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ASSET Econometrics

A Very Special Nekst

February surprised us with an ice-cold week in which we all could play with the snow. Some of us even went ice-skating. A few days later, however, it felt like it was already spring due to the lovely 'high' temperatures. Naturally, we would not be Dutch if we would not immediately go outside to enjoy the sun (while wearing sunglasses, of course). A foreigner might have thought it was already summer since nobody was wearing a jacket outside. Now, as the trees regrow their leaves, the birds start to sing their songs, and spring has started, the third edition of Nekst has also arrived.

In this edition, we have a large number of specials in store for you. We wrote an article about chess engines with a corresponding puzzle. Another special describes the phenomenon of short selling which is currently a hot topic in the world of finance. Moreover, Riley Badenbroek offered his insight on the history of money on page 17. Next up, we interviewed Herbert Hamers, the head of the EOR department, about education during the COVID-19 crisis. Finally, we also got the pleasure to interview the Career Service Officer of TiSEM: Joyce Ladenstein.

As you can see, there is a wide variety of articles to choose from in the spring edition of Nekst. With that said, I will not take up any more of your time. Get yourself a drink, enjoy the sun (unless it rains, you never know in the Netherlands), and start reading. I really hope you enjoy all the articles as much as I did!

Yours sincerely,

Mylan Tran
Editor-In-Chief

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Correspondence
Asset | Econometrics
Tilburg University
Room E 1.10
P.O.Box 90153
5000 LE Tilburg
Telephone: 013 466 27 47
info@Asset-Econometrics.nl
www.Asset-Econometrics.nl
www.Nekst-Online.nl

Editorial staff
Tamara Dert
Casper Heemskerk
Troy de Juncker
Nienke Kempers
Nienke Keuning
Maureen Lacet
Michelle Luijten
Karol Morales Salazar
Jarno Ringhs
Aimee Smarius
Marijn Wolferink

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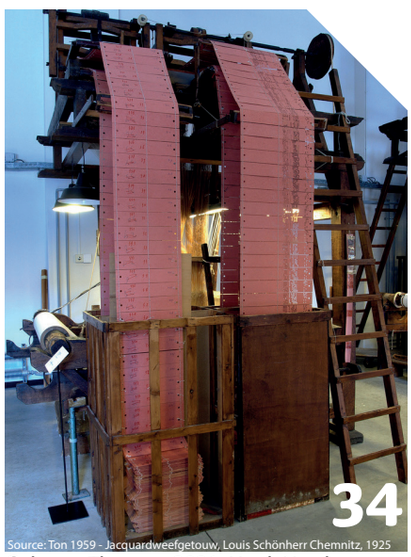

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Editor-in-Chief
Mylan Tran

Lay-out editor
Dahli Koskamp

Nekst-Online
Patrick Floor
Luuk Sommers

Contributions
Anne Balter
Riley Badenbroek
Dominique Bavelaar
Andries van Beek
Myra Coppens
Kuno Huisman
Nynke Koornstra
Henk Norde
Juul Schuurmans
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Dear Members,

At the moment, you are holding the third Nekst of this academic year and this automatically means that spring is here! During spring, the temperature is getting more and more comfortable, the number of hours of sun is increasing, and I think everyone's mood is going up as well. If the weather is nice enough today, I would suggest grabbing a cold drink and enjoy reading this beautiful edition of Nekst somewhere in the sun, for example in your backyard or in the Spoorpark.

If you have found yourself a comfortable place in the sun, I would like to glance back at the first few months of 2021. Since you received the previous edition of Nekst, a lot of things have happened! First of all, we as a board were welcomed back to our rooms in the Esplanade building. At the moment, we are allowed to work there approximately two days a week. This is of course a big improvement in comparison to working from home and we are very grateful for this opportunity. Unfortunately, only board members are allowed to work from there now, but we as a board cannot wait for the moment that all of you are allowed to visit our rooms again as well!

Besides this, we also organized a lot of events in the past few months. I would like to highlight two of them. At the beginning of this year, we organized the After Exam Pubquiz, which was a huge success. Over 90 of our members participated, and it can therefore be seen as our biggest informal event of this year so far! All participants could enjoy some drinks on the house and battle for some amazing prices in groups of four. The other event I would like to mention is the Brothers and Sisters evening. During this event, around 25 of our members could introduce our association to their siblings. All participants received a very nice cocktail box and enjoyed a nice evening program together.

Since this page is relatively small, I would like to continue by looking at what the future holds for our association! We have a broad range of events coming up, and I would like to invite you to all of them! For now, I will focus on three of them. On April 29, the Actuary Day Tilburg will be organized. During this event, we have room for 40 econometricians to get in touch with multiple companies within the field of actuarial sciences. Furthermore, the Connection Day on May 11 is a very nice formal event to get in contact with a possible future employer and to think about your future. But most of all, I would like to see you all on May 6. On this day, we will organize our famous Astrics Beer Cantus. It will most likely not be as we are used to, but I am certain that the Drink & Activities Committee will make the evening amazing.

While looking back and forth at all of the events of this year, I automatically look back at the board year I have had until now. The realization came that my board year is already halfway over. I have had an amazing year so far, for which I would like to thank you all. Let's make the remainder of this year even better together, and I really hope I will be able to see you all physically this spring and summer!

On a final note, I would like to wish you all the best in the final months of the second semester and I hope you will enjoy the spring as much as I will.

On behalf of the board,

Juul Schuurmans
Chairman Asset | Econometrics 2020-2021

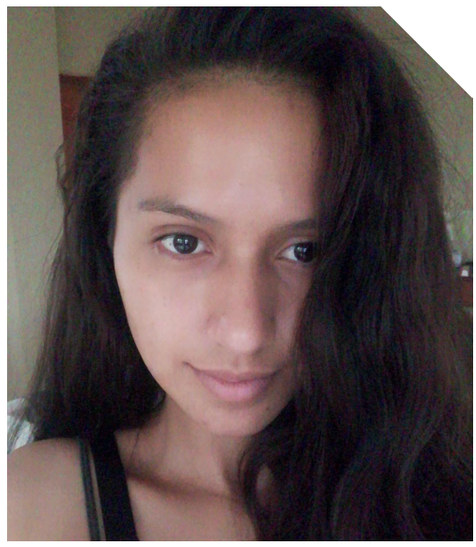
Meet the Crew 2.0

Maureen Lacet

Hi! My name is Maureen and I am 21 years old. I live in Lith (no, not lit), which is a small village in Noord-Brabant. I started studying Econometrics and Operations Research in 2017 and I recently started the Business Analytics and Operations Research (BAOR) Master. Before I joined the Nekst committee, I was part of the Active Members Day committee and the EOR Business Dinner committee. In my free time, I like to bake, watch movies, and spend time with my friends. I also like playing sports. I mainly play badminton but due to the lockdown, I have been exercising at home and I started running. I also really like skiing. I am even going to be doing a ski instructor training in Austria this November, after which I will be a ski instructor during the winter! Hopefully, I will be able to catch up with the missed parties in the après-ski, although I unfortunately need to miss out on some of my favorite 'cantussen' of Asset | Econometrics when these can be held again.

Karol Morales

My name is Karol. I am 25 years old and I am from South America. Currently, I am doing a pre-Master. I graduated as an economist at the University of Amsterdam in 2020, and I had a very depressing graduation ceremony by Zoom. This is my first year at Tilburg University, thus I have not been part of any other committee prior to Nekst. I was a professional track cyclist competing in international tournaments until the age of 20 after which I decided to retire due to unhealed injuries. Ever since my retirement, I have not played sports at any level, but I did get on the bike to go around Amsterdam's outskirts during the quarantine time. Since the quarantine started, I think what I miss the most is being allowed to go to the library at the university. I have yet to know the Tilburg University library, the campus, and the city. I hope by 2022, I can have a decent in-person graduation ceremony. Looking at the even further future, I would like to see myself at Tinbergen Institute or any other institute, completing a Research Master program.



Having a Great Time After Nine

On the evening of February 2, the After Exam Pubquiz took place. Due to the COVID-19 measurements, this was an online activity. I know that a lot of people are a tiny bit skeptical about these online activities, or at least I was at first. Since this is my first year as an active member of Asset | Econometrics, I do not know a lot of people who attend these activities. Moreover, I thought that with online activities, there was not really a way to connect with new people. However, one of my friends convinced me to participate, and so I did.

Before the pub quiz started, I got myself some snacks and drinks at the supermarket, Luckily, I could declare these costs at Asset | Econometrics for this event. The Zoom meeting started and immediately I noticed that there were a lot of people in the meeting: around 80 people participated! I did not expect that at all! At the beginning of the event, we were all assigned to different breakout rooms. In my breakout room, I got to meet my team of three other econometricians. I had never met any of them before, but with only four people in a breakout room, it is really easy to talk to each other without any disturbances. So, we could get to know each other better.

We had to watch a Twitch Livestream in which the questions of each round were presented by a different member of the board. The different rounds were: Brabant, actualities, mathematics, films and series, and the last round contained Asset | Econometrics related questions. My team and I were extremely competitive from the beginning on. I will even let you in on a secret. It turned out that we had a couple of extra 'secret' teammates, such as a roommate who was sitting in the same room. Together we went through the questions rather smoothly. Only the mathematics round was a bit confusing, which was kind of unexpected for us econometricians-to-be. In between the different rounds, there was some time to just chat or play games with your team. We played scribble, a game where one person draws something and the others have to guess what it is. This was hilarious because none of us could draw that well.

Myra Coppens

Bachelor EOR

Age: 20

At the end of the quiz, the winners were announced. It turned out to be my team! For our amazing pub quiz skills, we won a prize, which was a ten euro gift card from bol.com for each one of the team members. When I look back at the evening, I am really glad that I participated. I had a really fun evening and had a lovely time meeting new people. This event actually proved my prejudices about online activities wrong! Since Asset | Econometrics organizes a lot more of these kinds of online activities, I plan on attending them as much as I can. These events are a great way to meet new people and to have some fun in these somewhat boring times. So, I really look forward to all the future (hopefully soon not online) activities that Asset | Econometrics will organize, at which I for sure will make an appearance!

Checkmate for Traditional Chess?

The chess hype that the Netflix series 'The Queen's Gambit' has sparked is unprecedented. eBay revealed there was a 273% surge in searches for 'chess sets' on the auction site in the weeks following the show's release [1]. The series follows this clearly brilliant girl emerging in the US chess world. It is, however, notable that even she cannot perform at the top simply on her own merits. Studying others' theories, having a geek-team, and the occasional pills give her an edge. All these factors support a common goal: to help her study as many paths and combinations as possible. When stating it like this, it sounds very well optimizable, so let's see how far we have gotten over the years.

written by **Tamara Dert** and **Luuk Sommers**

Our modern version of European chess can be traced back to the fifteenth century. Throughout the years, the rules of the game varied a bit to make the game run faster. Pawns got the ability to move two squares in their first move and Queens could go 'mad', as the Italians liked to call the abilities of the modern queen. These kinds of changes made the game more accessible, but the base remained the same. For quite some time chess had clearly defined rules, having complete information for all possible states while each state can be evaluated. Therefore, it is a beautiful problem to target with math. So, why has chess not been 'solved' yet?

Combinatorial Complexity

The answer is simple, although the field of chess is only eight by eight, it is too complex. If you try making a decision tree you will soon find an exponential explosion, as visualized in Figure 1. At the start of a game, each player has sixteen pieces with a total of twenty possible moves (two for each of the eight pawns, plus two for each knight). This means that after just two moves, a game can be in 400 different positions [2]. On average a player has about 40 legal move options, so you can imagine that the number of scenarios will get enormous as the game continues. The current best estimation of the number of possible chess games is 10^{120} and belongs to Claude E. Shannon. This might seem like a graspable number, but please think again: the total estimated amount of atoms in the universe is only 10^{75}.

Although in 1996, it was estimated that only 10^{47} of these are actually reachable chess positions, the problem of chess is still unsolvable within a reasonable time, even with supercomputers [3]. In 2017, top supercomputers could do about 10^{16} floating point operations per second (FLOPS) which is the unit for computing power. Moore's Law assumes that the computer power roughly doubles every two years. If we assume that this law holds in the future and that it takes 100 operations to evaluate a position, which yields 10^{14} positions per second, then it would take about 128 years to 'solve' chess. Let alone if you try this with your own computer that can on average perform about 10^{13} flops. So computers have not cracked chess yet and probably will not do so anytime soon. However, you do not have to worry about your perspective in the computer science sector. Computers have been better than men for ages now. Even world chess champions have been getting defeated by chess engines since 1997.

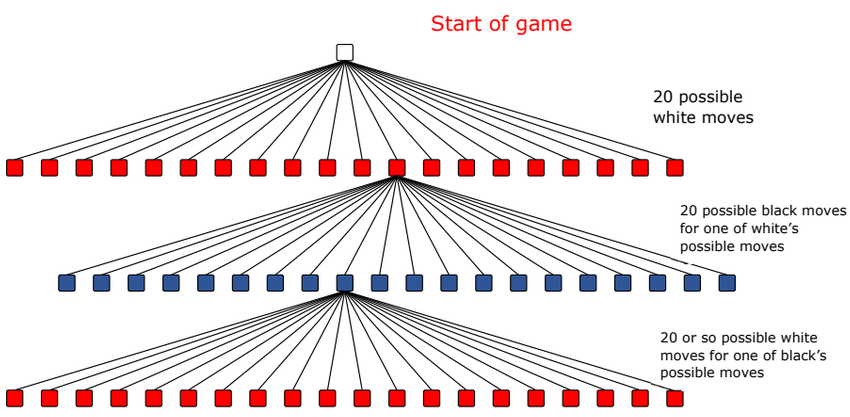


Figure 1: A visualization of the exponential growth of combinations for just the first two moves.

The working of a chess engine

So what kind of algorithm is behind a chess engine? Most chess engines work according to the same idea [4]. A chessboard and pieces are generated, this in combination with the implementation of the basic rules gives the computer the ability to calculate all legal moves. Then comes the creative part: position evaluation. Here, the computer gives a score to the position that each possible move conjures. If you, for example, build a simple chess engine, you could achieve this by counting the relative strength of the pieces on the board which the computers play minus the ones of the opponent. In the final part, the computer must determine which is the best move. For this problem, a *Minimax algorithm* with alternate moves is used to explore the recursive tree of all possible move scores to a given depth. The computer maximizes its score and the algorithm assumes that the opponent always reacts rationally: minimizing the score of the computer.

The performance of a chess engine is mostly determined by two things: the number of moves it can think ahead of and the strength of its position evaluation. The first is bottlenecked by the time. This race is won by the algorithm running on the computer with the biggest computing power, but strong *alpha-beta pruning* also plays a key role. *Alpha beta* is an optimization method that allows the engine to disregard non-rational branches in the tree. It stops evaluating a part of a search if it finds a move that leads to a worse situation than previously discovered. This makes it possible for the engine to evaluate the minimax search tree deeper whilst using the same resources. The second thing, position evaluation, is not constrained. The better a computer can evaluate positions, the less important the recursion depth becomes. A lot of chess theory is therefore often incorporated in this part. This varies from the belief that control of the center squares is important to upping scores for positions that could be the start of a favorable sequence.

Fall of the traditional chess engines

Chess computers are so widely developed that in 2010, Martin Thoresen constructed the Thoresen Chess Engines Competition (TCEC), later called the Top Chess Engines Competition. The most famous player of this tournament is Stockfish. Stockfish is an open-source chess engine that is developed by an entire community [5]. Since its first participation in the TCEC in 2013, Stockfish reached the final in every season with only one exception. Eight times it won the TCEC championship and it still is the reigning champion of the TCEC. Stockfish was worldwide considered as the strongest chess engine and seemed unbeatable.

In 2017, the chess world was shocked when Stockfish lost to a relatively new player called AlphaZero [6]. AlphaZero is an AI system created by Google researchers which developed superhuman performance in chess, shogi (Japanese chess), and Go. The main reason AlphaZero could defeat Stockfish is that this chess engine is constructed completely differently. As mentioned before, traditional chess engines, such as Stockfish, rely on position evaluation. These evaluations are mostly based on openings and strategies of human top chess players. Per second, Stockfish can calculate up to sixty million possible moves that are all valued according to previous human plays and their outcomes.

On the other hand, AlphaZero [8] uses a deep neural network that does not take any prior knowledge of the game except for the basic rules. In millions of games against itself, it learns which moves are 'good' moves and which are 'bad' moves. In the beginning, it plays randomly, but over time the system learns from wins, draws, and losses by adjusting the neural network. In future games, it can make decisions based on the adjusted neural network and again improve the neural network. In this way, the neural network keeps improving when the engine is playing.

Instead of considering millions of moves per second, AlphaZero only considers sixty thousand moves per second. However, using Monte Carlo Tree Search, it does not have to calculate each move, but certain strategies are evaluated. Let two moves have the same direct value, such as moves 2 and 3 in Figure 2. Then this implies for traditional chess systems that the moves are equally good in this level of the tree. Therefore, the system has to consider the next possible moves and dive deeper into the tree. In contrast, AlphaZero assigns values not only based on the move itself, but also how it experienced this move in previous plays. Therefore, it would have known from previous chess games that move 2 is less promising and is thus lower valued. The more games AlphaZero plays, the more accurate these values get.

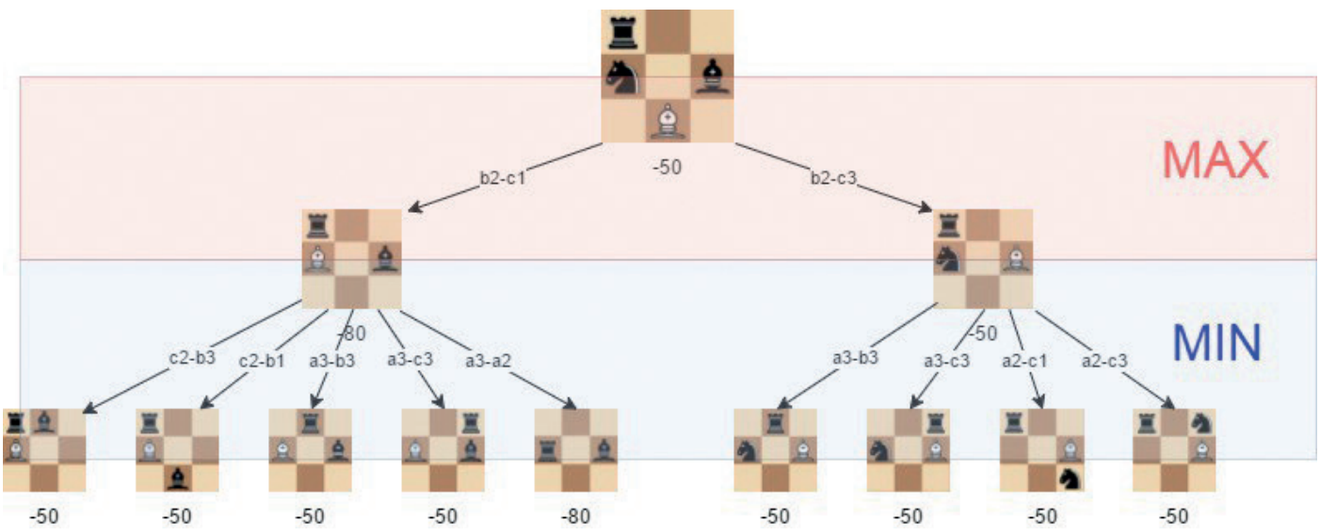


Figure 2: Alpha-Beta pruning on a recursive tree with depth 2 with a limited complication.
Note 1: Alpha-Beta pruning is more efficient as it visits the good paths first
Note 2: Alpha-Beta pruning does not influence the outcome of the minimax algorithm

During the training process of AlphaZero, Google kept track of the current Elo rating. This rating system, invented by Arpad Elo, reflects the player's chess performance [10]. In Figure 3, one can see that AlphaZero's neural network made huge improvements in the first 150,000 training steps. After approximately 300,000 training steps, it succeeded Stockfish's Elo rating and after 700,000 steps Google clarified that AlphaZero has mastered the game of chess. It took AlphaZero only an impressive 9 hours to complete those 700,000 training steps. After just four hours of training, it already outperformed Stockfish's chess rating. A rating that Stockfish achieved after years of development.

After AlphaZero's development was completed, it challenged reigning champion Stockfish. In the 100 games that the two chess engines played, AlphaZero won 25 games as white and three as black. As all other games resulted in a draw, AlphaZero managed not to lose once against Stockfish [7]. At this moment, chess players and researchers knew that AI-based chess engines would eventually overtake human-based chess engines. Although chess engines were beating humans for years, the only part in these engines that needs human input is now on the verge of being eliminated.

New chess arrives

For many chess players, this will not only be seen as the start of the AI chess engine era, but also as a new impulse to human chess. Garry Kasparov, considered as one of the best chess players in the world, stated the following about AI chess engines: "It was a mistake to think that if we develop very powerful chess machines, the game would be dull." He proceeds: "It found that it could actually sacrifice material for aggressive action. It is not creative, it just sees the pattern, the odds. But this actually makes chess more aggressive, more attractive" [9]. AlphaZero did not only break the Elo rating record, but it also created a whole new playstyle. A style in which pieces are sacrificed to keep control of crucial in-game positions. AI has proven that intuitively unusual moves can be considered as 'good' moves, which gives new opportunities to human chess. Where traditional chess engines learned from moves that top chess players performed, it is now up to top chess players to learn from moves that are performed by AI chess engines. ●

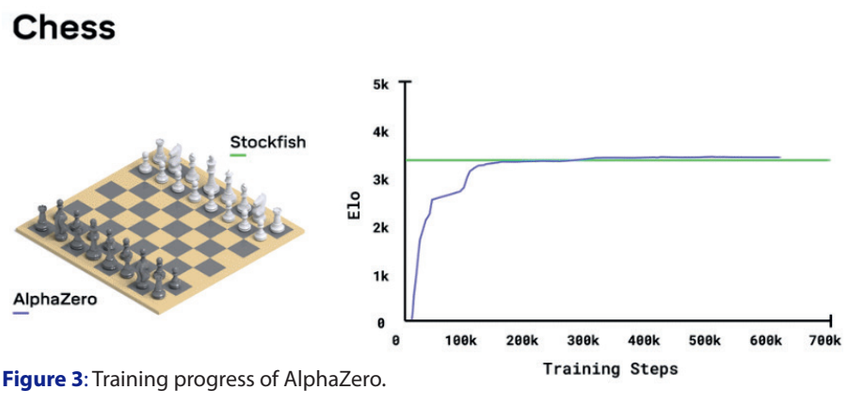


Figure 3: Training progress of AlphaZero.

Note 1:
Each training step represents 4,096 board positions.

Note 2:
The highest human Elo rating ever achieved is 2882.

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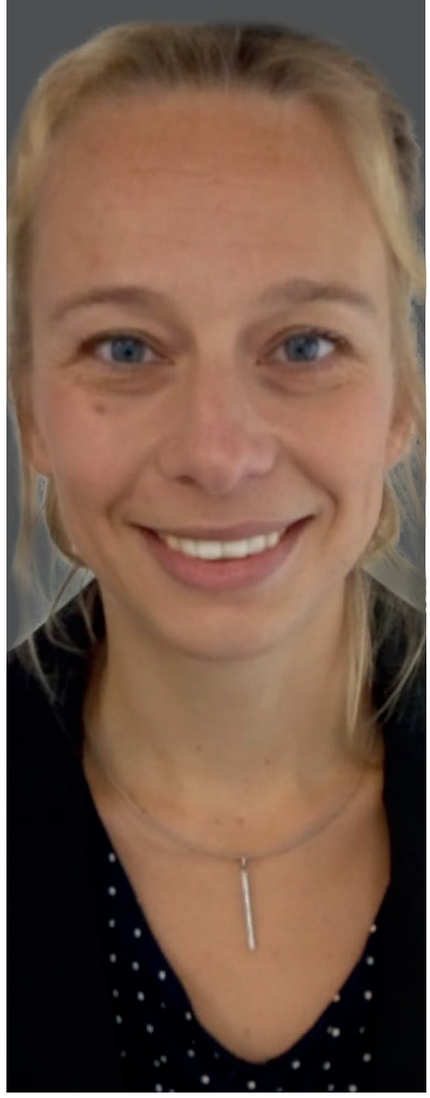
Carnival

Anne Balter
is an assistant professor at the Department of Econometrics and OR and a senior research fellow at Netspar. Her research interests include mathematical finance, in particular robust portfolio problems, pension economics, and real options.



Back in February many of us would probably have celebrated Carnival were it not for the coronavirus spreading around. Instead, I sat down to write this third column for the next issue of Nekst. Also, 2021 started digitally and after the first week of lectures and Q&A Zoom sessions, you already had time off for a week. Carnival usually means a week full of festivities, like parties, parades, and costumes, a tradition in the southern part of the Netherlands. This year, however, we unfortunately 'celebrate' the first year of the coronavirus and thus the first time that Carnival does not take place the way we are used to. However, this is not completely true.

The story goes that Tilburg actually has a history of skipping Carnival, not just once but for more than 100 years. Some time in 1857 in Tilburg, Father Bernard Hafkenscheid was leading the mass in the days before Christian Lent (40 days of fasting before Easter). Suddenly, the prayer was interrupted by noisy people celebrating Carnival outside the church. This incident prompted the church to take measures. From then onwards celebrating Carnival in Tilburg was prohibited, and it was so for the next 100 years. Some people would hide their colorful costumes while they secretly traveled to neighboring cities, such as Breda, to celebrate Carnival. In 1963 and 1964, the police acted very strictly on the prohibition of Carnival parades and fined those who violated the rules. It would take until 1965 before Carnival in Tilburg could be celebrated in public again.

Carnival traces its history back to a Catholic celebration taking place before the season of Lent, which is mainly celebrated in the province of Limburg where it is known as 'Vastelaovend' (literally meaning 'the evening before the fasting season') and in Noord-Brabant as 'Vastenavend'. In Lent, one commits to fasting and giving up certain luxuries. It begins on Ash Wednesday and ends 40 days later on the day before Easter Sunday. It typically involves public celebrations, including events such as parades and public street parties, and consumption of alcohol and other food that will be forgone during the upcoming Lent. Some say the word comes from 'carne vale' which means 'farewell to meat'. Nowadays, Carnival is less strongly tied to the Catholic church and many do not even recall the reason for the big party.

Carnival is celebrated worldwide with many different traditions connected to it. Even within the Netherlands, it knows lots of different local traditions. Hence, this is a brief non-academic reflection of 'my Carnival' from Gebrook (many villages use the name in their local dialect during Carnival). The Rhineland Carnival (which originates from the Carnival of Cologne, which itself originates from the Carnival of Venice) is mainly celebrated in Limburg, while the Burgundian Carnival is mainly celebrated in Noord-Brabant and Zeeland, a part of Gelderland, but also in parts of the Achterhoek and Twente. The Rhineland vastelaovend started at the end of the 19th century as a playful protest against the Prussians, while the Burgundian Carnival started as a costumed food festival, where people made fun of each other and everyone was equal. This difference is still visible since in Limburg, Carnival is all about dressing up oneself as beautiful or crazy as possible, sometimes even incognito, reflecting the intention of making fun of the establishment. The colorful 'schmink' (make-up) and masks clearly stem from the Venetian tradition. In Brabant, people typically dress up as farmers and all wear the same smock ('boerenkiel'), and in Oeteldonk (Den Bosch), with a red-white-yellow scarf. The traditional colors in Limburg are red-yellow-green. The number 11 is an important number for Carnival, being the 'crazy number' and thus the starting time of many events. The Carnival season itself starts on the 11th of the 11th (November 11) at 11.11 hours. I participated several times as part of the local 'harmonie' (orchestra) in which I play the alto saxophone.

Hopefully, this time you do not have to wait 100 years for the next Carnival. ●

Biform Linear Production Processes

This article presents a new model that combines cooperative and noncooperative game theory in a single two-stage model. In particular, we introduce a strategic element to the traditionally cooperative Linear Production (LP) process, thereby creating a *biform linear production* (BLP) process. Players compete for resources in the first stage, after which they cooperate to optimally use the obtained resources in the second stage.

Introduction[1]

Cooperative and non-cooperative game theory are often presented as two opposing branches of the same field, where players either cooperate and form coalitions, or do not cooperate and decide only on their own strategies. We analyze a hybrid model that combines elements from these two branches of game theory in one two-stage model. In particular, we incorporate strategy dependence into linear production (LP) processes.

Cooperative game theory studies situations in which groups of players can cooperate by signing a contract or establishing a joint plan of action. It is assumed that these agreements between players are binding. In cooperative games with transferable utility, one then assigns a (joint) value to every possible coalition, thereby defining the cooperative game. By 'solving' this game, we find allocations of the total joint revenue among the set of players. This stands in contrast to non-cooperative game theory, where binding agreements are not allowed. In a non-cooperative game, strategic players are interested in maximizing their individual payoffs, taking into account the strategic behavior of other players. The main topic of interest is often (the existence of) Nash equilibria [2].

Two-stage (or multi-stage) models are not uncommon in the game-theoretic literature, but the two-stages are often both cooperative or both non-cooperative. Combining cooperative and non-cooperative game theory into the same model is still far less common. Brandenburger and Stuart [1] create a two-stage model called a *biform game* to analyze strategic moves in business, where a non-cooperative first stage is followed by a cooperative second stage. The non-cooperative stage concerns a strategic decision like whether to invest in innovation, and these strategic decisions made by players then determine the competitive environment in which some cooperative game is played.

Of course, defining a model is in itself not interesting enough, the point is to also do something more concrete with the model. The general idea is as follows: for all possible strategy combinations (so all possible outcomes of the first stage), we determine some unique allocation vector in the cooperative second stage. These allocations per strategy combination are then used as the payoff vectors for the so-called induced non-cooperative game. In this way, we essentially end up with a standard non-cooperative game, for which we will investigate the existence of pure Nash equilibria (from now on simply called Nash equilibria).

We apply this idea of using a biform model to LP-processes. A (biform) LP-process is described more formally in the next sections. Conceptually, an LP-process in a general setting (as presented in [3]) can be used to model situations in which a set of players is able to pool a set of resources used in the manufacturing of a set of products. It is often assumed that resources are owned completely by the players (firms) at the start of an LP-process. This assumption is quite restrictive since in practice the firms are often dependent on their supply chain to obtain these resources. This is a situation that lends itself well for analysis with a biform model.

Starting with the non-cooperative first stage, players compete to obtain resources. One might think of a situation in which firms can obtain a scarce or hard-to-produce resource, like fossil fuels or complicated electronics, from different sources. There may be significant costs and preparation time involved with settling on a source, for example due to a need for lobbying to access some scarce resource in another country, or to train or financially support manufacturers of some hard-to-produce resource. Therefore, firms can only settle on one source. The resource bundle available at a source is often restricted, meaning this bundle has to be split between firms if multiple firms decide to settle on the same location. The competition for resource bundles gives rise to the first-stage strategic game which determines the exact LP-process that the firms end up in. Once each firm has obtained a resource bundle, it may be of interest to the firms to cooperate, as they might have a surplus in one resource and a deficit in another resource needed in the manufacturing process. This is modeled in the second-stage LP-process, which is solved us-

[1] This article, and the paper underlying it, are partly based on the EME Thesis of Benjamin Malmberg, who graduated in August 2018.

ing a payoff vector based on the Owen set or based on some game-theoretic solution concept. We refer to this model as a *biform linear production (BLP) process*.

The main goal of the remainder of this article is to present the model more formally and illustrate it with an example. We start with a section on (cooperative) LP-processes. If you have followed one of Peter Borm's courses on game theory and you are feeling confident about your memory, feel free to speed through this section. After this section, we are ready to define a BLP-process and look at Nash equilibria of the induced strategic game.

LP-processes

An LP-processes is described by the tuple

$$L = (N, R, P, A, \{b^i\}_{i\in N}, c),$$

where N represents the finite set of players, R the finite set of resources, P the finite set of products, A the $|R| \times |P|$ linear technology matrix of which the cell in the r-th row and p-th column corresponds to the number of units of resource r needed to manufacture one unit of product p, $b^i \in \mathbb{R}^R_+$ represents the resource bundle of player i, and $c \in \mathbb{R}^P_+$ represents the market price for a unit of each product.

Let 2^N denote the collection of subsets of N. These subsets are referred to as coalitions, and N is called the grand coalition. A transferable utility game (TU-game) is a tuple (N, v), where $v : 2^N \to \mathbb{R}$ with $v(\emptyset) = 0$ is referred to as the characteristic function. The number $v(T)$ in principle provides the highest total monetary value a coalition $T \in 2^N$ can jointly generate without the help of the players $N \setminus T$. The class of TU-games with player set N is denoted by TU^N.

Let $L = (N, R, P, A, \{b^i\}_{i\in N}, c)$ be an LP-process. Then, the corresponding transferable utility LP-game $v_L \in TU^N$ is defined such that the value of coalition $T \in 2^N \setminus \{\emptyset\}$ is the solution of the following maximization problem

$$v_L(T) = \max_{y\in\mathbb{R}^P} c^T y \text{ subject to } Ay \leq \sum_{i\in T} b^i,\ y \geq 0.$$

In words, the value of a coalition is the maximum revenue generated by the sale of products, where production is restricted by the sum of resource bundles available to the coalition. The value $v_L(T)$ of a coalition T can also be found by solving a dual problem instead. For a coalition $T \in 2^N \setminus \{\emptyset\}$,

$$v_L(T) = \min_{z\in\mathbb{R}^R} z^T \sum_{i\in T} b^i \text{ subject to } z^T A \geq c^T,\ z \geq 0.$$

For any $z \in \mathbb{R}^R$ that solves the dual program, z_r is the shadow price of resource $r \in R$ corresponding to this solution. Note that in the dual programs, the feasible region does not depend on the coalition T at hand. We denote the corresponding feasible region by F, formally defined as

$$F = \{z \in \mathbb{R}^R |\ z^T A \geq c^T, z \geq 0\}.$$

Having defined the LP-game itself, the next step is to 'solve' this game by determining a unique (payoff) allocation vector. We use two different concepts to derive two allocation vectors (thereby ultimately leading to two different induced strategic games), namely the Owen set and some 'anonymous' one-point game-theoretic concept. We will not formally define anonymity, but the basic idea is that the identity of a player (i.e., whether a player is called 'player 2' or 'player 3') does not influence a player's allocated payoff.

The Owen set [3] is a solution concept that exploits the unique structure of an LP-process to find an allocation vector without a need to explicitly derive the LP-game. The Owen set gives us an allocation vector that is based on the shadow prices that solve the linear programming problem for the grand coalition. Formally, the Owen set is defined as

$$Owen(L) = \{(z^T b^i)_{i\in N} \in \mathbb{R}^N |\ z \in F, v_L(N) = z^T \sum_{i\in N} b^i\}.$$

We denote the[2] vector of shadow prices of the resources that corresponds to the Owen set as $\bar{z}$.

For the anonymous one-point game-theoretic solution concept (from now on referred to as an anonymous solution), we will use the Shapley value [4] in our examples. We omit the formal definition here, but in the example below we can use the fact that for any $v \in TU^N$ with $N = \{1, 2\}$, we have

$$\Phi_i(v) = v(\{i\}) + \tfrac{v(N)-v(\{1\})-v(\{2\})}{2} \qquad (1)$$

for any $i \in N$.

Example

Consider $L = (N, R, P, A, \{b^i\}_{i\in N}, c)$ with $N = \{1, 2\}$, $R = \{r_1, r_2\}$, $P = \{p_1, p_2\}$, and

$$A = \begin{bmatrix} 5 & 5 \\ 6 & 6 \end{bmatrix},\ b^1 = \begin{bmatrix} 100 \\ 200 \end{bmatrix},\ b^2 = \begin{bmatrix} 300 \\ 50 \end{bmatrix} \text{ and } c = \begin{bmatrix} 9 \\ 9 \end{bmatrix}.$$

The objective function for the dual program of N is given by

$$z^T \sum_{i\in N} b^i = 400z_1 + 250z_2$$

[2] Though examples can be contrived for which the Owen set contains infinitely many allocation vectors, it generally prescribes a unique allocation vector. If not, we can simply take the average of the extreme points of the set. We will ignore the more formal side of this issue here.

for all $z \in F$, where the feasible region

$$F = \{z \in \mathbb{R}^2 |\ 5z_1 + 6z_2 \geq 9, z \geq 0\},$$

has two extreme points, $z = [9/5\ 0]^T$ and $z = [0\ 3/2]^T$. The unique extreme point of the feasible region that minimizes this objective function, is $\bar{z} = [0\ 3/2]^T$. For these shadow prices, the payoff allocation vector based on the Owen set becomes

$$\begin{aligned} Owen(L) = \{\bar{z}^T b^i\}_{i \in N} &= \left([0\ \tfrac{3}{2}] \begin{bmatrix} 100 \\ 200 \end{bmatrix},\ [0\ \tfrac{3}{2}] \begin{bmatrix} 300 \\ 50 \end{bmatrix} \right) \\ &= (300, 75). \end{aligned}$$

Note that for the LP-game we have $v_L(\{1\}) = 180$, $v_L(\{2\}) = 75$, and $v_L(N) = 375$. Applying (1), we get

$$\Phi(v_L) = (180 + 60, 75 + 60) = (240, 135),$$

for the Shapley value. △

BLP-processes

Now that we have a thorough understanding of LP-processes, we are qualified to analyze a *biform* LP-process. Our model introduces a strategic element to standard LP-processes by letting players compete for resources, rather than assuming each player owns some resource bundle beforehand. We assume that resources can be obtained from two locations, sources 1 and 2, with resource bundles $l_1 \in \mathbb{R}^R_+$ and $l_2 \in \mathbb{R}^R_+$, respectively. The strategic choice of the players will be to order at source 1 or at source 2.

To model this strategic phase, we need some notation on general strategic games. We only consider finite strategic games, for which the finite strategy set of player i is denoted by X^i for all $i \in N$, and the set of all strategy combinations is $X = \Pi_{i \in N} X^i$. The strategy that player i chooses is denoted by $x^i \in X^i$. A strategy combination chosen by all other players in $N \setminus \{i\}$ is denoted by $x^{-i} \in X^{-i}$, with $X^{-i} = \Pi_{j \in N \setminus \{i\}} X^j$. For any player i, $\pi_i : X \to \mathbb{R}$ is the payoff function of this player.

A strategy combination $x \in X$ is a Nash equilibrium of the strategic game $G = \left(\{X^i\}_{i \in N}, \{\pi_i\}_{i \in N}\right)$ if we have $\pi_i(x) \geq \pi_i(\tilde{x}^i, x^{-i})$ for all $\tilde{x}^i \in X^i$ and all $i \in N$. In words, a strategy combination is a Nash equilibrium if no player has a reason to change strategy, given the strategies of all other players. The set of all Nash equilibria of G is denoted by $E(G)$.

We are now ready to formally define a BLP-process and corresponding induced strategic games.

Definition *A BLP-process is a tuple*

$$\mathcal{L} = (N, \{X^i\}_{i \in N}, l_1, l_2, \{L(x)\}_{x \in X}),$$

in which for all $i \in N$ we have $X^i = \{1, 2\}$, l_1 and l_2 are the respective resource bundles at the two locations, and for any $x \in X$,

$$L(x) = (N, R, P, A, \{b^i(x)\}_{i \in N}, c)$$

is a corresponding LP-process, with

$$b^i(x) = \begin{cases} \frac{1}{|S_1(x)|} l_1 & \text{if } x^i = 1, \\ \frac{1}{|S_2(x)|} l_2 & \text{if } x^i = 2, \end{cases}$$

where $S_1(x) = \{i \in N : x^i = 1\}$ and $S_2(x) = \{i \in N : x^i = 2\}$.

Using the notation $L(x)$, we emphasize that an LP-process is strategy dependent. We explicitly show what part of the LP-process (indirectly) becomes strategy dependent in our notation as well, using for example $b^i(x)$ for the strategically determined resource bundle of player i. If a set of players chooses the same source, the resource bundle available at this location is divided using an 'equal bundle splitting rule', i.e., each player gets an equal fraction of the available resource bundle. For this, we let $S_1(x)$ and $S_2(x)$ denote the set of all players who choose location 1 and 2, respectively.

The next step is to determine the payoff vector associated with a BLP-process, thereby defining the induced strategic game. Let $\mathcal{L} = (N, \{X^i\}_{i \in N}, l_1, l_2, \{L(x)\}_{x \in X})$ be a BLP-process. For any given $x \in X$, we define $\bar{z}(x)$ to be 'the' shadow prices corresponding to the Owen set. The induced strategic game $G^{\mathcal{L}, Owen} = \left(\{X^i\}_{i \in N}, \{\pi_i^{\mathcal{L}, Owen}\}_{i \in N}\right)$ that follows from this BLP-process $\mathcal{L}$ is now defined by setting

$$\pi_i^{\mathcal{L}, Owen}(x) = \bar{z}(x)^T b^i(x)$$

for any $x \in X$ and all $i \in N$. Similarly, if we let $f : TU^N \to \mathbb{R}^N$ be an anonymous solution, we can define the induced strategic game $G^{\mathcal{L}, f} = \left(\{X^i\}_{i \in N}, \{\pi_i^{\mathcal{L}, f}\}_{i \in N}\right)$, for which the payoff of player $i \in N$ equals

$$\pi_i^{\mathcal{L}, f}(x) = f_i(v_{L(x)}).$$

for any $x \in X$, where $v_{L(x)}$ is the LP-game corresponding to LP-process $L(x) = (N, R, P, A, \{b^i(x)\}_{i \in N}, c)$.

Conveniently, there are only three possibilities for the shadow prices of a BLP-process. The key is that $\sum_{i \in N} b^i(x)$ is the only strategy dependent factor that influences $\bar{z}(x)$ for any $x \in X$. If all players choose the same location as their source, then only the resource bundle at that location will be available to the grand coalition. For these cases, we define $\bar{z}^1 = \bar{z}(1, 1, \ldots, 1)$ and $\bar{z}^2 = \bar{z}(2, 2, \ldots, 2)$. For all remaining strategy combinations, note that each location is chosen by

at least one player, so that the corresponding total resource bundle is the sum of l_1 and l_2. All such strategy combinations then lead to the same shadow price vector, denoted by $\bar{z}^{1,2}$.

Example (continued)
Consider a BLP-process $\mathcal{L} = (N, \{X^i\}_{i\in N}, l_1, l_2, \{L(x)\}_{x\in X})$ with

$$N = \{1,2\},\ X^1 = X^2 = \{1,2\},\ l_1 = \begin{bmatrix}100\\200\end{bmatrix} \text{ and } l_2 = \begin{bmatrix}300\\50\end{bmatrix},$$

where for any $x \in X$, $L(x) = (N, R, P, A, \{b^i(x)\}_{i\in N}, c)$ is as described in the example of the previous section, except that the resource bundles are now strategically determined. Note that the LP-process discussed in that example corresponds to $L(1,2)$, i.e., the BLP-process $\mathcal{L}$ with $x^1 = 1$ and $x^2 = 2$.

The LP-games $v_{L(x)}$ corresponding to each strategy combination are given in the Table 1.

S	$\{1\}$	$\{2\}$	$\{N\}$
$v_{L(1,1)}(S)$	90	90	180
$v_{L(1,2)}(S)$	180	75	375
$v_{L(2,1)}(S)$	75	180	375
$v_{L(2,2)}(S)$	37.5	37.5	75

Table 1: The LP-game $v_{L(x)}$ for each $x \in X$ in the example

We now also consider $x = (1,1)$. Since both players choose the first location, they (equally) share l_1 to end up with $b^1(x) = b^2(x) = [50\ 100]^T$. Note that the objective function for the dual program of N is now minimized by $\bar{z}^1 = [9/5\ 0]^T$, which yields $\pi_1^{\mathcal{L},Owen}(x) = \pi_2^{\mathcal{L},Owen}(x) = (\bar{z}^1)^T b^i(x) = 90$.

For the other strategy combinations, we have $\bar{z}^2 = \bar{z}^{1,2} = [0\ 3/2]^T$. Using these shadow prices and the various strategically determined resource bundles, we find $G^{\mathcal{L},Owen}$, as given on the left-hand side of the Table 2. Applying (1) to the LP-games from Table 1, we also find $G^{\mathcal{L},\Phi}$, given on the right-hand side. Note that $E(G^{\mathcal{L},Owen}) = \{(1,1)\}$, whereas $E(G^{\mathcal{L},\Phi}) = \{(1,2),(2,1)\}$. △

	1	2
1	(90,90)	(300,75)
2	(75,300)	(37.5,37.5)

	1	2
1	(90,90)	(240,135)
2	(135,240)	(37.5,37.5)

Table 2: The strategic games $G^{\mathcal{L},Owen}$ (left) and $G^{\mathcal{L},\Phi}$ (right) induced by the BLP-process of the example

It is interesting to see that the sets of Nash equilibria in the example are completely disjoint. However, both are always non-empty.

Theorem *Let $\mathcal{L}$ be a BLP-process, let f be an anonymous solution, and let $G^{\mathcal{L},Owen}$ and $G^{\mathcal{L},f}$ be the induced strategic games. Then, $E(G^{\mathcal{L},Owen}) \neq \emptyset$ and $E(G^{\mathcal{L},f}) \neq \emptyset$.*

For the proof, the interested reader is referred to the upcoming paper. And while we are talking about the paper, it will also include a section about *biform sequencing processes*, in which players compete for their initial positions in a queue, before cooperating to jointly optimize their order. But I have kept you busy long enough for now... ●

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Andries van Beek
Ph.D. candidate

Meet Our Enthusiastic Career Service Officer

written by **Casper Heemskerk** and **Juul Schuurmans**

Joyce Ladenstein has been our Career Service Officer for over a year now, so it was time to meet and introduce her. Joyce is 46 years old and grew up in Heerlen. 27 years ago, she fell in love with Breda and she has been living there ever since. She lives in a busy household with her boyfriend, three children, a cat, and a dog. After 22 years of working at Start People, she needed another challenge, and finally, this has led to the job: Career Service Officer at TiSEM (Tilburg School of Economics and Management). How did she end up here and what are the particular things she does as a Career Service Officer?

Joyce's education and career

Joyce left Heerlen when she graduated from pre-university education. She went to study at Utrecht University and moved there as well. It did not work out in Utrecht and she quit after a few months. The following year, she decided to study tourism at the NHTV (Nationale Hogeschool voor Toerisme en Verkeer, now Breda University of Applied Sciences) in Breda. During and after her study she did not know what job suited her best so she decided to start working at an employment agency to gain broad work experience. She accepted a job at Start People, nowadays part of USG People. She started as a consultant but eventually developed and moved on to several positions, to end up as national recruitment manager. After many beautiful and educational years, but also after many years of traffic jams, it was time for a new challenge. In good consultation, Joyce and Start People said goodbye to each other after 22 years and Joyce decided to follow her heart and look for a job that suits her and gives her energy. She took some time for herself to reflect and by then, a job offer at the university came along. Because this job entails everything she looks for in a career, she decided to accept the offer. So, since February 2020, she is the new Career Service Officer of TiSEM.

Career Service Officer

Not every student has yet been in contact with the Career Service Officer. Some do not even know that the econometrics department has a Career Service Officer, who is specialized in the programs. Every student can contact the Career Service Officer if he or she wants guidance or advice preparing for their future career. Through the Tilburg University career portal, you can schedule a career guidance appointment with Joyce. She can give guidance and advice for every stage of career preparation.

Besides the personal meetings with students, Joyce is regularly in contact with the Academic Directors and Education Coordinators for updates. In cooperation with them and Asset, they organize workshops, inspiration sessions, and several career perspective events with alumni. Furthermore, Joyce gives short information or inspiration sessions for big groups of students about current topics or frequently asked questions together with her colleague Simone.

Expectations about the job

Before Joyce started working at the university, she had some expectations

Joyce Ladenstein
Career Service Officer
Tilburg University

about the job. Like she said: "I expected to have much contact with the students and I could help them with their development. Not only should I give information to the students, but the students also have to explore things on their own and I want to guide them in that process." Her expectations are fulfilled, she enjoys the job and the contact with the students. The switch from working at a company to working at the university was very welcome. At the university, the speed of the processes is somewhat slower and the deadlines are less tight. Therefore, there is also room to come up with new ideas.

She noticed that for econometrics students, the job offers are not the problem. Econometricians are wanted and the students are aware of this fact. But, she noticed that econometrics students sometimes struggle with their prefer-

ence; which job and which organization suits them best. "Advice and guidance for econometrics students should lie more on the first two phases: who am I, what do I want, and which organization and function are best suited to this." The best time to start thinking about the future is already during the study, while there is plenty of time to reflect and explore.

In these times during the crisis, many companies are financially suffering. During the first lockdown, the companies were hesitant about hiring new people. However, the situation normalized and the amount of job offers is increasing again. Joyce thinks that for starters at the job market, it is not very difficult to find a job compared to the situation before the crisis.

Biggest challenge in your work

Joyce thinks that at the moment, one of the biggest challenges she faces is the differences in how important Academic Directors find labor market preparation. On one side you have Directors who see the importance and are willing to think along and promote Student Career Services. While on the other side, there are Directors who do not think it is so important because the labor market opportunities and prospects for the students are very bright. The biggest challenge, but also one of Joyce's goals is therefore to make sure that all Academic Directors find career orientation and preparation important and see the added value of Student Career Services. Joyce really sees it as a challenge and not a frustration. She is noticing improvements daily and everyone is always open for a conversation. Besides that, she also mentioned that the Vice Dean of Education is supporting them a lot. He does deem it really important to stimulate career orientation and preparation among the students. Furthermore, she mentions that help is on the way: "From March 1 onwards, there will be an extra Career Service Officer so that they can focus more on a specific program and really go more in depth to help the students."

Greatest loss at your job due to Corona

Our Career Service Officer started working at the university in February. This means that she only worked on campus for five weeks, and from that moment on she had to work from home. About what Joyce is missing the most, she said: "The social interactions for sure. To be able to walk to the desk of a colleague to ask a small question, and for example, the chats at the coffee machine." She also sees some advantages of working at home, but would really like to go back to the university when it is all possible again at least for a few days a week.

The most important developments in your field of work

Joyce explains that she considers herself to be working in the field of labor market preparation. In general, the most important development is the relevance of soft skills and work experience in the form of internships. Besides this, Joyce also notices some important developments in her own department at the university: "I think that for us, one of the most important developments is digitalization. When I started, almost everything on our website was just plain text without any visualization." In her team, Joyce became responsible for the digitalization. She and her colleagues started to implement short videos and animations. Besides this, dealing with data and increasing their visibility are also important. After explaining all of this, Joyce did have to admit something: "I might be a little biased since digitalization is my portfolio in the team."

Joyce on Econometricians

Lastly, Joyce gave her thoughts and opinions on Econometricians: "You are all very wanted on the labor market. There are always opportunities and your study really gives a good foundation for your career. It is one of the studies with the highest demand." However, Joyce indicated that all these opportunities are also a risk. Sometimes, Econometricians do not orientate a lot on the different options they have. Therefore, they can end up with a job which they do not like as much as they hoped. Because of that, Joyce would like to give all econometricians reading this interview two tips. Firstly, start developing your soft skills already during your study by for example becoming active at an association. The other tip Joyce has is to really orientate on what you like. Find out what your preferences are, such that you will end up at an organization you really enjoy working at. ●

A Heterodox History of Money

Once upon a time, people would barter goods. This was inconvenient, so we invented money – at least, that is what Adam Smith tells us. Anthropologist David Graeber disagrees, and argues that primitive economies operated on credit, while money was first created by states. What would that mean for cryptocurrencies such as Bitcoin?

David Graeber, professor of anthropology at the London School of Economics, passed away last year. One of his most prominent works was a history of debt [3], which among other things criticizes what he called 'the myth of barter,' the conventional history of money. As a sort of *in memoriam*, I will attempt to elaborate on his arguments below, and also speculate what this might mean for modern-day cryptocurrencies.

The myth of barter

Graeber traces the myth of barter back to Adam Smith, the founder of economics. In *The Wealth of Nations* [8], Smith writes that

> When the division of labour has been once thoroughly established, it is but a very small part of a man's wants which the produce of his own labour can supply. He supplies the far greater part of them by exchanging that surplus part of the produce of his own labour, which is over and above his own consumption, for such parts of the produce of other men's labour as he has occasion for. Every man thus lives by exchanging, or becomes in some measure a merchant, and the society itself grows to be what is properly a commercial society.

In other words, if a baker would like to eat something other than bread, he will go to the butcher and try to exchange some bread for a piece of meat. The baker and the butcher will then engage in barter, but that can be tricky:

> The butcher has more meat in his shop than he himself can consume, and the brewer and the baker would each of them be willing to purchase a part of it. But they have nothing to offer in exchange, except the different productions of their respective trades, and the butcher is already provided with all the bread and beer which he has immediate occasion for. No exchange can, in this case, be made between them. He cannot be their merchant, nor they his customers; and they are all of them thus mutually less serviceable to one another. In order to avoid the inconveniency of such situations, every prudent man in every period of society, after the first establishment of the division of labour, must naturally have endeavoured to manage his affairs in such a manner, as to have at all times by him, besides the peculiar produce of his own industry, a certain quantity of some one commodity or other, such as he imagined few people would be likely to refuse in exchange for the produce of their industry.

Such commodities, Smith argues, are early versions of what we now call money. They include salt, shells, and tobacco, but these seem to have given way to precious metals. Metals do not perish and can be divided in smaller units without any loss, making them ideal foundations for currency. Still, there are some problems: different pieces of gold or silver will have different weights, and therefore different values. This means that one would have to weigh these metals whenever a transaction is made. Moreover, one can mix a precious metal with substances of lesser value without changing their appearance.

> To prevent such abuses, to facilitate exchanges, and thereby to encourage all sorts of industry and commerce, it has been found necessary, in all countries that have made any considerable advances towards improvement, to affix a public stamp upon certain quantities of such particular metals, as were in those countries commonly made use of to purchase goods.

By stamping pieces of metal, the state affirms the weight and content of pieces of metal. Hence, coins were created.

This story probably sounds familiar – it is engraved in our common sense, and many economics textbooks repeat some version of it. However, to quote Graeber [3], "the problem is there's no evidence that it ever happened, and an enormous amount of evidence suggesting it did not."

Credit instead of barter

Let's go back to the beginning of Smith's story. The butcher has some meat left over which the baker wants, but the butcher does not need any more bread. There are some solutions that Smith did not consider: one option would have

the butcher just hand over some meat, without getting anything in return. This is not as far-fetched as it may seem. For instance, in his *Book of the Eskimos*, Peter Freuchen [2] writes:

> Every single walrus we got gave gains to everyone in the party. Big heaps of meat became my property, and with tears in my eyes I would thank the hunter who first had thrust his harpoon in the animal. They laughed uproariously at that, but even the best joke can be repeated too often, and old Sorqaq – who had been a great angakok and chief hunter in his day – took it upon himself to put me straight:
>
> "You must not thank for your meat; it is your right to get parts. In this country, nobody wishes to be dependent upon others. Therefore, there is nobody who gives or gets gifts, for thereby you become dependent. With gifts you make slaves just as with whips you make dogs!"

This last line is significant, because it shows that the Inuit do not view the sharing of food as a favor. It is not a gift, no optional gesture you should be grateful for. Sharing is fundamental to their culture.

But let's say that our butcher is not generously sharing the meat he does not need. Still, there is a solution other than barter. The butcher can say to the baker: "Alright, here you go, have some meat. But you owe me." If the butcher and the baker live in the same village, there will likely come some time when the baker has something the butcher needs, and they could settle the score. The butcher thus extends a credit to the baker.

Such credits can be used to cancel debts with third parties as well. Graeber writes the following about sixteenth- and seventeenth-century England, based on research by Craig Muldrew:

> Elsewhere, those frequenting the local butcher, baker, or shoemaker would simply put things on the tab. The same was true of those attending weekly markets, or selling neighbors milk or cheese or candle-wax. (...) Since everyone was involved in selling something, however, just about everyone was both creditor and debtor; most family income took the form of promises from other families; everyone knew and kept count of what their neighbors owed one another; and every six months or year or so, communities would held a general public "reckoning," cancelling debts out against each other in a great circle, with only those differences then remaining when all was done being settled by use of coin or goods.

Graeber is hardly the first anthropologist to argue that neighbors would have little reason to engage in barter. For example, Humphrey [5] writes that "no example of a barter economy, pure and simple, has ever been described, let alone the emergence from it of money; all available ethnography suggests that there never has been such a thing."

This does not mean barter never occurred. Credit systems require people to engage in relationships, to trust each other to one day repay the debt. This becomes hard, if not impossible to do with strangers or enemies. It is then, Graeber argues, that people may actually engage in barter. (One other reason people would barter goods is that they are used to money, but lose access to it. In some prisons, for example, inmates use cigarettes as currency.)

The uses of social currencies

If basic exchange can go on just fine with these credit systems and the occasional barter with outsiders, what are the examples of money that Smith mentioned actually used for? Graeber argues that

> what used to be called "primitive money" – that is, the sort one encounters in places where there are no states or markets – whether Iroquois wampum, African cloth money, or Solomon Island feather money, (...) is used almost exclusively for the kinds of transactions that economists don't like to have to talk about.
>
> In fact, the term "primitive money" is deceptive for this very reason, since it suggests that we are dealing with a crude version of the kind of currencies we use today. But this is precisely what we don't find. Often, such currencies are never used to buy and sell anything at all. Instead, they are used to create, maintain, and otherwise reorganize relations between people: to arrange marriages, establish the paternity of children, head off feuds, console mourners at funerals, seek forgiveness in the case of crimes, negotiate treaties, acquire followers – almost anything but trade in yams, shovels, pigs, or jewelry.

Marriages form a good example. In some cultures, it is common for a man to present 'bridewealth' to a woman's family when proposing:

> A suitor's family would deliver a certain number of dog teeth, or cowries, or brass rings, or what-

> ever is the local social currency, to a woman's family, and they would present their daughter as his bride. It's easy to see why this might be interpreted as buying a woman, and many colonial officials in Africa and Oceania in the early part of the twentieth century did indeed come to that conclusion.

Rospabé [7] however argues that such currency is actually an expression of a debt that cannot be repaid by any other means. No one would ever think that a whale's tooth is equally valuable as a woman. Women are not only human beings, but they are even able to create new humans. Hence, the only thing that could possibly be as valuable as a woman would be another woman. Until the man's family could 'return' a woman to the bride's family, they are in their debt. The money is a reminder of this unsettled score, a substitute for life.

In a way, these social currencies are almost unnecessary. Both parties engage in a relationship, so as long as everyone recognizes the outstanding debt, there is no need for whatever commodity to actually change hands. This is fundamentally different from how most of us use money: I do not start a lasting relationship with the cashier at my local supermarket, they really want my money. So where does money in the modern sense comes from?

The emergence of physical money

To answer this question, Graeber points us towards the state:

> Say a king wishes to support a standing army of fifty thousand men. Under ancient or medieval conditions, feeding such a force was an enormous problem – unless they were on the march, one would need to employ almost as many men and animals just to locate, acquire, and transport the necessary provisions. On the other hand, if one simply hands out coins to the soldiers and then demands that every family in the kingdom was obliged to pay one of those coins back to you, one would, in one blow, turn one's entire national economy into a vast machine for the provisioning of soldiers, since now every family, in order to get their hands on the coins, must find some way to contribute to the general effort to provide soldiers with things they want. Markets are brought into existence as a side effect.

As Graeber remarks elsewhere, "a heavily armed itinerant soldier is the very definition of a poor credit risk." No butcher would hand a piece of meat to a soldier and expect to be repaid the next time they meet: the soldier might die, not come by the butcher's village again, or just refuse to return the favor (remember that soldiers have weapons). To overcome this trust issue, the king imposes a tax on the village. Every villager has to pay the king a certain number of coins stamped with the king's face, or else you can expect an unpleasant visit from the army. The threat of violence has everyone scrambling to get their hands on some of those coins, which the king has distributed among his loyal soldiers. And thus all the villagers try to serve the state in some way.

This theory of money is called chartalist: money is just a token (*charta* in Latin) that has little to no intrinsic value. Its actual value derives from the fact that someone – a state or some other party, such as a bank – is willing to cancel a debt when you hand in such a token. This does not only apply to coins, but to banknotes and bank accounts as well: they too are ultimately symbols of outstanding debt. None other than John Maynard Keynes [6] was a proponent of this theory, and it lead him to declare that "to-day all civilised money is, beyond the possibility of dispute, chartalist."

Token money is most useful when the credit-based relationships we talked about before are hard to establish. This is particularly true in unruly times and places. Graeber notes that the ancient civilizations of Mesopotamia, Egypt, and China were relatively peaceful and operated largely on virtual credit money. Eurasia seems to have become a more violent place between 800 BC and 600 AD, and coinage dominated in this period. The Middle Ages started with the collapse of empires around the world, ushering in a time of relative social peace. Some have argued that the world reverted to barter in this period, but closer inspection reveals the type of credit economies we discussed before. European colonialism marked the return of an era of bullion, which can be said to have ended fifty years ago: in 1971, Richard Nixon announced the US dollar would no longer be tied to gold. With this move, the dollar and the world's other currencies became fiat money.

Cryptocurrencies

This brings us to the modern day, where the question of what money is has sparked a lively debate. New currencies such as Bitcoin have been proposed, and we have yet to see whether they will ever be as popular as 'regular' money. Graeber's book [3] does not cover these topics, but he has shared his opinion on Bitcoin on Twitter [4]:

> I have avoided going into it other than to say I think bitcoin is based on a false popular understanding of what money is & how it originated. It's more a speculative commodity than a viable currency.

Someone believing Adam Smith's theory might argue that modern fiat money, now that it is no longer redeemable for gold, has no intrinsic value. It only gets to be valuable because we all agree that it does, and the same could be true for Bitcoin. Not quite, says Graeber. Our fiat money is valuable because you have to pay your taxes in that currency, and if you do not pay your taxes, the state has the right to use violence against you. Of course, the violence propping up our government is somewhat hidden. Most Western governments will maintain that demanding taxes is a lot more legitimate than simple extortion. The services our governments provide are sufficient reason for most of us to, perhaps begrudgingly, pay our taxes. Still, if I keep my foot down and refuse to pay, the state will eventually use some force against me. This threat is a convincing argument to get my hands on at least some euros, dollars, or pounds. On the other hand, there has never been a pressing need for me to gather Bitcoins.

Let me ask a pretty facetious question: why do we not use my tears as an alternative currency? It shares some characteristics with Bitcoin: the total amount cannot increase too quickly (I can only cry so much every day) and it will at some point reach an upper bound (I will die one day, and this will stop me from crying). My tears can be split into smaller quantities (bring your own vial), and can be stored long-term without much loss (close your vial tightly). Let's also, for the sake of argument, assume that anyone can determine if tear fluid is truly mine or some imposter's. This tear currency even has an advantage over Bitcoin: it consumes significantly less electricity than all of Argentina [1].

Of course, the cashiers at my local supermarket will not accept a vial of my tears as payment. They have no reason to own it: it does not allow them to pay their taxes or to buy other commodities. The fact that my tears are rare does not automatically make them valuable. The story might be different if everyone truly believed that my tears have some value, because everyone else believed that as well.

But similarly, Dutch tulip bulbs could also have been a viable seventeenth-century currency, if only everyone kept faith in their extraordinary value. The price of tulip bulbs shot up dramatically in late 1636, and came crashing down again in early 1637. It seems fair to argue that this rise was merely due to speculation, not a reflection of changes in the inherent value of tulips. In the end, tulips are just tulips. They are valuable because they brighten up your house – there is no reason they should be worth more than your house. The same goes for vials containing my tears: their intrinsic value is pretty limited. You do not actually need them, no one does. Tulips and tears would make poor currencies.

If we believe Graeber's version of history, it would be a novelty if 'currencies' based purely on faith – Bitcoins, tulips, tears – would rival the debt-based dollars and euros of this world. Perhaps one day Bitcoin will be a stable currency, a digital piggy bank. But it is also possible that Bitcoin will go the way of the tulip, and it will end in tears. ●

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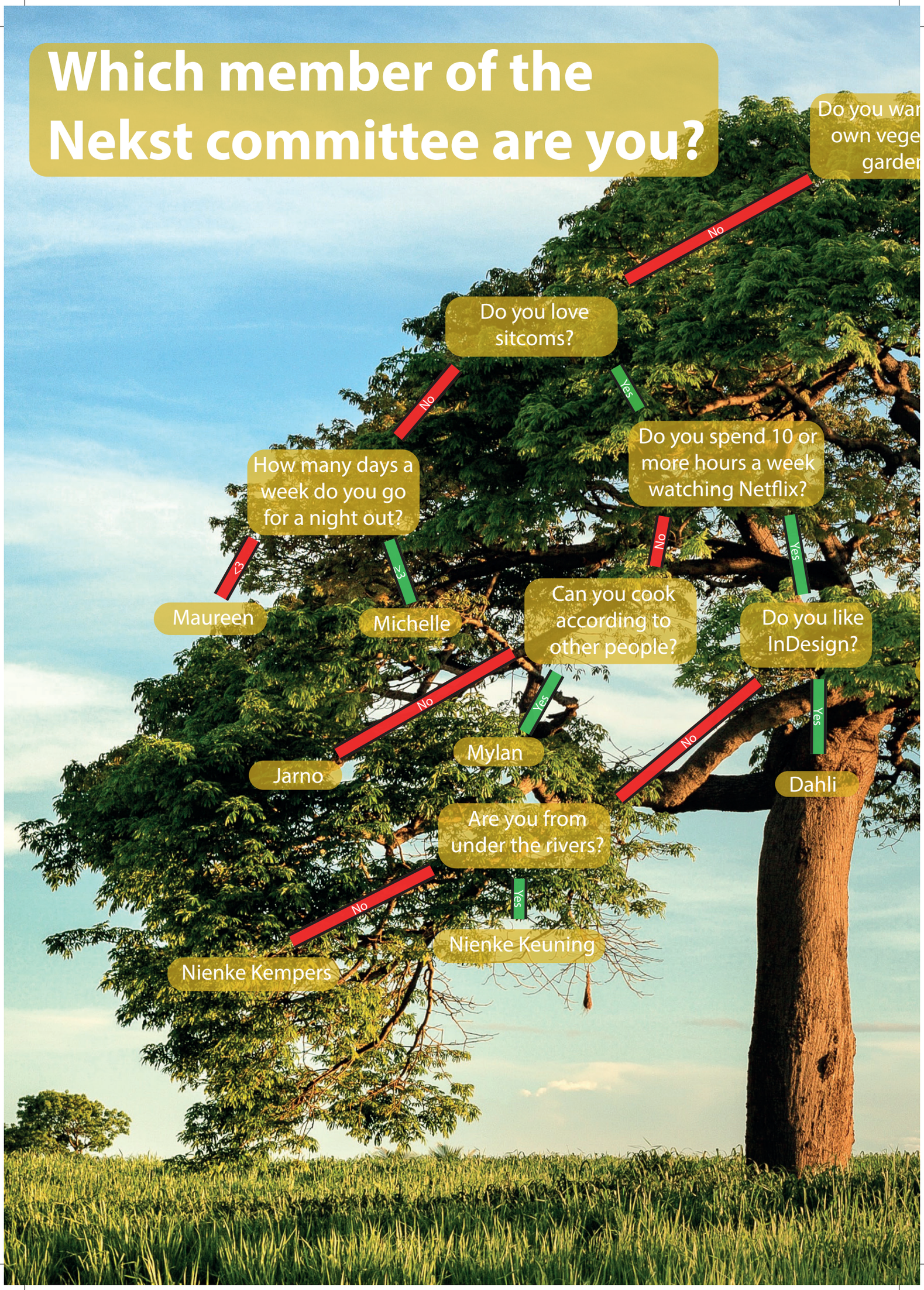
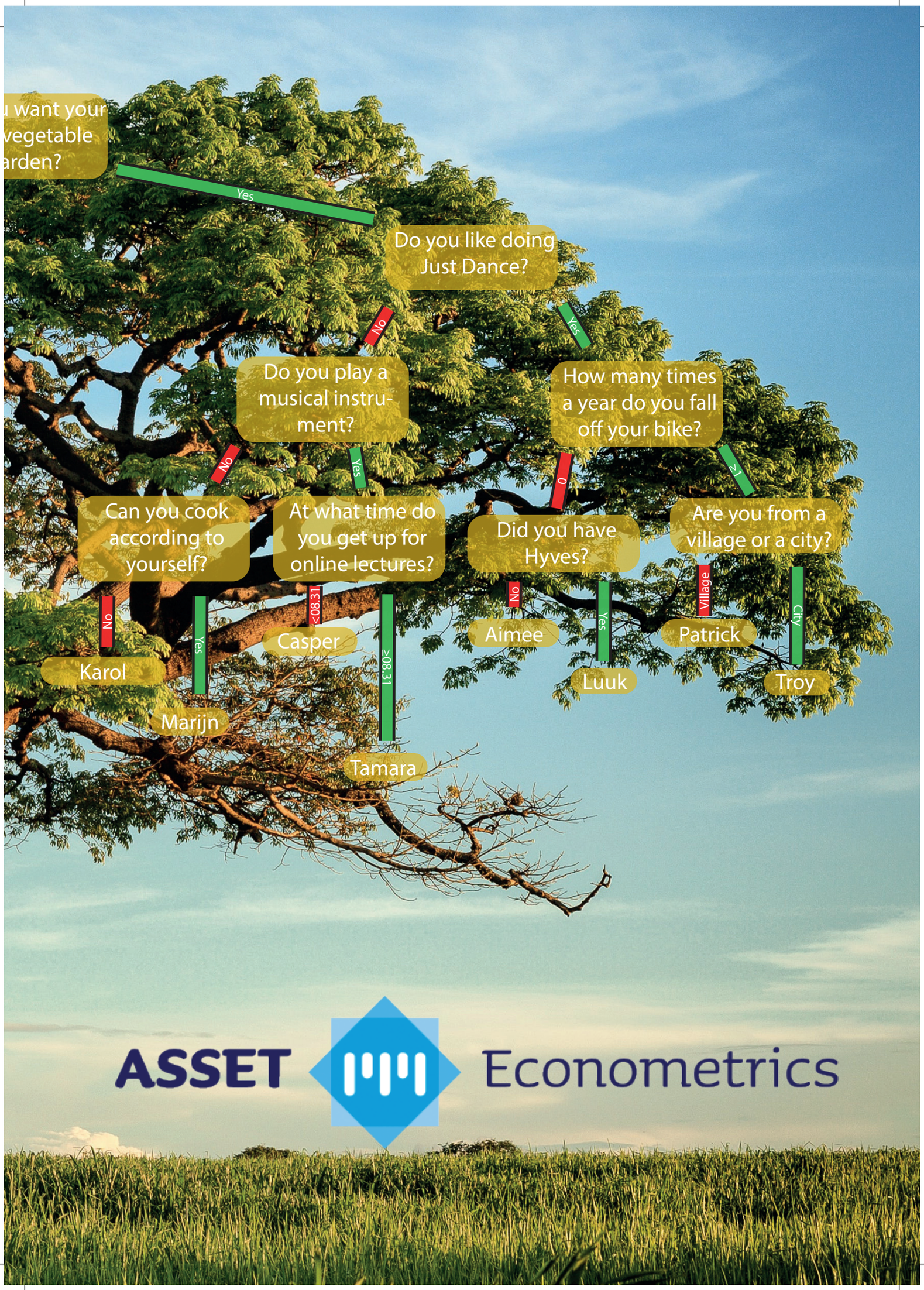
Riley Badenbroek
Ph.D. candidate


Which member of the Nekst committee are you?
Do you wan
own vege
garden
No
Do you love sitcoms?
Yes
No
Do you spend 10 or more hours a week watching Netflix?
How many days a week do you go for a night out?
No
Yes
<3
<3
Maureen
Michelle
Can you cook according to other people?
Do you like InDesign?
No
Yes
Yes
No
Mylan
Jarno
Dahli
Are you from under the rivers?
Yes
No
Nienke Keuning
Nienke Kempers


u want your
vegetable
arden?
Yes
Do you like doing Just Dance?
No
Yes
Do you play a musical instru-ment?
How many times a year do you fall off your bike?
No
Yes
0
≥1
Can you cook according to yourself?
At what time do you get up for online lectures?
Did you have Hyves?
Are you from a village or a city?
No
Yes
<08.31
≥08.31
No
Yes
Village
City
Karol
Marijn
Casper
Tamara
Aimee
Luuk
Patrick
Troy
ASSET
Econometrics

From Business Forecasts to Econometrics

written by **Troy de Juncker** and **Nienke Keuning**

Germany, near the mountains, where you can ski in the winter and hike in the summer, is the place where our professor Martin Salm was born. Most students will know him from his various Master courses or maybe even as a mentor for Improving Society Lab. Having studied in two different continents, Salm is now happily teaching at Tilburg University for already twelve and a half years. Today, we decided to take a look into his life at the university and everything that comes with it.

From Bachelor to PhD

Martin Salm was born in Freiburg, Germany, very close to the mountains. Salm started his studies in his hometown. During his Bachelor program, he went on a one-year exchange to the University of Wisconsin. "I really liked the American system, but after that year, I went back to Germany." He did not go back to Freiburg, but instead, he went to Mannheim. "One of my classmates in Mannheim was Tobias Klein, who is also a professor at Tilburg University. At this time, I was in a reading group, meeting with some other students. We would discuss papers, sometimes about economics and sometimes about other subjects, like Dada (an art movement in Germany in the 1920s). A lot of members in this group are now professors all over the world: New York, Barcelona, Tilburg, and so on." In Mannheim, he got a degree in economics. The next step for Salm was a PhD. Since he had already been in the United States and enjoyed it there, he went to Duke University. There, he decided to be a health economist, which is his main area of research. After he got his PhD, he went back to Mannheim.

Coming to the Netherlands

The very first time that Salm came to the Netherlands was when he visited Amsterdam as a guest researcher. "I was already above 30 years old before I set foot in the Netherlands for the first time, not even on a holiday. When I was offered to come to Tilburg, I was very excited. I came here in 2008 and I am still happily working here." Even though it has already been twelve years since he came to the Netherlands, Salm still remembers the difference between Amsterdam and Tilburg. He had only experienced the Netherlands by living in Amsterdam. He thinks that other cities in the Netherlands differ quite a bit from our capital city. "I think the mentality in Brabant is really nice. The people are very accessible, open, and a bit modest. I have had a lot of nice experiences here." After two years at Tilburg University, he got tenure, which is a permanent contract. He then became an associate professor. "I felt it was a bit of a miracle and it still feels like it. It is a privilege to work in such a nice department. The department cares about education and puts effort into it. It is not like this everywhere." Also, he thinks that the students in the econometrics program are really motivated and hardworking students, compared to the students in Germany and the US. At the moment, Salm teaches mostly in the Master and Research program. He gives the courses 'Microeconometrics', 'Econometrics 2', 'Health Economics' and 'Empirical Research in Business'. In the Bachelor program, you might know him as a mentor in the Improving Society Lab course.

Student life besides studying

Salm really enjoyed his student life. "It is obviously nice that you can choose what you like to study." Besides studying, there were quite a bit of extracurricular activities he took part in. In Freiburg, there was a group of students who wrote business forecasts. "This was a very active group. Every quarter we had a report together. This was a nice thing to do, even though the forecasts might not have been very professional." They even visited the German statistical office to find out how they make their forecasts. Around the time when he was studying in America, he told us there were a lot of movies being made about East Germany. He also had a roommate from East Germany. "I learned more about Germany while living in America, than while living in Germany." Lastly, Salm even volunteered as a paramedic (i.e., as an ambulance technician) for the emergency department. This brought some perks with it since paramedics were needed at events. So, while volunteering, Salm went to quite a few nice concerts.

His work at Tilburg University

Of course, we talked with Salm about the current pandemic that is going on. He told us that his overall workload is rela-

"I was already above 30 years old before I set foot in the Netherlands for the first time, not even on a holiday. When I was offered to come to Tilburg, I was very excited. I came here in 2008 and I am still happily working here."

tively similar to how it was before, but there are some changes he wanted to talk about. The most noticeable change is that everything has to be done online, from seminars to conference calls. The thing he misses the most is that there is no opportunity for on-campus classes. To do all classes online, he tells us: "There is some extra time and effort that I need to put in to get the online classes done, but I try to keep it relatively simple to how it was done before. So I do not pre-record any lectures and do them live on Zoom following the original schedule. Online lectures also give some opportunities, like breakout rooms for example."

A regular day

Salm likes to start his day early and get the most difficult stuff done first, which consists mostly of writing and working on research. Then, he likes to schedule seminar talks and meetings, and later in the afternoon, he answers all of his emails. On average, Salm spends around two days a week on research and the teaching part of his job at the university really depends on the time of year. In autumn, he is busier than he is in spring and of course, there is even less in the summertime. Besides his research and teaching, he also has four PhD students he likes to meet with once every two weeks. Another part of his job is a lot of administration, which he, unsurprisingly, likes the least. Next to this, there is also a lot of time spent on 'smaller' things like making and grading exams, reading and refereeing papers, and preparing reports. Salm says: "These are some things people may not expect we as professors have to do and how much time we invest in this. They are all small things individually, but together it sums up to a lot of work."

Besides his job

In the little time Salm has left besides his jobs, he enjoys having a few hobbies. He likes to cycle but mentions: "I am not a very fast cycler, so this is just to get outside and enjoy the landscape of Brabant." Besides cycling, he likes to read some economics and history books. The last thing he read was about how Eastern Germany experienced the period when the Berlin Wall came down, but he adds that most of what he is reading is not about Germany. Last year, he spent some more time reading about the Netherlands, because he thinks it is interesting to discover things that are still new to him, even though they might seem very obvious to locals. He regrets not reading as many novels as he used to, because he enjoyed that. When we asked him if he watched any television, he said he did not have that much time, but one thing Salm likes to watch is Arjen Lubach.

We asked Salm which profession he would choose if he could change. He said: "I think I am very happy with being an econometrics professor, I really like it. One thing I have always found fascinating is being an architect, but I do not think this would be very fitting for me."

Nekst to Salm

Salm mentioned he really likes to read Nekst to get some insight into the lives of students and other teachers. He mostly enjoys the Quatsch and the interviews. He said he liked reading the interview with the parents, which he thinks is a shame that it is not covered anymore. Salm was happy he could participate in an interview for Nekst, even though it took us twelve years to ask him.

One last thing Salm likes to mention to all econometrics students is that he used to be a teaching assistant back in his time in Freiburg as a student. He thinks, even though everyone has different preferences, that this is the perfect job for a student, because it gives you the opportunity to help other students and also understand the subject better for yourself. Also, to all the students that like the subject and like to do research, he says: "Think about doing a Research Master and PhD. Nowadays, we have relatively few applications from econometrics students and of course, not everyone would like it, but I think for some of you, this might be a very good option." ●

dr. Martin Salm

Bert & Ernie Questions

Students or Colleagues?
"Colleagues"
Beer or Wine?
"Beer"
Stress or Boredom?
"Boredom"
Computer or Pen and Paper?
"Computer"
Wordfinder or Sudoku?
"Sudoku"

The Online LED Experience

Abdel Zariouh

Master QFAS

Age: 24

It is November 25, a couple of minutes to 20.00 hours and I am sitting ready at my desk behind my laptop which is connected via a wired internet network. There is no room for any network delay and thus, nothing else but the Eventbrite page for securing a LED (Landelijke EconometristenDag) ticket is running. When the clock jumps to 20.00 hours sharp, I refresh the page, wait a couple of seconds, and see the page appearing on which I get the opportunity to secure a ticket. Within fifteen minutes, my registration is confirmed by email, and for a short moment, a feeling of euphoria is flowing through my body.

No, the LED is not a grand slam tournament or the maddest festival of the season, but hundreds of students in the Netherlands are sitting with sweaty palms behind their desks to get a ticket. Actually pretty sleek of Eventbrite to manage this large number of people on their server. You can tell by my well-thought-out strategy that this is not the first time that I am attending the LED, but due to the COVID-19 measures, it was the first time attending an online version of the event.

On the day before the event, there is always stuff to prepare such as which train to catch in the morning, the suit you are going to wear, and the memorization of social one-liners (just kidding). But since the event is hosted online this time, the preparation was a bit different. Instead of starting in the morning, the event's kick-off was in the afternoon which gave me time to start the day with a run. After lunch, I cleaned my desk, checked my internet connection multiple times, and I was ready for the event.

The LED started with an opening plenary session by Maarten van der Weijden, who talked about his 'Eleven Cities swim marathon' journey and raising over six million euros for cancer research. During his talk, students could ask questions in a public chat box which worked rather well. Since it was online, it was not possible to have a feeling about how all the other 600 participants were receiving his story, but I am quite sure everyone thought it was quite incredible. The main takeaway was that if you work hard, you can create successes, but if you are unlucky, it is not your mistake.

After the talk, the company cases were on the program. You were not walking from room to room, but you were clicking from one virtual environment to another virtual environment. Well, not you alone but all hundreds of participants were doing this at the same time which resulted in an overload on the server. The virtual environment was not working properly anymore and thus NN Group, the company I had my case with, sent us a Microsoft Teams link. After a few minutes of technical issues, the NN Group case could start. After an interesting case, we had the speed dates to get in contact with other companies that were present that day. This year, there was no business dinner, but the LED committee surprised us with a large box of food (olives, chocolate, popcorn, you name it!), goodies, and delicious wine. Hence, a networking drink was still possible.

The LED is one of the largest recruitment events in the Netherlands. In the years that I have been a student, this event gave me the opportunity to get in contact with a variety of possible future employees and to build a network with graduates in the same study area. All this had a very valuable and significant impact on the career choices that I am going to make when I graduate. Therefore, to all the LED committees over the past year, thank you for making this event so successful, and if you were unlucky, it was not your mistake. ●

Ten Years at ASML

In the spring of 2010, I had a conversation with a part-time student who also worked at ASML. He explained that ASML was rapidly growing and that they were hiring a lot of new employees. ASML grew from ten thousand to eleven thousand employees in 2010. I told them that I was familiar with the company since my three kids were born in the hospital next to its offices. As my wife had to stay in the hospital for some time in her first and third pregnancy, and her room had a view towards ASML, I already knew what ASML was doing.

I thought they were looking for bright students, but then the student said that they now had an opening for someone with five to ten years of work experience. He asked me: "For how long have you been working at CQM by now?" I was not planning on changing jobs, but after reading the job description, I became interested and applied for the job. After some nice interview rounds, I was hired as a Decision Support Expert in the summer of 2010. I mentioned, however, that I wanted to continue my work at Tilburg University. This was not a problem for ASML; even better, they liked it and encouraged me to keep going.

The Decision Support department at ASML supports the management board with strategic decision making to enhance the company-wide decision quality. This Decision Quality concept has been developed at Stanford University in the 70s and 80s of the previous century. The decision quality concept gives you a framework that can be used to judge the quality of a decision. To learn more about this concept from the 'founders', I visited Stanford University several times. All in all, I spent around a month there. In September 2012, I collected enough credits to graduate and received the Strategic Decision and Risk Management Certificate from Stanford University. At ASML, the Decision Support department, of which I had become the head, started getting more and more attention. I was involved in several interesting projects like negotiations with large suppliers, acquisitions, and technology decisions.

In 2013, the Decision Support department transferred to the newly founded Presidents' Office; the same year, ASML had a change in senior management, and two Presidents were appointed to lead the company. For my role in the Presidents' Office, I have been involved in the setup of the new meeting structures of ASML's executives of which decision making, of course, is a crucial part. The decision support team mainly has three tasks: 1. Facilitating strategic decision processes, 2. Creating quantitative models for strategic decision making, and 3. Spreading the knowledge of Decision Quality across ASML. The team grew from two to five people and in the years after, it became a great landing spot for talent to start their career within ASML.

At the university, I was promoted to associate professor in 2014 after my joint paper with Peter Kort, 'Strategic capacity investment under uncertainty', was accepted for publication in the RAND Journal of Economics. Two years later, the partnership between ASML and Tilburg University became even stronger when ASML decided to finance a chair on Decision Making under Uncertainty. In November 2016, I was appointed to that endowed chair and promoted to full professor. In July 2017, I held my inaugural speech which was a great moment as a long-term dream of mine came true. The focus of my role at university shifted as I also started doing teaching in postmaster education at, for example, JADS in Den Bosch. In the Master program Business Analytics and Operations Research, Hein Fleuren, Goos Kant, and I started the Professional Business Analytics Skills course where we teach students professional skills that they need in their professional careers after finishing their Master. We thoroughly enjoy teaching this course and we get good responses from students as it is a complementary course to all the more technical and hard skill courses.

My research on real options has continued in this period. Mostly together with Peter Kort, I created academic networks with academics working in Antwerp, Bielefeld, Lisbon, Trondheim, and York. There are joint PhD students who started working after finishing their PhDs. Moreover, the Dynamic Real Investment course has been running for more than 25 years now and it still attracts a lot of students.

For ASML, the 21st century was one of tremendous growth: turnover more than tripled from €4.5 billion to €14 billion, net income rose from €1 billion to €3.6 billion, R&D expenses grew from €0.5 billion to €2.2 billion, and the number of employees increased to 28000! All in all, a very interesting ride to be part of!

In my personal life, I have been enjoying family life with my wife and three kids. Two dogs were also added to the household and together we love to visit the mountains in Germany and Austria. Unfortunately, due to the COVID-19 pandemic, we had to cancel two of our trips. Hopefully, we can pick these up again later this year. From a sporty side, I shifted to running around the time my kids were born and added road cycling eight years ago. Furthermore, I like participating in half marathons and cycling the mountains in the Alps.

In the next and final column, I want to set some goals and make an outlook for the coming ten years! ●

Kuno Huisman
is director of business control Twinscan Factory at ASML. Next to that, he is a part-time full professor of decision making under uncertainty at Tilburg University where he teaches courses on professional skills and investment under uncertainty.

The Online Education Evolution

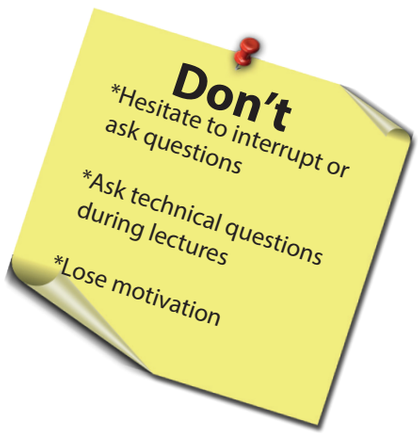
Over the past year, a lot of changes in our education had to be rapidly implemented due to the COVID-19 crisis. Now over a year in, it seems time to do a short review. Hence, we did so with the head of our econometrics department: professor Herbert Hamers. Herbert is for most students better known as their cycling Limburgish 'Introduction Analysis and Probability' professor with his occasional 'little jokes'. This positive vibe is something he definitely takes along to his more cloaked and serious responsibilities as head of the department. In this role, Herbert oversees the finances, staff, and education of both the Bachelor and Master econometrics programs. This mostly entails a lot of administrative work, but, especially in COVID-19 times, it asks for a bit of creativity from time to time. Of course, he does not do all of this alone. Especially with the education-related matters, he can count on the support from the academic directors who take the responsibility for the actual curriculum and Marieke Quant who is responsible for the allocation of the staff to all courses. The academic directors also have a place on the sounding board where student input is presented, among others, by our very own education committee of Asset | Econometrics.

written by **Tamara Dert** and **Casper Heemskerk**

Restructured education

Let us start with our education which had to be completely switched from offline to online in a matter of weeks. This has brought some difficulties, but Hamers pointed out some fine results as well. Hamers gave us some examples by telling stories about dr. Cristian Dobre, dr. Hannis Datta and professor Bart Dierynk. They all took, in a different way, the opportunity to restructure some of their courses. In their approach, the keywords were interactive feedback, flip the classroom, and engage the students (even on Zoom). Another advantage of the online environment is the absence of a time limit. From Hamers' own experience, he was glad to take some more time for the topics that were more difficult in his course. Online education brought (or required) some creativity too. Many teachers have made video clips for the students about the course material that they can view at any time. As a result, they have gained more time during their actual 'live' lectures.

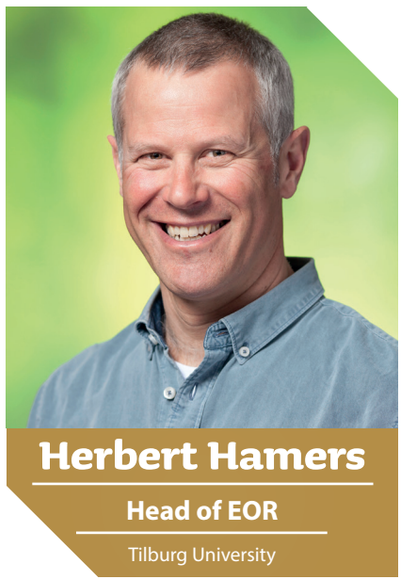
Despite the positive sides of online education, every teacher wants to go back to the normal on-campus lectures. The big downside of the online environment, according to Hamers, is the interaction with the students. Many of you would recognize the lectures with only a couple of students with their cameras on. Hamers said: "You cannot see the reaction on the material by the students. Normally in the lecture room, you immediately see if the students understand the material." Although Hamers is rather positive about the possibilities with Zoom, he thinks that the conversations are not as fluent as face to face. It is almost impossible to interrupt. Hamers does see big differences between the teachers: some take this crisis as an opportunity to explore some new methods while others are more conservative and stay by their well-known approach. In the meantime, students and teachers will have to make the best of it together. Here are some Do's and Don'ts to make it all a bit more pleasant and educational.



Exam results

Last year, most of the students and teachers were at some point stressed about the examination. Online examination was completely new and questions were raised about the security and privacy of the examination. Hamers prefers examination on campus since it is easier, takes less time, and is much less susceptible to fraud. However, he does think that Proctorio is an adequate program that protects the validity of our diplomas. He stated that it could be an interesting possibility for students who are abroad on the examination date, to take the exam with Proctorio in a foreign country. The focus, however, should be that all faculties should uniformly approach the examination in the same way. In the exam period of last semester, some faculties dropped a few balls at fraud detection, whilst other departments including ours were primarily a bit hypersensitive at red flagging.

When undergoing such drastic changes, it is tensive what it will do with the results. Hamers and Henk Norde, the academic director of the EOR Bachelor, were especially worried about the first-year students. The university is a completely new environment for new students and this year, they also had to adapt to online education. On top of that, the results after the first unit were not as good as in previous years, as the Linear Algebra course was not the only course with a seriously low passing percentage. Therefore, the relief was big when the results after the second unit came in. These results were comparable with the previous years and the percentage of the students who will obtain a positive BSA-advice will be as high or even a bit higher than last year. Furthermore, the crisis does not seem to have an impact on the fraction of graduates. The results for the other year students are not yet in and are more difficult to track as Hamers truthfully states: "There are not just second-year students following second-year courses..." The hope is, however, that these students have a better knowledge of what is expected of them and will be able to adjust easier.



Herbert Hamers
Head of EOR
Tilburg University

Future

How long this situation will last is still unknown, but a time will come when everything is possible on campus again. Many teachers would be relieved to finally see the students enter the lecture rooms and have some small talk with their fellow colleagues by the coffee machine. However, this period has absolutely delivered some great ideas and methods for the teachers. Since the material does not change every year for many courses, many pre-recorded clips on the material could still be available and relevant in the future. This could give the teachers more time to interact during the lectures or to give some clearer explanation about certain topics. Hamers is also very positive about the online accessibility. Q&A sessions are, for example, far more useful since students can come online for just ten minutes, which is a lot easier and more accessible for them than showing up to the real-life ones.

Did you know that there is a special committee that focuses on sharing student experiences with the Academic Director and Program Coordinator?

In this so-called Education committee, there are two representative students for each year of the Bachelor. These students gather the feedback of all students that follow the Bachelor courses through questionnaires. At the end of every unit, there is a sounding board session in which the Education committee has a meeting with the Academic Director and the Program Coordinator. During this meeting, there is an open conversation in which the members of the Education committee talk about the student's feedback, and the Academic Director and Program Coordinator explain the university staff's perspective on these points. The students of the Education committee are always looking for more points of view about the courses in the Bachelor program, so if you have any feedback, please let us know by sending an email to info@Asset-Econometrics.nl!

Financial compensation

The Cabinet of the Netherlands is worried about the mental health of the students and argues that the lockdown is responsible for learning delay. To compensate for the possible delay, students only have to pay half of the tuition fee in the next year. However, proof of lower results has not arrived yet. When asked about it, Hamers questions if this compensation would help the students to improve their results and if it really helps for their mental health. Hamers added: "I admit that the quality of education has sometimes decreased last year but the teachers have worked twice as hard. Besides that, the compensation is for students in the upcoming year while those new students did not suffer from it during this year and the soon-to-be graduates did. In my opinion, it feels more like a political gesture." Next to the compensation for the students, the university will get extra money as well. Regarding this measure, the hard question will be how much money there will be left for each department or program. Herbert is clear about this: "Every amount of extra money is welcome, because then extra faculty can be hired to teach our students."

Professorship during COVID-19

The last of Herbert's main responsibilities is the well-being of our professors. Just as students are having a hard time, it is not so easy for professors either. Especially single professors and foreign professors are having a tough time. At work, they have to give it their all while the social aspects have almost disappeared. To support the teachers, Herbert has organized some helpful training on for instance how to use Zoom or how to create exams in Canvas. "Everybody did their best in their own way", Herbert stated, which is of big importance for him. It is important to realize that it takes teachers a lot of time to keep adapting to all the different rules. Furthermore, teachers have more responsibilities than just 'doing the teaching'. Overall, he is just really proud of the staff! Next to the training, Hamers, therefore, tries to keep spirits up by organizing a monthly online drink for the professors, with the fun new program m called 'Gather Town'. Hopefully, we will all see each other soon again at university grounds. It will never be the same as before, but that might be a good thing. ●

Now, to end this article on a positive note: we asked our students for some comments about what they are thankful for, during these hard times for both students and teachers. Here are some reactions:

Investment Strategies Under Scrutiny

It all started on January 31, 2012. An information technology consultant named James Rogozinski had some spare money that he wanted to invest. Regularly, he went on different forums and asked for advice. Most of the time, he received the advice that his choices were too risky and that he was never going to win. Disappointed by the dull comments he received, he decided to create his own forum 'r/WallStreetBets' on Reddit. A place where like-minded people could discuss their trades, which actually resemble gambling more than rational trading. Little did he know that eight years later, this forum would frighten the big institutions of the financial markets.

written by **Jarno Ringhs** and **Mylan Tran**

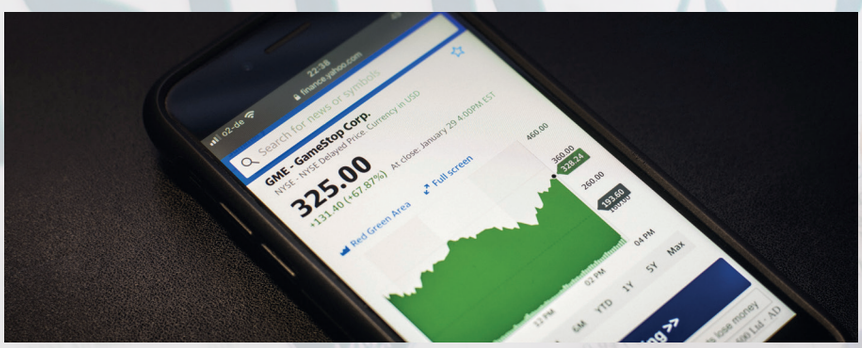
The development of the platform

During the last few years, r/WallStreetBets had only a couple of thousand users, but this changed in 2019. During this year, several brokerage giants eliminated trading commissions from their apps. It resulted in trading being much more accessible for the public. In addition, people had a lot of spare time during 2020, because of the pandemic and all the lockdowns that were implemented across the world. Due to these two factors, the number of 'degenerates', as the amateur investors call themselves, went through the roof. A few thousand users became a few hundred thousand in a short amount of time. There was also an unpleasant side to all of this. The amount of offensive content on the platform grew. Mr. Rogozinski himself discovered a private chatroom on Discord that was filled with racist, antisemitic, and antigay comments. He deleted the chatroom and also kicked out some of the moderators that let this happen. Eventually, this resulted in some backlash for him. This, in combination with some other actions, was for multiple moderators a good reason to kick the founder off the page. Mr. Rogozinski has therefore not been able to moderate the community since April of last year. Now in 2021, his forum was the start of the trading insanity surrounding the company GameStop [1].

Short and long for dummies

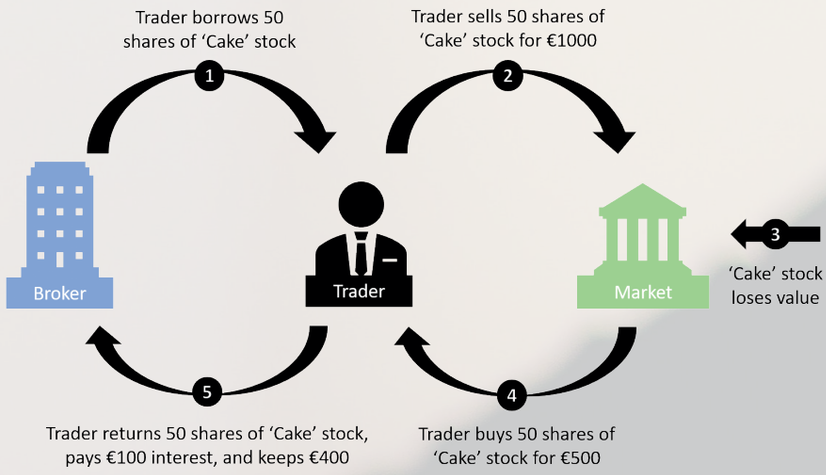
Before we go into detail on how r/WallStreetBets started the trading frenzy around GameStop, we will first illustrate a trading strategy that was used by the large hedge funds: short selling. For the people who followed the GameStop mania, understanding short selling is a piece of cake. In this section, which is designed for dummies, we will explain short selling in such an elaborate way that everybody will be able to understand how this trading strategy works. At the end of this section, we will also briefly discuss its counterpart: establishing a long position.

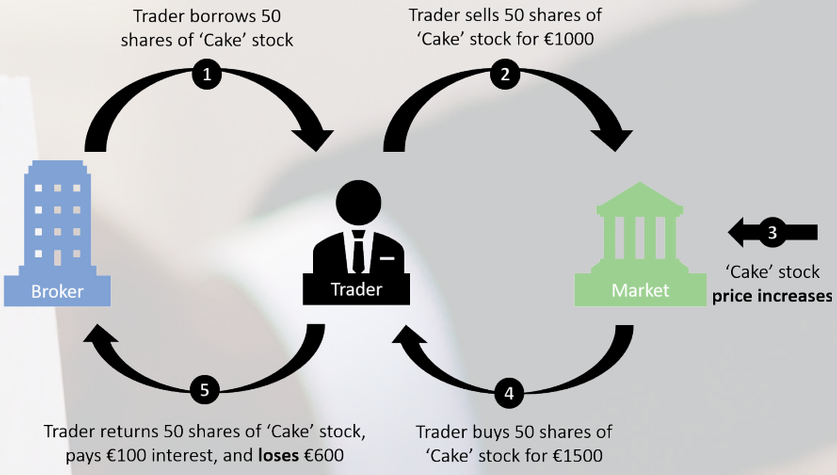
Short selling is mainly motivated by the belief of a stock's investor that the price of a security will decline in the future [2]. Therefore, speculation is the word that we are looking for when describing the idea behind short selling. Investors speculate on the depreciation in value and will act accordingly upon their speculation. Intuitively, one might think that we want the prices of the assets that we own to increase, not decrease, right? Then, we can sell the shares at a higher price than what we purchased them for. However, short selling would obviously not exist if you were not able to earn some money with it. Before describing the process of short selling, it is important to note that it is a rather untraditional way of trading. The investor, in this case, does not actually own the shares of the stocks, bonds, or other assets that he is going to sell. Instead, the trader opens a short position by borrowing the shares from a broker (or lender) that he thinks will drop in price on a given date - its expiration date [3]. Note that borrowing is only possible if the stock is not already 'shorted' by other investors. After borrowing the shares of interest, the investor will sell these shares to any buyer that is willing to pay the current market price. Consequently, the investor will be 'short' because he sold something that was borrowed and therefore not in his possession. After a while, the investor can close the short position by buying the shares back on the market for a lower price than what he borrowed the shares for. Finally, he will return these shares to the lender. We should, however, not forget that the trader has to take the interest rate charged by the lender on the borrowed shares into account. Nevertheless, if the strategy is well-executed, the trader will make a profit (hooray!). We will demonstrate the principle of short selling in the example on the next page:



Example

*Suppose that a nonexistent stock -- for story purposes, let us call it the Cake stock – has a price of 20 euros at the moment. A trader speculates on the decline in the price of 'Cake' in the next few weeks. So, the trader will borrow 50 shares of 'Cake' from his broker, after which he will sell them for the price of €20 each on the market. After two weeks, the 'Cake' company states that they are financially not doing so well. Hence, the stock price drops to €10. The trader will now close his short position at €10 by buying 50 shares of 'Cake' and return them to the broker. Now if the broker charged an interest rate of €100 (again, this is a non-realistic example) the trader will gain a profit of 20*50 – 10*50 – 100 = €400!*





Although short selling is untraditional, it is not uncommon. Diether, Lee, and Werner (2009) stated that this strategy makes up for around 30 percent of overall trading [4]. However, this is not an incentive for you to start short selling because it is intriguing to start making money out of 'nothing'. Taking the same example as before, we can also see that there is no such thing as a free lunch:

*In this nightmare scenario, the trader did not close his short position at €10 but took a risk by waiting for the 'Cake' stock price to decline even further. Unfortunately, there is an unexpected soar in the value of the 'Cake' stock due to a new CEO, pushing up the price to €30. The trader now has no choice but to close the short position at this much higher price and obtain a loss of 20*50-30*50-100 = €600.*

As you can see, an unanticipated increase in stock prices instead can stand in the way of the short seller's strategy. This forces short shellers to cover their short position by buying back the shares of the stock, stated by Investopedia [3]. However, all traders want to diminish their losses by buying back the shares as soon as possible. Hence, a domino effect will arise where the high demand pushes the price even further. Consequently, there will be a lack of supply and an excess of demand for the shares of the stock. This phenomenon is what we call a Short Squeeze. Filippou, Garcia-Ares, and Zapatero (2021) stated: "(..), a short squeeze can be triggered by positive news, earning announcements, and abnormal trading volumes." [5] The latter cause is what happened to the stocks of GameStop.

Now that we have explained what short selling means, you might be curious about its opposite: going long on a stock. Going long is also described as holding a long position. It means that the trader buys and owns stocks with the expectation that the prices will increase over time [3]. You often read that the investor is bullish in this case, which is just a fancy word to say that he thinks the securities' prices will rise. The term 'long' can also refer to the length of time of a long-position investment because traders who perform this strategy are usually not eager to sell their assets after a short period of time.

The power of the degenerates

The GameStop saga started with a person named Keith Gill. He had his eye on the stocks of the firm. GameStop is a gaming retailer that is mostly dependent on selling physical copies of games. Due to the fact that an increasing number of people download their games from the internet, the business model of GameStop is pretty outdated nowadays. However, in Keith's view, the stocks of the firm were undervalued. On his YouTube channel, he explained how he came to this conclusion. Eventually, he shared his thoughts with the WallStreetBets community. At the same time, it was discovered that 48% of the stocks of GameStop were held as short-positions [6]. As mentioned in the previous section, this means that the hedge funds involved were speculating that the stock price would decrease, executing their short selling strategy. Meanwhile, one of the members of the forum on Reddit posted a long thread called 'Bankrupting Institutional Investors for Dummies, ft. Gamestop'. He concluded in the thread that the hedge funds were exposed to a much higher risk than the 'degenerates'. The users of the forum would only lose the money they invested if the firm went bankrupt, but the hedge funds could lose an infinite amount of money if the price of the stock would skyrocket. The degenerates, mostly amateur investors, then decided that they would take on these hedge funds by buying large amounts of GameStop stocks.

In the end, the plan of the 'degenerates' succeeded. The increase in demand for the GameStop share resulted in an immense price increase in the second half of January 2021. At some point, the hedge funds had to accept their losses and buy the GameStop shares back in order to close their short positions. This stimulated the price to rise even more. The members of the forum, who joined in from the start to buy GameStop shares, made huge profits. Moreover, they were encouraging each other to hold on to their shares to maintain the high price. On the forum, this phenomenon is called 'diamond hands'. However, RobinHood, one of the big investment apps, concluded that the situation was out of control. Therefore, on the morning of January 28, they made it impossible for users to buy GameStop shares on their platform [7]. People were only able to sell their stock which resulted in a price decrease and big losses for a lot of investors. Many of them held on to their stocks, because they believed that the big hedge funds had to buy back the shares sooner or later. This determination is the reason that the war on GameStop is still going on. Nonetheless, the private investors were not the ones who came out as the big winner. Several Wall Street companies did not let an opportunity to make a good amount of money pass [8]. In total, nine investors like BlackRock and Fidelity's FMR made an amount of $16 billion on their GameStop stakes in January. This is more than three-quarters of the total $20.4 billion gain in the company's market value during the first month of this year [8].

One thing this saga has shown us is that the power of the people is unlimited when they unite to fight for the same goal. Although several social media companies banned the degenerates' groups from their platforms [9] and the SEC (Security and Exchange Commission) is investigating their platforms on fraud [10], these investors still persevere. As of now, r/WallStreetBets is even targeting other companies such as Nokia, Blackberry, and electric carmaker Nio. Hence, it is definitely worth it to keep following the developments in the financial market! ●

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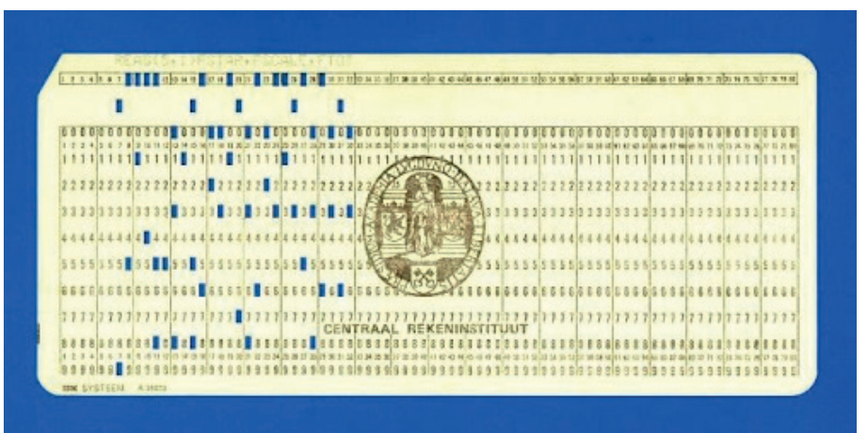
The Year 2021

In high school, I had my first experience with computers. As of year four, we used a calculator for the first time, instead of a slide-rule, and in year five we had an optional class of computer science. One hour per week, taught by our math teacher. We did not have real computers in our classroom, oh no. In fact, we did not have a computer in the entire school building at all. In these weekly sessions, we made our first steps in computer programming. I remember that we had to write a program that checks whether an integer number is prime or not. How to write such a program without real computers? Well, we had to write the program on paper first, in some very basic computer language. Then, we had to transform our program into input that a real computer could read with the use of the so-called 'ponskaarten'. You can see one depicted below:

For every line of our program, we had to fill in such a 'ponskaart' and for every character, some box had to be crossed off. In this way, the entire program turned into a pile of 'ponskaarten'. As we had no real computers in our school, we had to send this pile via ordinary mail to some central location in the Netherlands (a 'rekencentrum'), where this pile was compiled by a real computer. We have never seen this computer, but in my imagination, it must have been a huge device with many cables and blinking lights. Of course, the program did not work right away, due to a serious programming mistake or a small syntax error like a missing semicolon. In that case, you received your pile of 'ponskaarten' back together with a report, again via ordinary mail. In short, after handing in your program to your math teacher you usually received three or four weeks later a report with an error message. Then, it started all over again. You replaced the 'ponskaarten' containing the error with new ones (now crossing of the missing semicolon for example), send them via ordinary mail back to the 'rekencentrum', etcetera. You can imagine that most of us did not manage to produce a working 'prime number check' program within one year.

By the way, do you know that our current year 2021, is a perfect test case for such a 'prime number check' program? It is not hard to see that you should check only divisibility by prime numbers smaller than or equal to the square root of 2021, which is 44,9555… So, you have to check whether 2021 can be divided by some prime number that is smaller than or equal to 43. The full list of this set of prime numbers is 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, and 43. The number 2021 is tough, it survives all the checks for the prime numbers 2 up to and including 41: it cannot be divided by any of these prime numbers. In a euphoric mood, we carry out our last check: can 2021 be divided by 43? Too bad, this prime number spoils the party: 2021 = 43 x 47.

In many aspects, 2021 is a year that we will not forget easily. Here is one reason more: it is a 'nearly prime' year. Enjoy it! You have to wait until 2209 (= 47 x 47) for the next 'nearly prime' year. ●



Henk Norde
is a full professor in Mathematics and Game Theory at Tilburg University. His research interests are cooperative and non-cooperative game theory. He has won our own award for Lecturer of the year seven times!

Escaping the Curfew

On the evening of Tuesday February 23, I participated in the Female activity of the Male/Female activity organized by Asset | Econometrics. Due to the COVID-19 measurements, this was an online activity. I already participated in one of these online activities before (the bingo) and had a great time, so I knew this would also be a lot of fun. The afternoon before the activity, everyone got a package delivered to their home with some supplies and snacks for that evening (and to my surprise, they even thought of giving us a hangover breakfast!). The COVID-19 regulations said that we could have one guest over per day, so that evening at 20.00 hours, Myra Coppens and I sat together in front of our laptops with a glass of wine, ready to begin this mystery activity.

The first activity of the evening was an online escape room. We were divided into smaller groups and had to compete against the other groups to escape first. I had participated in escape rooms in the past but never online, so I was curious to find out how this would go. We received a link to an ordinary clothing website, and it started from there. I did not know anyone in my group, except Myra of course, and it seemed like no one else really knew each other that well. However, as soon as we started, we were already working together as a great team by dividing tasks. The story of the escape room was that within a company, three people were killed, and we got the task to find out how they were killed, gather the evidence, and find the antidote to a poison. We flew through the exercises and after just a couple of minutes, everyone was super competitive. I remember getting super excited when I was looking through the 3D maps and found a poisoned agent. We were really close to winning, but Myra had made a mistake and had said that C2H5OH was alcohol instead of ethanol. After figuring out this mistake, we escaped and finished second. This was a really fun activity and I would definitely recommend online escape rooms to other people.

After this activity, it was time for the second game. That afternoon, I had already looked at the bag of supplies and saw that there was a prosecco pong set. I had never heard of this before, but it was just like beer pong only with prosecco glasses (and prosecco instead of beer of course). We were divided into teams of two and had to play against other teams via Zoom. The way this worked is that you only had to put the glasses of your opponents at the other end of the table (a very smart idea). In our first round, we lost, unfortunately, but after this we were warmed up a bit and realized that if the glasses were fuller the balls would not bounce out so quickly. In our second round, it was a tie. However, after some negotiations with our opponents, we decided to settle it with a game of rock paper scissors, which we won! In our third round, we were better than ever and ended up winning. We did not win the tournament, but we did have a great time playing the game and talking and getting to know other people.

Nynke Koornstra

Bachelor EOR

Age: 19

After these activities, the official activity was over. However, the committee suggested that we could stay in the Zoom meeting. The boys who had just finished their poker tournament also joined. We stayed and played 'radje adtje' and talked to a bunch of people. This was so much fun, and I had not expected that I would laugh so much. The next morning we had our hangover breakfast and I decided that I should join more of these online activities.

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ASSET Econometrics

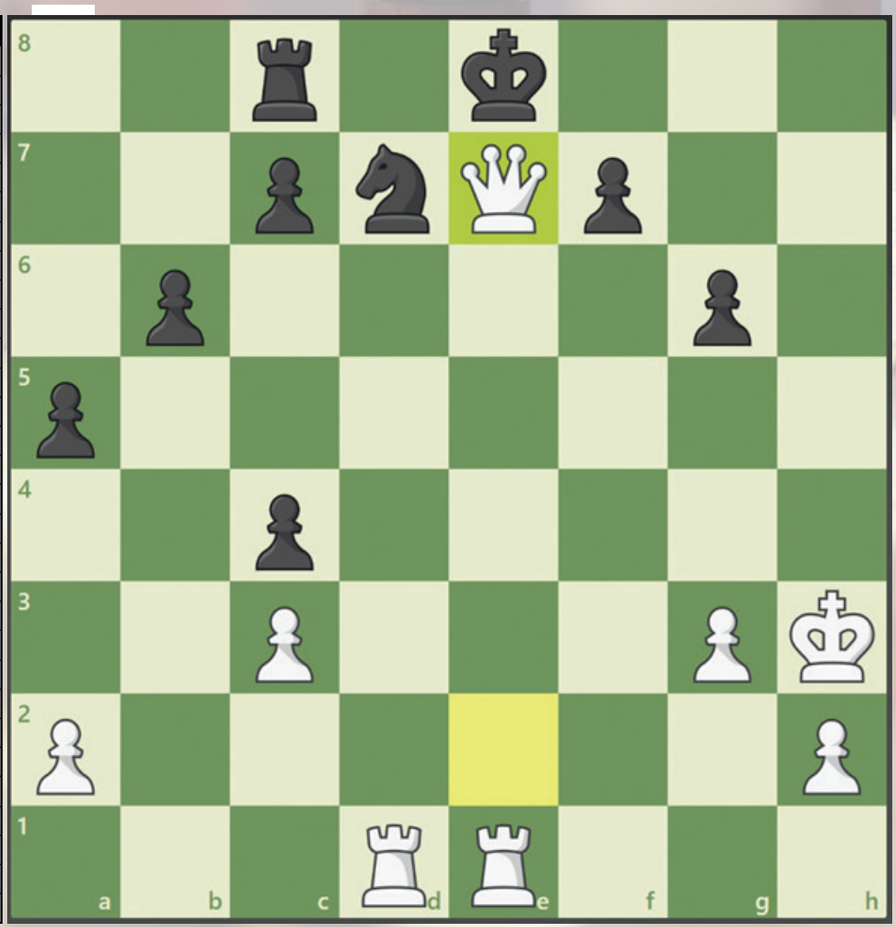
PuzzleTime

On a Friday afternoon, Stockfish and AlphaZero are playing chess. After a total of forty moves played by both, Stockfish is able to beat AlphaZero with a checkmate. However, you notice that something does not add up and you try to analyze the game that just had been played. Sadly, the game you just watched has not been written down correctly and almost all the moves done by a King (K), Queen (Q), Rook (R), Knight (N), and Bishop (B) are unknown. Luckily for you, there is only one possible game for the moves that have been written down and thus the game can be recreated.

written by **Patrick Floor**

On the left, you find all the moves that have been written down by both players, where Stockfish is white and AlphaZero is black. All moves that contain a question mark are moves that are incomplete and need a Q, K, R, N, or B on the spot of the question mark. Fortunately, all pawn moves are given and therefore known. On the right, you can find the end positions of the chess game.

	WHITE	BLACK		WHITE	BLACK
1.	d4	d5	31.	?xh5	?c6
2.	c4	e6	32.	?g4	?d7
3.	?f3	?f6	33.	?f1	?b5
4.	g3	dxc4	34.	?f4	?d8
5.	?g2	?d6	35.	?h5	?a4
6.	o-o	h5	36.	?xd7	?xd7
7.	e3	b6	37.	?f6	?e5
8.	Re1	Rg8	38.	?g2	?c8
9.	?h1	?b7	39.	?xd7+	?xd7
10.	?c3	?e7	40.	?h3	?e8
11.	?g1	?h8	41.	Qe7#	
12.	?e2	?e4	42.		
13.	?d1	?xc3	43.		
14.	bxc3	h4	44.		
15.	e4	h3	45.		
16.	?h1	?d8	46.		
17.	?e1	?f8	47.		
18.	?f1	?h5	48.		
19.	d5	exd5	49.		
20.	?f4	?c8	50.		
21.	exd5	a5	51.		
22.	?d2	?d8	52.		
23.	?g1	?a6	53.		
24.	?f3	?d7	54.		
25.	?g4	?xd5	55.		
26.	f3	g6	56.		
27.	?xh3	?c5	57.		
28.	?ad1	?e6	58.		
29.	?g5	?xg5	59.		
30.	?g2	?xf3	60.		



Polybius Square

After figuring out the whole chess game you smell something fishy about it. At first, their moves look very normal, but the moves get stranger by the minute. It seems like there is a hidden message within the game. If you look even closer you notice how to decipher the message, at each turn you have a combination of two letters that had to be filled in at the question marks. A letter combination can be translated to a different letter with the use of a Polybius Square found at the right. Repeating this process for all the moves creates a sentence. Can you figure out what sentence is hidden within this chess game and find out what the two players were trying to communicate to each other?

	B	K	N	R	Q
B	a	b	c	d	e
K	f	g	h	i/j	k
N	l	m	n	o	p
R	q	r	s	t	u
Q	v	w	x	y	z

To give you a head start, a few things should be known in order to solve this chess puzzle. First of all, the basic rules of chess can be found at chess.com/learn-how-to-play-chess. Secondly, the chess notation can either be found below or at chess.com/article/view/chess-notation. Finally, the Polybius square cipher. The explanation of this cipher can be found below or at practicalcryptography.com/ciphers/polybius-square-cipher/.

Chess Notation

To decipher the chess game, you need to know a bit about chess notation. In chess, we have a total of six different chess pieces: King, Queen, Rook, Knight, Bishop, and a Pawn. In order to distinguish which piece has been moved, a letter is assigned to each piece except for the pawn. For the King this letter is a K, Queen a Q, Rook an R, Knight an N, and for the Bishop a B. To see to which square the piece is moving, the rows and columns of the board are assigned a name from 1 till 8 and a till h respectively. If we have the move Re1, this means that the Rook is moved to the square in column e and row 1. In addition, if there is already a piece on that specific square an 'x' is added to the notation, which means that in that move a piece of the opponent has been captured. For example, Bxc3, which means that the bishop has captured an opponent's piece at square c3. Furthermore, if the move causes a check on the opponent's king a '+' is added to the notation. For instance, Nd2+ means that the knight is moved to square d2 and the opponent's king is in check. Lastly, if the move causes the opponent's king to be in checkmate a '#' is added to the notation. For example, Qe7#, means that the queen is moved to square e7 and the opponent's king is in checkmate and therefore queen to e7 is a winning move.

In exceptional cases, it is possible that a move can be made by multiple pieces. If this is the case, the starting column of the piece that makes the move is also stated in the notation. For example, assume the back-rank is empty except for two rooks. One rook is on a8 and the other rook is on h8. Then Rad8 means that the rook in column a is moving to square d8. Notice that this move can also be performed by the other rook, therefore, the 'a' is added to the notation.

In chess, there are two special moves, en passant and castling. En passant is a special rule that allows pawns to capture pawns on adjacent tiles under special circumstances and is denoted with e.p. behind the specific move if en passant is performed. Castling consists of moving the king two squares towards a rook on the player's first rank and then moving the rook to the square that the king crossed. This move is written down as o-o.

Polybius Square Cipher

A Polybius Square uses a 5x5 grid filled with all letters of the alphabet for encryption. In order to encrypt a message, each letter is replaced by its coordinates, row and column, according to the Polybius Square. For example, if we want to encrypt the message 'hi' with the Polybius Square found above we can do this as follows. H belongs to the row labeled K and the column labeled N, which gives us KN. For i, we get KR and thus the encrypted message equals [KN] [KR] KNKR. To decipher a message, this method is done in reverse. Each pair of letters are the coordinates of the original letter. So (K, N) gives us h, and (K, R) gives us i. Which gives us the message 'hi'.

Can you figure out the puzzle?

Please enter your solutions at **www.Nekst-Online.nl.** A goodiebag will be waiting for whoever has sent the best (partial) solutions. Please note that, as before, every recipient of this magazine is eligible to send in their solutions, so members of the department are invited to participate as well. Good luck!

Quinten Huikeshoven is the winner of the previous puzzle. The solution can be found at **www.Nekst-Online.nl.**

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...on obtaining their Master's degree

Quatsch!

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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!
Please send in your quotes at:
www.Asset-Econometrics.nl/more/nekst/Quatsch

Emma
"Die trein in Japan weet je wel, die met 38 coupons"

Mylan (1 week later)
'Ohh ze bedoelt coupés"

Job
"Is kip vegetarisch?"

Tijdens een gesprek over Corona sneltesten:
Maureen
"Werkt dat dan hetzelfde als een zwangerschapstest?"

Bas
"Ik ben allergisch voor kerstbomen, maar denk niet dat die door het eten zitten."

Terwijl ze op de snelweg rijden:
Ricardo
"Wow echt veel wegen hier naast elkaar!"

Willem
"Ja, leuk een bordspel in het Yearbook, Econometrie eendengans!"

Yearbook commissie
"... ganzenbord"

Agenda

Agenda Events
As the situation regarding COVID-19 is constantly changing, our agendas might also change over time. This agenda is made without having a clear sight of what the future holds, and therefore, the set up of events are prone to change.

THU **08** APR **Astrics Easter Dinner**
Have you missed the Asset | Econometrics Christmas Dinner last December? Then join this year's great alternative, namely the Asset | Econometrics Easter Dinner! You will get great food from a restaurant and enjoy a lovely dinner together with some other members.

TUE **13** APR **Beer Games Drink**
On Tuesday, April 13, the Drinks & Activities committee will organize the Beer Games Drink. Make sure to eat well before the night starts, because there will be quite some drinks this evening!

WED **14** APR **Chess Tournament**
As the Landelijke Econometristen Sport Tournooi (LEST) could not be organized physically this academic year, an online alternative has been made! Join the online Chess Tournament on April 14, and maybe you end up being amongst the top 5 econometricians that play chess!

TUE **20** APR **Active Members Evening**
As our Active Members Weekend has been rescheduled to the beginning of the new academic year, the Active Members Weekend committee has thought of a nice prelude for the weekend. They will namely organize the very first Active Members Evening! Be prepared for a night filled with games and fun..

WED **21** APR **Econometricians for Society Run**
The Econometricians for Society committee has thought of a nice running or walking route through Tilburg. Along the route are several stops, where you will be motivated to do some exercises. All the money that is raised will go to charity and you will have a sporty afternoon!

WED **28** APR **QIG Inhouse Day with Northpool**
This year's Inhouse Day for the Quantitative Investment Group will be in cooperation with Northpool, a company that trades in short-term energy products. In fact, the basic principle of trading in energy is namely the same as the principle of trading in shares.

THU **29** APR **Actuary Day Tilburg**
On this day, you gain insight into the work of an actuary and your career opportunities in this field. As the Actuary Day Tilburg is only organized every two or three years, you do not want to miss out on this opportunity!

MON **03** MAY **EOR Academy with Mploy Associates**
As an econometrician, you learn a lot of hard mathematical skills, but your soft skills can always be improved. Therefore, Mploy Associates will join our EOR Academy on May 3 to give an interesting training to refine your soft skills.

FRI **07** MAY **Inhouse Day with CZ**
On Friday May 7, we will have an interesting inhouse day with CZ together with Asset | Economics and Asset | Accounting & Finance. During this afternoon, CZ will explain the structure of the company and provide all students with a case.

TUE **11** MAY **Connection Day**
During the Connection Day, you have the opportunity to get to know several companies through cases and company presentations. On this day, you can get insight into the daily work of the company employees and show your econometric skills.

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

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