TSE Digital Center

Toulouse School of Economics

THE JEAN-JACQUES LAFFONT DIGITAL CHAIR

IAST

# Annual Report 2019

## Economics for the Common Good

# Editorial

One year has passed since the inauguration of the TSE Digital Center. This is a good time to take a look back at what has been achieved so far, and a look forward at what we want to do in the near future.

The Center brings together 50 researchers who share a common interest in digital technologies but have various backgrounds, including economics, finance, mathematics, psychology, and law. The members of this community published more than 30 peer-reviewed articles on the Center's topics of interest in 2019, and are currently involved in dozens of promising projects. Their cutting-edge research has improved our understanding of key issues such as the regulation of digital platforms, the social acceptability of artificial intelligence, or the value of cryptocurrencies.

The production of scientific knowledge is not our only objective. We also pay special attention to the diffusion of that knowledge to non-academic audiences and used various means to achieve this over the past year. First, we organized several conferences and workshops that enabled interactions between researchers, industry representatives, and policymakers. Second, we launched a new series of policy papers dealing with topics of current interest to public authorities. Third, several of our researchers have acted as advisors to policymakers or members of expert groups set up by regulators. Finally, the research produced in the Center was disseminated to the wider public through many press articles.

You will find in this report an overview of our activities in 2019 and a glance to our current research projects and future events. I wish you a pleasant read and hope that you will share with us your thoughts about what we could do to contribute more to the Common Good.

Last but not least, I would like to warmly thank the partners of the TSE Digital Center (Airbus, Ant Financial, Microsoft, Nokia, and Orange) and those of the Jean-Jacques Laffont Digital Chair (ACCOR, CDC, Ministère de la Culture, SACD, SACEM, Samsung, and Société Générale) for their support. Without them, this exciting adventure would not have been possible.

**Yassine Lefouili**

Director of the TSE Digital Center
and the Jean-Jacques Laffont Digital Chair

# Highlights

## TSE Digital  Forum 2019
## Special digital workshop



# TSE Digital Forum

## Paris, May 17, 2019

At the TSE Digital Forum 2019, economists, decision-makers and industry players gathered to discuss artificial intelligence and better understand the consequences of this major technological upheaval.

**Jean-François Bonnefon**, Research Director at TSE and CNRS presented its most recent research work on the Morality of Machines.

**François Poinas**, Senior Lecturer at TSE and Toulouse Capitole University, presented a masterclass on the impact of AI on employment.

It was followed by a roundtable discussion on AI regulatory issues, bringing together **Matthieu Agogué**, Deputy Director of Regulatory Affairs at Orange, **Yassine Lefouili**, Director of the Digital Center at TSE, **Etienne Pfister**, Chief Economist at the Competition Authority and **Françoise Soulié**, Scientific Advisor at Hub France AI.

Masterclass

# What morality for machines?


## Jean-François Bonnefon
Research Director, CNRS-TSE


Deprived of a moral sense, artificial intelligence nevertheless contributes to decisions with a moral significance. Thus, the study conducted by the research director focused on the decisions that future autonomous vehicles will have to make and their moral consequences.

For Jean-François Bonnefon, *"citizens must have a say in this debate"*. Should the car prefer to save its passengers or pedestrians, and on what criteria should it make its risk management decisions?

To determine socially preferable decisions and their causes, the research group designed a viral website to collect more than 60 million citizen choices in more than 200 countries.

A new way of doing social sciences had to be invented, using the latest digital tools. Internet users were asked to choose between two accident situations, each combining up to nine factors such as the age, gender or social status of the victims. Several universal trends are emerging, with a preference to save humans rather than animals, the largest number of individuals, and in priority the youngest. Jean-François Bonnefon also points out the importance for designers of autonomous systems to take the public into account.

The study shows that there are three main areas of choice that stand out from each other: Western Europe, Asia and South America. The researcher also denotes the special place occupied by France: *"France, and its former colonies, respond in the same way as the countries of South America, we do not yet know how to explain it."*

**A new way of doing social sciences had to be invented, using the latest digital tools**

The researcher concluded that it is important to take into account the social preferences of individuals, particularly when designing sensitive algorithms in areas such as health or law. It also highlights the effectiveness of webbased viral methods for collecting data useful to system designers and decision-makers.

Masterclass

# Artificial intelligence and employment


## François Poinas
Senior Lecturer, TSE, UT1 Capitole


The researcher began his presentation by recalling *"the fear is that artificial intelligence replaces the human in all its dimensions"* in many fields and many jobs. This fear is similar in many ways to past fears about the arrival of mechanization or electricity. Various economic studies justify this sentiment, predicting that machines will replace 10% to 70% of jobs in the next ten years.

For François Poinas, however, the job-destroying impact of artificial intelligence should be put into perspective. The current development of this technology focuses on predicting missing information, resulting in lower prediction costs.

While it is possible to replace humans with a more productive machine in these tasks, this replacement is not possible for every single task; the assumption of certain prerogatives by the machines will allow humans to concentrate on other more productive tasks.

François Poinas also explains that there is no correlation between wage levels and the possibility of the job disappearing: *"higher-paying jobs are not better protected against the advent of the AI"*. According to the economist, the effect of artificial intelligence on employment therefore remains uncertain, and will depend on the ability of agents to *"change the scope of jobs"*, and to take advantage of the additional productivity provided by the machine. To this end, he emphasizes *"the central role of training for humans to perform tasks different from that of artificial intelligence"*.

**Higher paying jobs are not better protected against the advent of the AI**

Round table

# AI regulatory issues

Moderated by Rémy Demichelis *(Les Echos)*

Matthieu Agogué *(Orange)* – Yassine Lefouili *(TSE)*
Etienne Pfister *(Competition Authority)* – Françoise Soulié *(Hub France AI)*

This decade was marked by the great return of artificial intelligence: since 2012 and the success of neural network algorithms in image recognition, the technology has been constantly improved in different fields. Energy optimization of data centers, reduced trips for transport operators, diagnostics in ophthalmology are just some of the many examples where AI can improve a service or save money. *"Artificial intelligence is a general-purpose technology, like electricity, steam engines or microprocessors,"* explains **Yassine Lefouili**, director of the TSE Digital Center. The particular challenge of AI is that it creates *"positive externalities"*, he adds, i.e. *"a situation where the action of an economic agent benefits other agents"*.

This is good for society as a whole, but it also means that the first firm, the one that produces innovations, *"only manages to capture a part of their value,"* says Yassine Lefouili. This may lead to an underinvestment problem in the absence of adequate public support.

For **Françoise Soulié**, scientific advisor at the France IA Hub, the issue is less about algorithms: *"The real subject of AI is data"*. The question is how to get companies to work together on the data already, and then produce common models. *"If we learned to share data, everyone would benefit"*. The government has launched a call for projects, the results of which will be known in 2019.

**Etienne Pfister,** Chief Economist at the French Competition Authority, nevertheless notes that *"not all data are good for sharing"*, particularly pricing data. This is for the simple reason that they are likely to betray the strategies of each company. Conversely, these companies may agree that these algorithms create a situation of collusion, as was observed for the sale of posters on Amazon. A second problematic configuration would be where two companies buy a pricing model from the same supplier. The latter could then have an interest in producing a model that does not threaten either of the two buyers. The third configuration would be the situation where entities would use a similar or different algorithm that would come to believe that *"competition costs more than it brings"*, continues Etienne Pfister. In other words, the models could agree on prices without this intention on the part of the players. One issue that appears in the background is therefore that of market access. Access that can be hindered by some agents to the extent that "they are the market", as one member of the public notes. Only algorithms, if they can encourage collusion, and if they can come to pose new barriers in customer access, can also be useful to improve the network and thus make the market more fluid. The principle of net neutrality, for example, does not allow one operator to allocate more network than another.

Yet, notes **Matthieu Agogué**, Deputy Director of regulatory affairs at Orange, AI algorithms would offer better use of the network without harming any of them; consumers and operators would not see the difference. "*There are a number of regulations that will be affected by AI,*" he explains. "*Presumably, there will be adjustments to be made, checking that all regulations are relevant.*"

New regulations for new markets, themselves likely to encounter new barriers: AI is still far from having revealed everything it holds in store for our society, but the questions arise today.



# Special digital workshop with Luc Julia

November 15, 2019

TSE was very pleased to welcome Luc Julia, CTO and Senior Vice President of Innovation for Samsung Electronics. As part of his visit, the Digital Center organised a special Digital Workshop during which Luc Julia explained to over 50 TSE researchers and students why there is no such thing as AI.

*The artificial intelligence we hear about every day in the media is Hollywood's, from Robocop to Her, it's an artificial intelligence that doesn't exist. It is alternatively called strong, or general, artificial intelligence and it simply does not exist. Human intelligence is the only intelligence there is and the only intelligence there will ever be. In particular areas, the machine is able to surpass us, for example in chess or Go game, but the energy deployed is completely different from that mobilized by the human. For example, the AI that defeated the world champion of Go uses 440 KwH when humans use 20 watts. IA are therefore mobilizing energies and amounts of data that have absolutely nothing to do with what humans need.*

*Read Luc Julia's full interview in our next TSE mag out in January.*

*The full video of the workshop is available on our website: www.tse-fr.eu/video*

# Research





## Focus research programs

### Digital platforms

In many industries, platforms allow two (or more) groups of economic agents to interact with each other. Our research program on digital platforms aims at understanding the business models of these firms and their impact on society and welfare. We produce both theoretical and empirical research that sheds light on the functioning of platform markets and offers policy recommendations to public authorities regarding the regulation of such markets.

**Head of the research program:**

**Bruno Jullien** works on industrial organization, in particular network economics, IT, competition policy and the economics of multi-sided platforms.

### Analytics and economics of Big Data

This research program gathers mathematicians developing optimization techniques, applied econometric tools and game theory concepts that help to handle high-dimensional random phenomena, and economists studying data-related issues such as privacy protection, the markets for data, and the impact of data on competition.

**Head of the research program:**

**Sébastien Gadat** works on applied mathematics involved in machine learning and artificial intelligence, with an emphasis on statistics and stochastic on-line optimization algorithms.

### Artificial intelligence and society

The researchers involved in this program investigate the ethical expectations that citizens and consumers hold for artificial intelligence, in order to smooth the transition to the new AI society. The team is also conducting research in the high-stake domain of algorithmic justice and is also interested in other areas in which AI and powerful algorithms can redesign the social fabric.

**Head of the research program:**

**Jean-François Bonnefon** works on decision-making and moral preferences. He explores the kind of ethics people want for self-driving cars and other machines.

### Financial technologies and digital markets

The objective of this research program is to investigate the implications of key features of FinTech and cryptocurrencies, and their impact on social welfare. The research team involved in the program studies in particular the way markets, institutions and regulations should be designed to mitigate problems such as coordination issues, information asymmetries and other market failures.

**Head of the research program:**

**Christophe Bisière** works on FinTech, blockchain and cryptocurrencies.

## Scientific team: 50 researchers involved

Bruno Biais
Christophe Bisière
Jérôme Bolte
Jean-François Bonnefon
Marcel Boyer
Emilio Calvano
Giacomo Calzolari
Stéphane Caprice
Catherine Casamatta
Daniel L. Chen
Frédéric Cherbonnier
Claude Crampes
Jacques Crémer
Vessela Daskalova
Alexandre de Cornière
Fany Declerck
Roberta Dessi
Isis Durrmeyer
Anna D'Annunzio
Daniel L. Ershov
Sébastien Gadat
Daniel F. Garrett
Fabien Gensbittel
Bertrand Gobillard
Renato Gomes
Alexander Guembel
Johannes Hörner
Marc Ivaldi
Doh Shin Jeon
Bruno Jullien
Augustin Landier
Yassine Lefouili
Leonardo Madio
Estelle Malavolti
Nour Meddahi
Sophie Moinas
Antonio Penta
François Poinas
Jérôme Renault
Patrick Rey
Mathias Reynaert
Andrew Rhodes
Anne Ruiz-Gazen
David Salant
Wilfried Sand-Zantman
Paul Seabright
Christine Thomas-Agnan
Jean Tirole
Stéphane Villeneuve
Takuro Yamashita

# Scientific projects

*The projects presented in this section are just a few examples of the numerous ongoing research projects of the Digital Center.*

Research program Artificial Intelligence and Society

## The Morality of AI Based Agents

**Jean-François Bonnefon** (CNRS, TSE)

AI will allow machines to take many of the routine decisions that humans must take every day, thus freeing their unique cognitive skills for more rewarding and more productive tasks. However, we must ensure that AI based decisions do reflect human objectives, and, in particular, that they act ethically. This is important in itself, and also for the social acceptability of AI based technologies. The aim of this research is to study some of the considerations involved in the important case of self-driving cars.

Drivers, whether human or AI based must make many decisions which affect the safety of others. For instance, a self-driving car may position itself away from a truck, and closer to a cyclist - minutely increasing the risk incurred by the cyclist. Or it could position itself closer to the truck - minutely decreasing the risk to the cyclist while minutely increasing the risk incurred by its passengers. These are not dramatic, life and death decisions, but aggregated over thousands of cars driving thousands of miles, these small decisions add up to different rates of fatalities for different road users. At the present time, we do not have enough data to estimate how self-driving cars (will) distribute risk between road users. Before fatalities accumulate (as they necessarily will), we need to assess what citizens and consumers would consider an acceptable distribution of risks. The first objective of this project is to reach a fine-grained understanding of what citizens and consumers will accept as a morally grounded distribution of risks between various road users; and to capture the individual, social and cultural variations of this preferred distribution. The second objective is to measure the impact of deviating from this preferred distribution, on key variables such as trust in self-driving cars; acceptance of their presence on the road; support for government regulation of statistical risk distribution; and willingness to travel in self-driving cars as a primary owner or as the user of a ride-sharing service. Lessons for the general acceptability of AI based solutions will be drawn.

Research program Digital platforms

## Data and Competition

**Alexandre de Cornière** (TSE) - **Greg Taylor** (University of Oxford)

The question of data has been at the center of recent debates around competition policy in the digital era. Concerns in this area are wide-ranging, and encompass privacy, collusion, barriers to entry, exploitative practices, and data-driven mergers.

Data can serve several purposes: for instance it can be used to improve algorithms, to target advertising, or to offer personalized discounts to consumers. While this heterogeneity of uses for data has sparked a large literature in economics, the multiplicity of models makes it difficult to draw general conclusions about the competitive effects of data.

In this paper we introduce data into a competition-in-utility framework à la Armstrong and Vickers (2001). The three key features of data are that (i) it allows to generate more revenue for a given level of utility, (ii) it is a byproduct of firms' economic activity, and (iii) it is a club good (non-rival and excludable). We provide a sufficient condition for data to be pro-competitive, and apply it to several environments illustrating the variety of uses for data. This analysis sheds light on the tension between the static and the dynamic effects of data: this is precisely when data increases short-term equilibrium consumer surplus that it can be used as a barrier to entry or that it can result in market-tipping.

We then use this framework to study data-driven mergers. We consider two data-connected markets A and B: the data obtained as a byproduct of firm A's activity can be used by firms in market B. While the concerns expressed so far by antitrust authorities revolve around the idea of input foreclosure, we show that a merger between firms in the A and B markets also affect the incentives to collect data. A critical condition for the merger to be desirable is for data-trade to be impossible absent the merger.



Research program Financial Technologies and Digital Markets

## Equilibrium Bitcoin Pricing

**Bruno Biais** (HEC)
**Christophe Bisière** (TSE, TSM-R)
**Matthieu Bouvard** (TSE, TSM-R)
**Catherine Casamatta** (TSE, TSM-R)
**Albert J. Menkveld** (VU Amsterdam)

*Christophe Bisière*

*Matthieu Bouvard*

*Catherine Casamatta*

What is the fundamental value of cryptocurrencies, such as bitcoin? Could the rising price of bitcoin reflect an increase in its fundamental value, or does it only reflect speculation? Does the volatility of cryptocurrencies suggest investors are irrational? We examine these issues by testing an equilibrium model with new data on bitcoin's transactional costs and benefits.

First, we first build an overlapping generation model in which investors use two types of money, central bank currency and cryptocurrency, to transfer consumption over time. In this model, the link between future and present prices implies that returns can exhibit large volatility unrelated to fundamentals. More precisely, the expected return of bitcoin resulting from investors' demand depends on two key elements: I) the transactional benefits that investors expect to obtain when using bitcoins (stemming from the fact that bitcoins allow them to buy goods or services they cannot obtain with central bank money), and II) the costs investors have to bear to hold bitcoins rather than central bank money (for instance, the cost of holding digital wallets that can be lost or stolen, or the fees investors have to pay to have their transactions mined). This shows that the notion of "fundamental" means something very different for stocks (backed by dividends) and money (backed by transactional services). In particular, the feedback loop from prices to transactional benefits naturally leads to equilibrium multiplicity: agents who expect future prices to be high (resp. low) rationally anticipate high (resp. low) future transactional benefits, which in turn justifies a high (resp. low) price today. Second, we collect original data to build a time series of these transactional benefits and costs. Last, we investigate whether our model-implied pricing condition can explain observed bitcoin returns.

Consistent with the model, GMM estimates show a negative and significant relation between expected return and transactional benefits and a positive and significant relation between expected returns and transactional costs. We also analyze how these different components affect the required return (implied by our model) over time. We estimate that the costs induced by the difficulty to trade bitcoins were large in 2011.

Research program Analytics and Economics of Big Data

# Mathematics of Stochastic and Deterministic Optimization for Deep Learning

**Jean-Francois Aujol** (IMB)
**Bernard Bercu** (IMB)
**Jérémie Bigot** (IMB)
**Jérôme Bolte** (TSE)
**Charles Dossal** (IMT)
**Gersende Fort** (IMT)
**Sébastien Gadat** (TSE)
**Edouard Pauwels** (IMT)
**Jérôme Renault** (TSE)
**Aude Rondepierre** (IMT)

*Jérôme Bolte*

*Sébastien Gadat*

*Jérôme Renault*

Machine learning (ML) and artificial intelligence (AI) have been rising themes of research for decades because they have been considered as one way to produce novel algorithms for solving striking challenges such as language understanding, best expert advice finding, automatic signal treatment, or financial fraud detection.

The explosion of data scientist jobs is certainly an evidence of the societal, economic and scientific impact of ML. The fields of application of ML and AI have been rapidly growing, and these technologies are now crucial for decision making in many areas such as industry, banking, internet, bio-informatics or medical imaging (among many others).

The cornerstone of ML methods is the intensive use of mathematics with a focus on tools from optimization and statistics. Indeed, ML generally involves the computation of hidden parameters for a system designed to make decisions based on yet unseen data for which optimization and statistics play a crucial role. However, for a long time, these two domains of applied mathematics were considered separately with little interactions. Nevertheless, in the last decades, new ML problems have led to the evidence of the imperious necessity to mix the research fields of statistics and optimization as wells as game theory to solve complex learning tasks due to the amount of a new data in the digital age.

The combination of these research fields allow to handle both randomness and high dimensional features, the development of efficient numerical algorithms for recovering unknown parameters, and the understanding of worst-case scenarios for robust learning or cooperative behaviour.

Within the Digital Center of TSE, a consortium of leading researchers of TSE (**Jérôme Bolte**, Optimisation, Aniti Chair - **Jérôme Renault,** Game Theory, Aniti Chair - **Sébastien Gadat,** Statistics, IUF) and other universities (Bordeaux, University Toulouse III - Paul Sabatier) will specifically study optimization methods for deep learning, Generative Adversarial Networks (GANS) and their striking relationship with game theory, as well as the stability of AI interacting systems.

The consortium brings together a unique mix of researchers in statistics, optimization, machine learning and game theory. This unique mix of these areas of mathematics is expected to achieve significant breakthroughs in the theory of deep learning, as well as in the understanding new equilibrium behavior of abstract dynamic complex systems and games. The research outcomes of the project may help to answer some of the various issues arising from the need to better understand the recent success of deep learning for AI with a focus on applications in signal/image processing, bio-informatics and data processing on graphs. The results of the project are expected to be presented on international and national workshops/congresses, and to lead to publications in leading international journals.



# Key numbers / Visitors

**12** Donors

**50** Researchers

**8** International conferences

**19** Digital workshops

**13** Working papers

**31** Articles in peer-reviewed journals

**3** Policy papers and reports

**David Reiley** (UC Berkeley) *October 2-3, 2019*

**Vili Lehdonvirta** (Oxford Internet Institute) *May 14-15, 2019*

**Andrea Mantovani** (University of Bologna) *April 15-16, 2019*

**Elena Krasnokutskaya** (Johns Hopkins University) *April 2-4, 2019*

**Maiting Zhuang** (CNRS, Paris School of Economics) *March 12-14, 2019*

# TNIT Toulouse Network for Information Technology

The Toulouse Network for Information Technology (TNIT) was created in 2005 to stimulate high quality economic research on the software industry, the development and role of the Internet, and intellectual property. The aim of the network is to encourage some of the best academic economists in the world to engage on the issues generated by the rapid development of information technology.

The members of the TNIT network meet once a year at Microsoft Campus in Redmond to discuss each other's research and dialog with high-level practitioners about the evolution of the industry. The 2019 meeting presentations addressed subjects such as AI, Data and Digital Platforms. In particular, Susan Athey (Stanford University) gave a lunch talk on Policy Challenges in regulating AI Applications.

## Members of the TNIT network:

**Daron Acemoglu** (MIT), **Susan Athey** (Stanford University), **Nicholas Bloom** (Stanford University), **Glenn Ellison** (MIT), **Joshua Lerner** (Harvard Business School), **John Levin** (Stanford University), **Matthew Gentzkow** (Stanford University), **Heidi Williams** (Stanford University).

*Scientific coordinator:* **Jacques Crémer** (TSE)

Microsoft

*From left to right: J. Crémer, G. Ellison, D. Acemoglu, J. Lerner, M. Gentzkow, S. Athey, N. Bloom, H. Williams*

# Events

Conferences 2020
Conferences 2019
Weekly digital workshops



# Conferences 2020

## The 13th Digital Economics Conference, TSE, January 9-10

The objective of the conference is to discuss recent contributions to the understanding of the digital economy and its consequences for modern societies.

## Fifth Economics of Platforms Workshop, Capri, Italy, May 8-9

This workshop gathers economists working on platforms from a theoretical or empirical perspective. The aim of the workshop is to encourage discussion among participants about current research and help them identify topics for future research.

## Tokenomics, TSE, May 11-12

Tokenomics is an international forum for theory, design, analysis, implementation and applications of blockchains and smart contracts. The goal of the conference is to bring together economists, computer science researchers and practitioners working on blockchains in a unique program featuring outstanding invited talks and academic presentations.
*Keynote speakers:*

- **Jean Tirole**, 2014 laureate of the Sveriges Riksbank Prize in Economic Sciences in memory of Alfred Nobel
- **Long Chen,** Secretary-General of the Luohan Academy, an open research institute initiated by Alibaba, and former Chief Strategy Officer at Ant Financial.

## The Economics of Digitization 4th Doctoral Workshop, TSE, May 19-20

Hosted by Toulouse School of Economics, this two-day international workshop will gather in Toulouse doctoral students involved in research in the field of the Economics of Digitalization with both theoretical and empirical focus.

*Keynote speaker:*
- **Luis Cabral** (New York University)

# Conferences 2019

## The 12th Digital Economics Conference, TSE, January 10-11

The objective of the conference is to discuss recent contributions to the understanding of the digital economy and its consequences for modern societies.

## Workshop on Privacy and Data Governance, Hangzhou, China, March 19-20

This workshop was co-organised by the Digital Center and our partner Ant Financial, affiliate company of the Chinese Alibaba Group and was held on their premises in Hangzhou.

*TSE speakers:* Jean Tirole, Doh-Shin Jeon & Yassine Lefouili.

## The Economics of Digitization 3rd doctoral Workshop, Louvain-la-Neuve, Belgium, May 3-4

This 2-day international workshop is a joint initiative of UCLouvain, CESifo Munich, Liege Competition and Innovation Institute, Telecom ParisTech and Toulouse School of Economics.

It was hosted by the Université Catholique de Louvain in Louvain-la-Neuve in Belgium and gathered doctoral students involved in research in the field of the Economics of Digitization. The 2020 edition of the workshop will be held at TSE in Toulouse.

### Workshop on the Economics of AI and Data, Brussels, Belgium, May 6-7

Artificial Intelligence technologies and Big Data are currently receiving a lot of attention from both policymakers and firms. In contrast, there is relatively little academic work by economists on these topics.

This workshop brought together academics, policymakers and industry representatives to discuss economic issues related to AI and data. It included 3 keynote lectures by world-leading experts, policy-oriented panel discussions and presentations of academic papers. The event was co-organised by TSE Digital Center and the Joint Research Center of the European Commission.

*Keynote speakers:* **Jacques Crémer** (TSE), **Avi Goldfarb** (University of Toronto) **and Hal Varian** (Google)

### 4th Economics of platforms Workshop, Bologna, Italy, May 17-18

This workshop brought together a group of academic experts in the field of platform economics. The objective of the workshop was to enable fruitful discussion among the participants and help them identify topics for future research.

### TSE Digital Forum, Paris, France, May 17

This yearly outreach event in Paris gathers world-class economists and practitioners working at the forefront of the digital sector to offer their insights and debate the current stakes in artificial intelligence.

### TNIT annual meeting 2019, Redmond, Washington, USA, October 4-5

The Toulouse Network for Information Technology (TNIT) organizes a yearly meeting on the Microsoft campus in Redmond WA, where the members of the network discuss each other's research and dialog with high-level practitioners about the evolution of the industry.

## Weekly Digital Workshops

- **Didier Bosque** (Innovation and Digital Transformation Manager Sopra Steria), *"Presentation of Occitanie Data"*, December 18, 2019.
- **Yi Huang** (Graduate Institute of International and Development Studies), *"Digital Finance and Customer Capital Development"*, December 11, 2019.
- **Bernhard Rieder** (Universiteit van Amsterdam), *"Online Platforms: From Transparency to Observability"* December 4, 2019.
- **Annette Brooks** (EC - JRC), *"Assessing the impact of online travel agencies on hotels and travellers"*, November 20, 2019.
- **Luc Julia** (Samsung), *"There is no such thing as Artificial Intelligence"*, November 15, 2019.
- **Mike Ostrovsky** (Standfor GSB), *"Carpooling and the Economics of Self-Driving Cars"*, November 6, 2019.
- **Daniel Chen** (TSE), *"Stereotypes in High Stake Decisions: Evidence from U.S. Circuit Courts"*, October 16, 2019.
- **Michelangelo Rossi** (Universidad Autonoma de Barcelona), *"How Does Competition Affect Reputation Concerns? Theory and Evidence from Airbnb"*, October 9, 2019.
- **David Reiley** (UC Berkeley), *"Measuring Consumer Sensitivity to Audio Advertising: A Field Experiment on Pandora Internet Radio"*, October 2, 2019.
- **Michele Fabi** (Universitat Autonoma de Barcelona), *"A Simple Model of Crowdfunding Dynamics"*, September 25, 2019.
- **César Hidalgo** (MIT), *"From Public Data to Responsible A.I."*, June 21, 2019.
- **Giacomo Calzolari** (European University Institute), *"Artificial Intelligence, Algorithmic Pricing and Collusion"*, May 27, 2019.
- **Sridhar Moorthy** (Rotman School of Management - University of Toronto), *"Advertising strategy in the presence of reviews: An empirical analysis"*, May 22, 2019.
- **Vili Lehdonvirta** (Oxford Internet Institute), *"The Global Platform Economy: Connecting emerging-economy service labour to international demand"*, May 15, 2019.
- **Jakub Kastl** (Princeton University), *"Platform Design and the Value-of-Time in Dynamic Matching Markets: An Empirical Analysis of Ride Hail"* (with N. Buchholz, L. Doval, F. Matejka and T. Salz), April 17, 2019.
- **Jean-Michel Loubes** (Institut de Mathématiques de Toulouse), *"Fairness in Machine Learning: from Legal issues to mathematical solutions"*, March 27, 2019.
- **Maiting Zhuang** (CNRS, Paris School of Economics, France), *"TV shows, social media and anti-Japanese protests in China"*, March 13, 2019.



# Outreach

Education
Prizes and awards
Press articles

# Education

## Machine Learning for Economics

The main goal of this course is to familiarize students with a number of machine learning methods for prediction and causal inference. Both supervised and non-supervised methods are studied. In particular, the course covers the following methods: Lasso and Ridge regression, random forest and boosting, neural networks and deep learning, as well as support-vector machine and kernel methods.

## Big Data

This course is dedicated to machine learning methods for big data problems. It starts with a reminder of optimization algorithms and then tackles several problems and machine learning algorithms. In particular, it deals with collaborative filtering, the Netflix problem, mixture models, unsupervised classification problems, tree-based methods, and sequential prediction with online methods.

## Digital Economics

This course aims at exploring how the internet and digitization affect firms, consumers and markets. The first part of the course will involve a mix of theoretical models and policy discussions dealing primarily with network effects, online media platforms, big data and privacy. The second part will explore empirical papers on topics such as search, reputation mechanisms and copyright. Master students will also learn about the different kinds of data that are available with online markets and how to look at this data.

## Market Regulation in the Digital World

This course at the master's degree level was created in 2016. The course discusses recent regulatory issues and competition policy topics related to the digital economy. Lectures cover the following topics: net neutrality, uses of personal data online, bundling in platform markets: economic analysis of the Microsoft and Google cases, news aggregators and their effect on traditional media and the sharing economy.

## Economics of Innovation and Intellectual Property

This lecture introduces the Master students to a selection of important current issues in the economics of intellectual property (IP). After the introduction to the current situation of the IP world and firms' IP strategies, it reviews important economic contributions to topics such as: standard setting organization licensing - litigation - weak patents and patent pool.



# Prizes & Awards

- **Uriel Rothblum award by Operations Research Society of Israel**, for *"First Order Methods Beyond Convexity and Lipschitz Gradient Continuity with Applications to Quadratic Inverse Problems"*, by **J. Bolte**, S. Sabach, M. Teboulle, and Y. Vaisbourd.
- Congratulations to **Daniel Garrett awarded the "ESEM 2019 Prize"** for his best Applied Economics Paper *"Payoff Implications of Incentive Contracting"*.
- Congratulations to **Andrew Rhodes,** assistant professor at TSE, **awarded the Robert J. Lanzillotti prize** for the best article *"Multi-product Mergers and Quality Competition"* (joint with Justin Johnson, Cornell) in antitrust economics at the International Industrial Organization Conference in Boston.
- Congratulations to **Jean-François Bonnefon** who was appointed **President of the expert group at the European Commission** to advise on specific ethical issues raised by driverless mobility.

# Press articles

- **Jean-François Bonnefon,** *"Êtes-vous un robot ou un homme ?"*, Sciences et Avenir, November 2019
- **Yassine Lefouili,** *"El nou reglament de protecció de dades ha de passar encara la prova dels tribunals"*, Revista Economica de Catalunya, October 2019
- **Jean-François Bonnefon,** *"Semi-autonomous cars 'less likely' to get blame for crashes"*, Tech Digest, October 29, 2019
- **Jean-François Bonnefon**, *"La voiture autonome pose des questions éthiques vertigineuses"*, Le Figaro, October 24, 2019
- **Maxime Derex and Jean-François Bonnefon**, *"Humans Can Improve Technology without Really Understanding It"*, Scientific American, September 2019
- **Jean-François Bonnefon**, *"Le robot, un animal comme les autres ?"*, Journal du CNRS, September 2019
- **Jacques Crémer**, *"Forcing tech giants to share data not the way to go"*, Irish Times, April 18, 2019
- **Jacques Crémer**, *"Changes to EU antitrust enforcement on Big Tech urged"*, Financial Times, April 4, 2019
- **Jean-François Bonnefon**, *"Trusting self-driving cars is going to be a big step for people"*, Horizon, the EU Research & innovative Magazine, April 2, 2019
- **Alexandre de Cornière**, *"Ce qui va changer la prochaine fonction "effacer l'historique" de Facebook"*, Le Figaro, February 28, 2019
- **Daniel Chen**, *"How artificial intelligence can help us make judges less biased"*, The Verge, January 17, 2019

# Publications

Policy papers and reports
Articles in peer-reviewed journals
Working papers



# Policy papers and reports

## The Economics of Platforms: A Theory Guide for Competition Policy

**Bruno Jullien and Wilfried Sand-Zantman, September 2019**

Over the past 20 years, the development of the internet has transformed the global economy and had an impact on almost every aspect of our lives. Designed primarily as a means of communication, the internet has revolutionized the way we produce and exchange services and goods, whether they are digital or not. The past 15 years have seen the emergence of a new wave of companies - like Amazon, Alibaba, Baidu, Facebook, Google, Airbnb, Booking.com or Uber, to name a few - whose business model is mainly to facilitate interaction between individuals and/or businesses. These companies rely on different business models but they belong to the same general category, now known as platforms, and share many characteristics. The objective of this report is to discuss these common features in order to explain the functioning of markets with platforms. The main focus of this report will be on whether competition can be effective.

## Special Advisers' Report for the EU Commission: Competition Policy for the Digital Era

**A report by Jacques Crémer, Yves-Alexandre de Montjoye and Heike Schweitzer, April 2019**

In March 2018, EU Commissioner **Margrethe Vestager** appointed the academics - **Jacques Crémer,** professor of economics at the Toulouse School of Economics; **Yves-Alexandre de Montjoye**, assistant professor of data science at Imperial College London and **Heike Schweitzer,** professor of law at the Humboldt University of Berlin - as special advisers for a period of one year to help explore how competition policy should evolve to continue to promote innovation in the digital age.

In their much-awaited final report, the three experts describe what they see as the main characteristics and challenges of the digital economy and they make general suggestions on the application of EU competition rules to platforms, data, and digital and tech "killer" acquisitions.

## Committee for the Study of Digital Platforms Market Structure and Antitrust

**Subcommittee by**

**Fiona Scott Morton** (chair) – **Theodore Nierenberg,** Professor of Economics, Yale School of Management – **Pascal Bouvier**, Managing Partner, MiddleGame Ventures – **Ariel Ezrachi**, Slaughter and May Professor of Competition Law, The University of Oxford – **Bruno Jullien**, Senior Researcher, CNRS, Toulouse School of Economics – **Roberta Katz**, Senior Research Scholar, Center for Advanced Study in the Behavioral Sciences Stanford University – **Gene Kimmelman**, President and CEO of Public Knowledge – **Douglas Melamed**, Professor of the Practice of Law, Stanford Law School – **Jamie Morgenstern**, Assistant Professor of Computer Science, Georgia Institute of Technology, **May 2019**.

This report is part of a project initiated by the George J. Stigler Center for the Study of the Economy and the State, aimed at addressing issues arising from the emergence digital platforms, which created huge benefits to society but some challenges to policy. Economies of scale and scope, the use of data and network externalities form a unique combination of economic forces that favors tipping and shifts the competitive process from competition in the market to competition for the market.

The report emphasizes the role of competition policy in promoting fair dynamic competition, either head-to-head or through disintermediation by a partner or complement. After identifying harms to consumers that may result from market power, the report discusses some potential policy options. Effective enforcement requires incorporating the existing knowledge from behavioral economics and from the analysis of free goods. The report suggests the creation of a specialist regulator, the Digital Authority, tasked with creating general conditions conducive to competition.

The DA could collect data for policy makers and researchers, define codes of conduct, and promote data interoperability when needed and open standards. The DA could also oversee the behavior of platforms with "bottleneck power", for which the report suggests an obligation of enforcing fair competitive conditions on the platform and a reinforcement of merger review to account for potential competition.

# Articles in peer-reviewed journals

- **Alexandre de Cornière and Greg Taylor,** *"A Model of Biased Intermediation"*, The RAND Journal of Economics, 2020, forthcoming.
- **Francesc Dilmé and Daniel F. Garrett**, *"Residual Deterrence"*, Journal of the European Economic Association, 2019, forthcoming.
- **Sébastien Gadat, Sebastien Gerchinovitz and Clément Marteau,** *"Optimal functional supervised classification with separation condition"*, Bernoulli, 2019, forthcoming.
- **Sébastien Gadat, Clément Marteau and Cathy Maugis,** *"Parameter recovery in two-component contamination mixtures: the L2 strategy"*, Annales de l'Institut Henri Poincaré, 2019, forthcoming.
- **Andrei Hagiu, Bruno Jullien and Julian Wright**, *"Creating platforms by hosting rivals"*, Management Science, 2019, forthcoming.
- **Daniel L. Chen, Manoj Kumar, Vishal Motwani and Philip Yeres**, *"Is Justice Really Blind? And Is It Also Deaf?"*, Computational Analysis of Law, 2019, forthcoming.
- **Daniel Fischer, Alain Berro, Klaus Nordhausen and Anne Ruiz-Gazen**, *"REPPlab: An R package for detecting clusters and outliers using exploratory projection pursuit"*, Communications in Statistics - Simulation and Computation, 2019, forthcoming.
- **Doh-Shin Jeon and Jay Pil Choi,** *"A Leverage Theory of Tying in Two-sided Markets with Non-Negative Price Constraints"*, American Economic Journal: Microeconomics, 2020, forthcoming.
- **Lei Xu, Tingting Nian and Luis Cabral**, *"What Makes Geeks Tick? A Study of Stack Overflow Careers"*, Management Science, 2019, forthcoming.
- **Sjaak Hurkens, Doh-Shin Jeon and Domenico Menicucci,** *"Dominance and Competitive Bundling"*, American Economic Journal: Microeconomics, vol. 11, n. 3, August 2019, pp. 1-33.
- **Emilio Calvano, Giacomo Calzolari, Vincenzo Denicolò and Sergio Pastorello,** *"Algorithmic Pricing: What Implications for Competition Policy?"*, Review of Industrial Organization, vol. 55, n. 1, August 2019, pp. 155-171.
- **Emmanuelle Auriol, Sara Biancini and Rodrigo Paillacar,** *"Universal Intellectual Property Rights: Too Much of a Good Thing?"*, International Journal of Industrial Organization, vol. 65, July 2019, pp. 51-81.
- **Bruno Jullien and Alessandro Pavan,** *"Information Management and Pricing in Platform Markets"*, The Review of Economic Studies, vol. 86, n. 4, July 2019, pp. 1666-1703.
- **Bruno Biais, Christophe Bisière, Matthieu Bouvard and Catherine Casamatta,** *"The blockchain folk theorem"*, The Review of Financial Studies, vol. 32, n. 5, May 2019, pp. 1662-1715.
- **Iyad Rahwan, Manuel Cebrian, Nick Obradovich, Josh Bongard, Jean-François Bonnefon, Cynthia Breazeal, Jacob W. Crandall, Nicholas Christakis, Iain Couzin, Matthew O. Jackson, Nicholas Jennings, Ece Kamar, Isabel Kloumann, Hugo Larochelle, Hugo Lazer, Richard McElreath, Alan Mislove, David Parkes, Alex Pentland, Margaret Roberts, Azim Shariff, Joshua Tenenbaum, and Michael Wellman**, *"Machine behaviour"*, Nature, vol. 568, April 29, 2019, pp. 477-486.
- **Maxime Derex, Jean-François Bonnefon, Robert Boyd, and Alex Mesoudi,** *"Causal understanding is not necessary for the improvement of culturally evolving technology"*, Nature Human Behaviour, April 2019.
- **Marcel Boyer,** *"Erreurs méthodologiques dans l'évaluation des investissements publics et privés"*, Revue Française d'Économie, n. XXXIII, April 2019, pp. 49-80.
- **Gary Biglaiser, Emilio Calvano and Jacques Crémer,** *"Incumbency advantage and its value"*, Journal of Economics and Management Strategy, vol. 28, n. 1, April 2019, pp. 41-48.
- **Manon Costa, Sébastien Gadat, Pauline Gonnord and Laurent Risser,** *"Cytometry inference through adaptive atomic deconvolution"*, Journal of Nonparametric Statistics, vol. 31, n. 2, April 2019, pp. 506-547.
- **Jean-François Bonnefon, Azim Shariff and Iyad Rahwan,** *"The Trolley, the Bull Bar, and Why Engineers Should Care About the Ethics of Autonomous Cars"*, Proceedings of the IEEE, vol. 107, n. 3, March 2019, pp. 502-504.
- **Luis Cabral and David Salant,** *"Sequential Auctions and Auction Revenue"*, Economics Letters, vol. 176, March 2019, pp. 1-4.
- **Hélène Bourguignon, Renato Gomes and Jean Tirole**, *"Shrouded Transaction Costs: Must-Take Cards, Discounts and Surcharges"*, International Journal of Industrial Organization, vol. 63, March 2019, pp. 99-144.
- **Daniel L. Chen**, *"Judicial Analytics and the Great Transformation of American Law"*, Artificial Intelligence and the Law, vol. 27, n. 1, March 2019, pp. 15-42.
- **Daniel L. Chen**, *"Machine Learning and Rule of Law"*, Computational Analysis of Law, vol. 27, n. 1, March 2019, pp. 15-42.
- **Stéphane Caprice and Shiva Shekhar,** *"Negative market value and loss leading"*, Economics Bulletin, vol. 39, n. 1, January 2019, pp. 94-103.
- **Joao Correia da silva, Bruno Jullien, Yassine Lefouili and Joana Pinho,** *"Horizontal Mergers Between Multi-Sided Platforms: Insights from Cournot Competition"*, Journal of Economics and Management Strategy, vol. 28, n. 1, January 2019, pp. 109-124.
- **Daniel L. Chen**, *"Intermediated Social Preferences: Altruism in an Algorithmic Era"*, in Advances in Economics of Religion, Jean-Paul Carvalho, Sriya Iyer, and Jared Rubin (eds.), Palgrave Macmillan, series "International Economic Association Series", vol. 158, 2019, pp. 119-138.
- **Prosper Dovonon, Silvia Goncalves, Ulrich Hounyo and Nour Meddahi**, *"Bootstrapping high-frequency jump tests"*, Journal of the American Statistical Association, vol. 114, n. 526, 2019, pp. 793-803.
- **Rodrigo Montes, Wilfried Sand-Zantman and Tommaso M. Valletti,** *"The value of personal information in online markets with endogenous privacy"*, Management Science, vol. 65, n. 3, 2019, pp. 955-1453.
- **Zhijn Chen and Patrick Rey**, *"Competitive Cross-Subsidization"*, The RAND Journal of Economics, vol. 50, n. 3, 2019, pp. 645-665.
- **Bruno Biais, Christophe Bisière, Matthieu Bouvard and Catherine Casamatta**, *"Blockchains, Coordination, and Forks"*, in AEA Papers and Proceedings, vol. 109, "AEA Papers and Proceedings", 2019, pp. 88-92.

# Working Papers

- **Jérôme Bolte, Camille Castera, Edouard Pauwels and Cédric Févotte,** *"An Inertial Newton Algorithm for Deep Learning"*, TSE Working Paper, n. 19-1043, October 2019.
- **Jérôme Bolte and Edouard Pauwels**, *"Conservative set valued fields, automatic differentiation, stochastic gradient methods and deep learning"*, TSE Working Paper, n. 19-1044, October 2019.
- **Gary Biglaiser, Jacques Crémer and André Veiga,** *"Migration between platforms"*, TSE Working Paper, n. 19-1038, September 2019.
- **Susan Athey, Juan Camilo Castillo and Bharat Chandar**, *"Service Quality in the Gig Economy: Empirical Evidence about Driving Quality at Uber"*, TNIT working paper, September 2019.
- **Y. De Castro, Sébastien Gadat, Clément Marteau and Cathy Maugis,** *"SuperMix: Sparse Regularization for Mixture"*, TSE Working Paper, n. 19-1040, September 2019.
- **Wilfried Sand-Zantman and Anastasios Dosis**, *"The Ownership of Data"*, TSE Working Paper, n. 19-1025, July 2019.
- **Bruno Jullien and In-Uck Park**, *"Communication, Feedbacks and Repeated Moral Hazard with Short-lived Buyers"*, TSE Working Paper, n. 19-1027, July 2019.
- **Claire Borsenberger, Helmuth Cremer, Denis Joram, Jean-Marie Lozachmeur and Estelle Malavolti**, *"Platform competition: market structure and pricing"*, TSE Working Paper, n. 19-1010, April 2019.
- **Francesco Decarolis, Maris Goldmanis and Antonio Penta**, *"Marketing Agencies and Collusive Bidding in Online Ad Auctions"*, TSE Working Paper, n. 19-1011, April 2019.
- **Bruno Jullien, Markus Reisinger and Patrick Rey**, *"Personalized Pricing and Brand Distribution"*, TSE Working Paper, n. 19-995, March 2019.
- **Camelia Goga and Anne Ruiz-Gazen**, *"Improving the Estimation of the Odds Ratio in Sampling Surveys using Auxiliary Information"*, TSE Working Paper, n. 19-1000, March 2019.
- **Bruno Jullien, Markus Reisinger and Patrick Rey**, *"Personalized Pricing and Brand Distribution"*, TSE Working Paper, n. 19-995, March 2019.
- **Elisabetta Iossa, Patrick Rey and Michael Waterson**, *"Organizing Competition for the Market"*, TSE Working Paper, n. 19-984, January 2019.

# Welcome to the new TSE

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