you see the meaning behind the figures. As a trader in asset management, because you see where the best opportunities are for boosting pension assets.
As DevOps engineer, because you help us to open our eyes to the power of innovation and technology. As a trainee or in one of the other many functions in APG in which we keep our eyes fixed on the pensions of millions of people. Because for us pensions are about people, life and living together.

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