

## How to fast-track green transport

# Mobility for the 21<sup>st</sup> century



Christian Gollier,  
TSE Director

Rocked by the onset of climate change and a major energy crisis, the world is in dire need of more efficient transport systems. Our societies have been dependent on fossil fuel-powered cars for far too long: we must develop alternative ways of moving people and goods around cities, countries and the world.

To address the challenge of better and greener transportation, you will find in this magazine an in-depth interview with our TSE expert on transport economics, Marc Ivaldi, as well as insights from recent research led at TSE on low-carbon delivery for parcels, funding greener infrastructures, incentives for consumers to switch to electric cars, as well as an interview with Jean-Pierre Farandou, CEO of French rail operator SNCF.

You will also find a six-page recap of the second edition of our annual public conference, the Common Good Summit, at which CEOs, public officials and TSE economists confronted the future of urban transport and many of the other urgent challenges facing us today. We are already looking forward to next year's edition which will be held in Toulouse, inviting an exciting lineup of prestigious speakers and distinctive thinkers.

We also feature interviews with two leading experts in their fields. Roland Benabou, winner of the 2021 Jean-Jacques Laffont Prize, discusses his work on our motivated biases. César Hidalgo, Director of the Center for Collective LEARNing at ANITI and TSE associate professor, imagines what AI will look like in the near future.

I wish you a great read, green transportation, and hope to see you soon.

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## News



### Christian Gollier lecture at Collège de France published

An adaptation of the TSE Directors inaugural lecture at Collège de France, *Entre fin de mois et fin du monde* ("The end of the month or the end of the world"), has been published as a book in French. To fend off climate disaster, Christian urges more careful consideration of long-term costs using two key economic tools: the discount rate and carbon pricing.

### ERC grants awarded to Koen Jochmans, Patrick Rey and Jean-Charles Rochet

Congratulations to Koen Jochmans, Patrick Rey and Jean-Charles Rochet who have been awarded ERC grants for their research projects. Patrick Rey will work on 'Competition and regulation in the digital economy', Jean-Charles Rochet on 'Digital payments, multidimensional taxes' while Koen Jochmans will work on 'A Coherent Approach to Analysing Heterogeneity in Network Data'.

### TSE supports Ukraine

The TSE community has mobilized in support of Ukraine following the Russian invasion, participating in a webinar series *Frontiers in Economics for Ukraine*. The series is jointly organized with Kyiv School of Economics, University of Birmingham, Carlos III Madrid University, Mannheim University, and the ENTER Network. TSE also organized a conference titled 'Ukraine: Role and Prospects in the European Economy' with the Free Ukraine association and the Occitanie region. At this occasion, Jean Tirole, Carole Delga and Joël Echevarria discussed the consequences of the war.

### Introducing TSE Reflect

Get all the latest research and activities from TSE in your inbox, via our monthly thematic newsletter, aimed at bringing insight to economic practitioners. Sign up at [tse-fr.eu/tse-reflect](https://tse-fr.eu/tse-reflect).

### Jean Vincens, 1926 - 2022

Jean Vincens founded the Interdisciplinary Research Laboratory on Human Resources and Employment (LIRHE) with Michel Despax, linking jurists, economists and managers. He was also involved with Georges Létinier in the emergence of a group of young, passionate doctoral students who, under the impulse of professors Michel Moreaux and Georges Molins-Ysal, formed a vibrant research environment around Jean-Jacques Laffont when he returned to Toulouse to launch what would become the Toulouse School of Economics. The TSE community pays tribute to Jean and expresses its condolences to his family and friends.

## Prizes & Awards



### Jean Tirole appointed Fellow of the American Finance Association

Congratulations to TSE's Jean Tirole for his nomination to the Board of Directors of the American Finance Association. Its Society of Fellows aims to recognize those members who have made a distinguished contribution to the field of finance.

### French University Institute welcomes new TSE members

Three TSE researchers, Pierre Dubois, Doh-Shin Jeon and Nour Meddahi, have joined the French University Institute, which promotes the development of high-level interdisciplinary research in universities. Nineteen TSE professors are currently members.

### Ingela Alger wins 2022 CNRS Silver Medal

Every year, the CNRS awards medals to researchers from a range of disciplines who have made exceptional contributions to science. Congratulations to Ingela, Director of the Institute for Advanced Study in Toulouse, Research Director at CNRS and TSE (CNRS/Toulouse 1 Capitole). Ingela is a specialist in the long-term evolution of human motivations and intra-family behaviors.

### Mathias Reynaert awarded Malinvaud Prize

Congratulations to Mathias Reynaert, assistant professor at TSE, who received the Malinvaud 2022 Prize for his article "Abatement Strategies and the Cost of Environmental Regulation: Emission Standards in the European Automobile Market" published in *behaviors*.

### Victor Gay wins the Open Science Award for Research Data

Congratulations to Victor for winning the prize from the French Ministry of Higher Education and Research. These awards highlight projects, teams and young researchers engaged in best practices in research data management, dissemination and reuse.

### Congratulations to Pierre Dubois

The TSE Professor has been elected Fellow of the Econometric Society, as many other TSE colleagues.

### Céline Bonnet and Pierre Dubois awarded Lilien Practice Prize

The TSE professors received the prize for their work on nutrition labels. The Gary Lilien Practice Prize is awarded for an outstanding implementation of marketing science.

# Rebuilding a better world

Common Good Summit 2022

From war to wildfires and soaring prices, many of the challenges facing Europe were impossible to ignore this summer. The stark realities of apocalyptic weather, pandemic risks and Russian aggression have helped to forge international consensus on the need to work together for the common good. But as TSE director Christian Gollier observed, there is little agreement on the solutions. With our societies still reeling from multiple crises, how will we rebuild a better world? This year's Common Good Summit invited high-level industrial and political leaders to engage with some of the world's most eminent economists – including four Nobel laureates – to inform the urgent collective decisions that must be taken to safeguard our future. For the second edition of this flagship event, held in May, panelists focused their minds on climate change, the return of inflation, the future of transport, the aging economy, and the digital revolution.

**'Global warming is the greatest market failure in the history of humanity. We produce 50% more CO<sub>2</sub> today than at the time of the 1992 Earth Summit in Rio. We know we are heading into a wall and our foot is still on the accelerator'**

**Christian Gollier,**  
TSE Director

Toulouse is no stranger to forceful debate, as evidenced by some of the more heated exchanges between Nobel Laureate Bengt Holmström and EU Commissioner Thierry Breton at the first Common Good Summit. This year, vehement opinions clashed again as environmental activists interrupted debates to decry the participation of companies such as ExxonMobil and Amazon as 'greenwashing'. Should such powerful business interests be invited to the debates? If they are part of the problems, might they also be part of the solutions? We hope that frank, open-minded discussion can strengthen the public debate and the legitimacy of evidenced-based policy for the common good. Be they militants or multinationals, TSE welcomes voices from all sectors of society.

## The climate challenge

"The planet is in danger," warned Toulouse Mayor Jean-Luc Moudenc in his opening address. "But we must not lose ourselves in pessimism or abandon the ideas of progress and development." From start to finish, environmental concerns were center stage at this Summit. Emotions ran high, as economists underlined the immense scale, complexity and urgency of the climate challenge, business leaders expressed optimism in technological and market solutions, while politicians evoked the potential of radical state intervention. "Today, any inaction on the environment is absolutely criminal," said Nadia Pellefigue, the Occitania region's Vice President. "We have the skills to act. If we bring together our science and knowledge, business leaders and employees, and the state, we have the capacity to build solutions together."

"Global warming is the greatest market failure in the history of humanity," observed TSE director Christian Gollier, sharing activists' frustration at the world's collective response. "Today, we produce 50% more CO<sub>2</sub> emissions than at the time of the 1992 Earth Summit in

Rio. We know we are heading into a wall and our foot is still on the accelerator." Avoiding catastrophe will require painful sacrifices, he warned. "Apart from abandoning coal and replacing oil-fired boilers with heat pumps, most climate actions will have considerable costs. With today's technologies, reaching net-zero implies an enormous revolution with considerable loss of growth, purchasing power, comfort and welfare. In France, we're talking about up to €70bn in extra annual costs over the next decade."

## Carbon pricing

The policy tool favored by most economists is carbon pricing, accompanied by redistribution mechanisms. "When we emit CO<sub>2</sub>, we are not incentivized to integrate the cost of the damage that we cause," Christian explained. "A carbon price that reflects these damages can, at least in theory, align private interests with the common good. It incentivizes all producers to search for the least costly actions in terms of CO<sub>2</sub> produced." It's a system that has functioned very well, he added. "The 20% reduction in European emissions over the past 30 years is largely due to the industrial and electricity sectors, which are those covered by the existing carbon price. By contrast, emissions have increased in the residential and transport sectors."

Pascal Canfin, chairman of the European Parliament's Environment Committee, agreed that carbon pricing can work well in many industries. But he warned that we should be wary of the political costs of extending it to households. "A company can gain in productivity, not a household. If you put the social acceptability of the transition at risk, you will have lost everything. Consumers, companies and politicians will not get on board." To avoid another 'gilet jaunes' uprising, he advocated more politically palatable green measures such as leasing electric cars to rural households that otherwise would

**'Red meat has 10 times more impact on global warming than chicken, which has 10 times more impact than fruit or vegetables'**

**Zohra Bouamra-Mechemache**  
TSE

**'We are on the way to ending the combustion engine, changing Europe's largest industry to zero emissions in 12 years. This is extremely radical'**

**Pascal Canfin,**  
Chairman of the European Parliament's Environment Committee



Frédéric Duval,  
Amazon General Director  
at the Common Good Summit

struggle to afford them.  
**Sustainable choices**

Decarbonized transport was also a key focus for two sessions involving representatives from SNCF, Amazon, GetLink and TransDev, and we have dedicated a special dossier to this issue (see page 12). The green transition will also affect the way we eat, recalled TSE's Zohra Bouamra-Mechemache in a session on food production. After transport, agriculture is the second largest emitter of greenhouse gases. But there are big disparities between products as explained by the TSE professor: "Red meat has 10 times more impact than chicken, which has 10 times more impact than fruit or vegetables."

Zohra stressed the complexity of measuring the impact of food products and helping consumers to make healthier, greener decisions. For example, organic food production can have lots of ecological benefits, especially for the local environment; but lower yields can also increase the carbon footprint per kilo. The food transition will require other tools to complement a carbon tax, she noted: "We'll need a panoply of policy

instruments, including informational tools like food labels, and educational tools like 'Green Mondays' in restaurants, canteens and schools." Private finance can lend a hand, suggested Antoine Sire (BNP Paribas) in a session on carbon-neutral growth: "We can direct financial flows in the right direction," he insisted. "We must be a catalyst for solutions." Economists at TSE's Sustainable Finance Center have conducted important research in this area and Christian Gollier acknowledged the potential of markets as an important lever. But he also warned that this path is easily undermined by "carbon leaks" that allow polluting firms to find funding elsewhere.

#### Europe as flagbearer

Europe is the global region with the least fossil fuel capital and the most zero-carbon patents, Pascal Canfin observed. Leading the climate fight is therefore both Europe's responsibility and in its economic interest. "We are on the way to ending the combustion engine, changing Europe's largest industry to zero emissions in 12 years. This is extremely radical." There will be winners and losers in this Schumpeterian transition, he

warned. "We cannot freeze history and continue to travel on horseback. But we must also address the social issue with support for the tens of thousands of jobs at risk."

Despite the geopolitical weaknesses exposed by Russian militarism, he stressed that Europe can use other weapons to press for global change. "If you don't accept the Paris treaty, for example, we will not sign trade agreements with you. Or we stop importing agricultural products if they have contributed to tropical deforestation. We are building up European defense but that takes time. Today, our tremendous power is the single market. We are putting it to work for the ecological transition at home and abroad."

#### The demographic challenge

We have our heads in the sand about the coming upheaval in the world's aging societies, warned TSE's Catarina Goulão. In particular, she noted the fast-rising costs and likelihood of entering old-age dependency. "Today, there are 280,000 people over 85 years. In 2060, there will be around a million. This is a new risk: after the war,

**'The French pension system has enormous fragmentation as people move across lots of different systems. This is very unusual in advanced countries. It creates inequities and is costly'**

Peter Diamond  
2010 Nobel laureate

the average person died at 60, five years before the retirement age." How can we reduce these risks? Individuals and society must invest more in healthy, active lifestyles and preventative medicine to delay biological aging. We must also return elderly people to their place at the heart of our societies, she observed, arguing that the Orpea scandal arose because social links with older generations have been broken.

In a related session, Nobel laureate Peter Diamond discussed France's failure to embrace pension reform, highlighting its hodge-podge of retirement schemes. "The current pension system has enormous fragmentation," he observed, "people move across lots of different pension systems. This is very unusual in advanced countries. It creates inequities and is costly." In the private sector, basing pensions on 25 years of earnings rather than a full career favors those with fast-growing earnings. Basing pensions on final pay in the public sector is another bad design, he argued, allowing the system to be manipulated with late-career promotions.

Another major flaw in the French

system is the lack of an automatic mechanism for financial balance, forcing governments to take unpopular measures to reduce deficits. France could learn from other countries, the MIT professor suggested. In Sweden, for example, the level of pensions is indexed to life expectancy. In Germany, pensions are reduced if the ratio of pensioners to contributors increases. In Canada, the government must take action to address deficits revealed by regular financial projections.

#### The digital challenge

How can we harness new digital technologies to serve the common good? In the first of two sessions on this topic, TSE psychologist Jean-François Bonnefon joined a panel discussion on the opportunities and threats posed by artificial intelligence, drawing on his cutting-edge research into the morality of self-driving cars. This was followed by a much anticipated debate in which Jean Tirole and the European Commission's Vice President for Competition Margrethe Vestager welcomed European efforts to rein in the power of digital giants like Google, Amazon, Facebook, Apple and Microsoft.

Upcoming regulation will boost the digital economy by creating market openings for smaller players while keeping big tech in check, said the Commissioner. Among other benefits, she noted that platforms will be prevented from hoarding search data or using it against smaller competitors. Customers will also have more choice, able to use different app stores or easily remove pre-installed programs. Levelling the digital playing field will strengthen democracy, she argued: "The rules of the game when we are *offline* will now also be the rules *online*. This is not a slogan anymore. With the Digital Services Act and the Digital Markets Act, it has real muscle."

Existing competition laws are no longer appropriate in Europe, agreed TSE's Nobel laureate. "The old-style regulation doesn't work, because the tech giants are global platforms. Historically, utilities in telecoms or electricity were domestic platforms so you had only one regulator, not hundreds. We also don't follow these platforms along their lifecycle. Google makes a lot of money but we haven't followed all the wannabe Googles and many of those have failed."

**'We are in a crucial moment. It is time for democracies to regulate the digital world, as we have done for finance or the economy'**

Margrethe Vestager  
European Commissioner for  
Competition



**‘We need to invest much more in research to increase the likelihood that, when we have the next pandemic, we’re ready to react rapidly’**

**Michael Kremer**  
2019 Nobel laureate

Regulators also need to step in because platforms’ ad-based models often provide the wrong incentives for moderating content. “They want to keep you interested as long as possible,” said Jean, “and sometimes we are more interested in fake news than the common good. There is the same difficulty with digital addiction. You can supervise the platform’s processes but it’s not easy to give guidelines: for example, you can be anti-vaccine without saying anything

formally wrong. It’s very dangerous for our societies.”

#### Lessons from the pandemic

In the wake of the Covid-19 crisis, what lessons can be learned to reduce the risk and severity of future public health crises? Nobel laureate Michael Kremer (University of Chicago) emphasized that investing in R&D and vaccine capacity now is essential to cost-effective protection. “We’ve built a lot of capacity for mRNA vaccines that could potentially be used for many other things. Let’s make sure that we keep capacity on standby. If that means paying to keep a South African factory open, that’s an expense that’s worth making. The second lesson is we need to invest much more in research to increase the likelihood that, when we have the next pandemic, we’re ready to rapidly test many possible drugs, vaccine candidates and diagnostic devices.”

#### Roadmap for the new president

What are the burning issues in the in-tray for Emmanuel Macron’s second term? To conclude the Summit, three world-class French economists were

asked to offer essential advice to the newly re-elected president.

**1 Climate action** must move to the top of the agenda, urged Jean Tirole, underlining the global consensus among economists in favor of carbon pricing. Recognizing the hostility of public opinion, he called for the removal of “inefficient and unfair” exemptions, support for R&D, compensation for the poorest, and border taxes to prevent carbon-intensive industries relocating to low-tax countries. He also stressed the need to take advantage of low-hanging fruit: “Whether we are for or against nuclear power, it is impossible to do without it. Otherwise, we face disaster for the planet. We are lucky to have this decarbonized energy.”

**2** Echoing his own comments during a session on the return of inflation, Philippe Aghion insisted that boosting **innovation** will be essential if France is to ride out economic turmoil and the green transition. “France has experienced an industrial decline in all sectors since the mid-1990s: our trade deficit will exceed €84 billion in 2021. This reflects a lack of innovation. It is only in nuclear, aeronautics and luxury that we have retained technological leadership.” He called for investment in a new innovation ecosystem, inspired by US research institutions like DARPA

**‘France has experienced an industrial decline in all sectors since the mid-1990s: our trade deficit will exceed €84 billion in 2021. This reflects a lack of innovation’**

**Philippe Aghion,**  
Collège de France

**‘Each euro invested in France must create at least one euro of social value, France is the country in need of public policy evaluation’**

**Christian Gollier**  
TSE Director

and BARDA, and for the research tax credit to target smaller firms.

**3 Pension reform** was another pressing issue, all three experts agreed, advocating an increase in the retirement age. “The alternatives to balance the pension system are to lower benefits or to increase contributions,” said Philippe. “This lowers purchasing power and it’s bad for the economy. The only non-regressive measure is to increase the contribution period.”

Christian proposed a two-pillar reform, with a minimum state-financed ‘solidarity’ pension and a points-based system based on an individual’s decisions about their optimal date of retirement. “After all, the compromise between purchasing power and leisure is a fundamental decision: There are jobs and leisure activities that people are passionate about; other people attach great importance to their purchasing power.”

**4 Inequality** is another ticking time bomb, Jean warned, that requires policymakers to embrace long-term thinking. “Some inequalities in France are relatively well addressed by taxation and social transfers. But our inequality of opportunity is monumental. We must invest in education, training, and learning.” Relatedly, he noted that meritocratic ideals are increasingly under threat. “In many countries, there is a dominant elite that thinks it deserves everything it has earned. Obviously, we are not totally responsible for our family, conditions, or colleagues; there is a whole factor of chance.

This demoralizes those who are not in the elite, creates populism, and justifies the lack of redistribution. Criticism of meritocracy is quite strong; but what can we use instead?”

**5** To rebuild better, France must **spend wisely**. Financial crisis and the pandemic justified the principle of ‘whatever it takes’ but we must now return to reality, said Christian. Budgetary discipline must be combined with carefully designed policies for the common good. “Each euro invested in France must create at least one euro of social value. Today, France is the country of public policy evaluation, but we still have a lot to do.” Public investment must be accompanied by good governance and subject to performance tests, agreed Philippe. “Not all investments are equal,” he added. “There are recurrent and unproductive expenditures caused, for example, by the structural deficit of the pension system, or the territorial ‘millefeuille’. On the other hand, there are useful investments in growth and the ecological transition. If you invest in growth, you increase your ability to pay your long-term debt.”

**‘Whether we are for or against nuclear power, it is impossible to do without it. Otherwise, we face disaster for the planet. We are lucky to have this decarbonized energy’**

**Jean Tirole**  
Nobel laureate



# How to fast-track green transport

Much of the world's population lives in cities choked by traffic and air pollution, with emissions from our cars, planes and other vehicles fueling the advance of climate catastrophe. Meanwhile, the most unfortunate are trapped in poverty by crumbling infrastructure. Does the future of transport hold any light at the end of the tunnel?

This special dossier builds on the ideas explored at this year's Common Good Summit, drawing on the latest research by TSE experts to explore the road to a greener, cleaner future with sustainable growth for all.

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# 'Optimization is key to sustainable transport'

Marc Ivaldi, TSE



**Our transport specialist Marc Ivaldi talks to TSE Mag about his vision of tomorrow's transport, focusing on the urgent need to embrace the green transition. Following his participation in the debate at this year's Common Good Summit, the EHESS director highlights the optimization problems that could be solved using digital technology and data analysis.**

## What are the major challenges in transport economics today?

The major issue is the reduction of greenhouse gas emissions. Emissions from the transport sector are increasing, and represent one third of global emissions.

This is largely due to the disproportionate use of private cars, which is difficult to reduce because of urban sprawl. The distances involved prevent the deployment of simple solutions allowing a switch from individual to collective transport. These are problems of infrastructure and organization.

**'We produce a lot of data, the use of which could allow us to imagine solutions better adapted to the needs of individuals, such as sharing vehicles or infrastructures. The question is: how do we pool this data?'**

Economists propose various solutions, such as congestion charges, which are not much favored by public decision-makers, who generally prefer prohibition through the implementation of low emission zones. These systems are inefficient and generate more inequalities but they are less unpopular.

The other issue is data management. We produce a lot of data, the use of which could allow us to imagine solutions better adapted to the needs of individuals, such as sharing vehicles or infrastructures. For the moment, each mode of transport is managed by a different player, and data interoperability is a major issue. The question is: how do we optimally pool this data?

## You have worked on the impact of the Covid-19 crisis on bike-sharing systems. What are your conclusions?

We studied bike-sharing systems in Toulouse, Lyon and Montreal, with a lot of data at our disposal. It emerges that individuals are willing to use bicycles longer and to go further, provided that the infrastructure is deployed. In Toulouse, for example, the City Council quickly created new bicycle lanes, which generated a clear increase in bicycle use. We observe a real shift in public

## 'Competition authorities must keep closely monitoring the impact of air alliances on prices, as these alliances increase price variances'

opinion in favor of bicycles, which must be supported by infrastructures. It seems obvious to me that tomorrow's cities will have more bike lanes. It's a strong trend.

## How could these systems be improved in the future?

One of the big problems with bike-sharing systems is the station logic. There would be much more flexibility if you could leave the bike anywhere. The problem then becomes different because you have to be able to better manage the flows and the parking areas, as we have seen with electric scooters.

In China, the user is penalized for not leaving the bike in an acceptable zone. This incentive to respect the rules could be interesting insofar as it reduces the number of cases where a cyclist cannot find a place to put the bike.

## What did you learn from the roundtable discussion on the future of urban transport at the Common Good Summit?

The Common Good Summit roundtable highlighted initiatives that seem to show companies are willing to go beyond the current regulation, which is positive news for the fight against global warming.

It may be in the operator's interest to set up virtuous systems because they will have the support of public authorities. It is also important for companies to show that the solutions it proposes can be sustainable. For example, Amazon has highlighted

its desire to decarbonize the last mile using decarbonized modes of transport, a solution not only more virtuous but also more efficient and less costly for the company. Transdev also presented its significant efforts to decarbonize its vehicle fleets, particularly through electric solutions.

## You have worked on the effects of airline cooperation. What are some of the key concerns?

Airline alliances can sometimes be likened to monopolies, which could lead to fears of higher prices. In air transport, people travel via hubs, which lowers costs. This is why the competition authorities have accepted alliances that allow for the sale of cheaper tickets, as they include routes that include hubs.

On the other hand, these alliances also increase price variance, which can make some consumers unhappy, as they pay more than others. Our work offers a warning to the competition authorities, who must keep closely monitoring the impact of these alliances on prices.

## How can the aviation sector contribute to the ecological transition?

Air transport only accounts for 3% of greenhouse gas emissions. Even if this is not negligible, the impact of decarbonization in this sector will necessarily be limited compared to initiatives that could be taken in the automotive sector.

Of course, we still need to look at this issue. We can see the massive demand for air travel at the end of the crisis, which has outstripped supply and infrastructure. This demand will still be there tomorrow, so we can expect a continued increase in greenhouse gas emissions. We can start by optimizing air networks and developing greener flight management. This is an extremely complex issue but we

know that it can be an important lever. The advantage is that the necessary technologies have already been mastered and can therefore be implemented today, provided that they are economically viable. Economists, airlines and flight optimization experts need to work together, and this is what the Institute for Sustainable Aviation (ISA) aims to achieve (see panel).

Another important solution favored by the industry is the development of biofuels. The problem is that their production can have negative consequences in other areas. There are many promising avenues but it is not yet certain that we can really rely on these fuels.

Finally, we can think of a technological breakthrough, such as the hydrogen engine. This requires the production of green hydrogen, which is not yet technically easy. The electric plane could also be a solution for short distances between small airports with a low number of passengers. This could allow the development of networks to connect local territories.

## Institute for Sustainable Aviation - ISA

ISA is a Toulouse-based consortium of research centers whose objective is to develop interdisciplinary or multidisciplinary research projects aimed at proposing solutions to decarbonize aviation.

The project brings together experts in their respective fields. In addition to economists from TSE, engineers from Isae-Supaéro and ENAC, a research team from Météo France, experts from TBS, sociologists from Université Jean Jaurès, lawyers from UT1 Capitole and also a team from CERFACS are participating. This is an unprecedented collaborative adventure in the Toulouse research landscape.



# Can poor countries afford better roads?

Stéphane Straub

Professor – TSE

Lack of investment in transport is stifling development for the world's least fortunate citizens. Together with Marianne Fay (World Bank), new research by Stéphane Straub and David Martimort (TSE) examines whether private finance can jump-start improvements to key infrastructures. Rejecting standard policy narratives, their analysis suggests developing countries should balance private and public-sector strategies.

At current rates of investment, the world's infrastructure gap will not be closed soon. Fay et al. (2019) report annual spending estimates of between 1.9% and 3.5% of GDP for Africa, far below its estimated need of 9.2%. From transport, to jobs, sanitation and electricity, this deficit is derailing efforts to build better futures. When Liberia, one of the poorest countries on Earth, solicited support from the Millennium Challenge Corporation (MCC) to tackle its crumbling road network, its rate of return was deemed too low to justify the investment, let alone attract private investors.

Lebanon is another unhappy example. The tremendous inefficiencies of its energy sector lead to rolling blackouts several hours a day. With prices well below cost-recovery levels, the state electricity company losses generated about half of the national fiscal deficit between 2008 and 2017. Similar inefficiencies plague Lebanon's telecom services and transport network.

With low levels of individual income, poor countries are often unable to charge meaningful user-fees without wiping out demand. At the same time, their governments cannot afford to extend subsidies to substitute fee-based resources. Private finance, international institutions and bilateral donors have so far been unable to bridge the spending gap. In developing Asia, for example, multilateral development banks have contributed just 2.5% to infrastructure investment. Globally,

**'The efficiency of bankruptcy procedures is among the key characteristics correlated with the share of private debt. Ensuring stronger creditors' rights tops the list of desirable policy reforms'**

less than 13% of investment in developing countries comes from the private sector.

### Will private finance come to the rescue?

The hope is that public finance may help to crowd-in private finance through 'blended finance' arrangements. The poster child for this 'billions to trillions' strategy is Turkey, where \$5.6 billion in loans to develop the energy sector, as well as technical and policy assistance, led to 10 times as much in private investments. This happened as Turkey's average incomes increased rapidly.

Other developing countries have been less fortunate. In 2018, an \$11 billion pledge from the international community to invest in Lebanon was supposed to attract at least 35% of these resources from the private sector. However, no such investments have materialized. This is unsurprising in a country where public-private partnerships have been plagued by governance

**'The poster child for 'billions to trillions' strategy is Turkey, where \$5.6 billion in loans to develop the energy sector led to 10 times as much in private investments'**

failures, including corruption, government opportunism and internal division, and the lack of credible creditors' rights or independent regulators.

Reliance on private investors is no simple solution. In fact, this strategy may be hardest in countries and sectors that are most in need of investment. Using World Bank data, we show that the actual share of private debt in our sample of public-private infrastructure projects is only 39%, and varies within countries across projects, but also across countries at similar levels of development. While richer countries like Turkey attract slightly higher levels of private finance, some upper middle-income countries like Lebanon have been quite unsuccessful.

### Lessons for policymakers

The authors develop a model to analyze the feasible level of private finance for infrastructure projects, in which access to outside finance, the extent of cost recovery resulting from regulatory decisions on pricing, and the amount of public subsidy are jointly determined. This highlights key trade-offs. To achieve a sufficiently attractive combination of regulated prices and subsidies, policymakers are often forced to make difficult choices between financial viability and social inclusion.

As well as underlining the need for sufficient levels of demand, the model shows how the feasibility

and desirability of outside finance is affected by the nature of projects and economic and institutional features such as regulatory capacity and corruption. The efficiency of bankruptcy procedures is among the key characteristics correlated with the share of private debt. Ensuring stronger creditors' rights tops the list of desirable policy reforms.

Interestingly, some institutional improvements can make public subsidies more efficient, including those that lower the cost of public funds and improve financial competitiveness. As budgetary pressures and the cost of taxation decrease, it becomes more attractive to rely on transfers rather than user fees. Similarly, more efficient financial markets enhance the sensitivity of finance to regulated prices, resulting in lower levels of private finance and lower prices. Other improvements have more mixed effects. Reduced corruption, greater bureaucratic efficiency, or regulatory quality allow for higher levels of private finance but induce higher prices for the service.

Policymakers should not consider private finance as the only way to close the infrastructure gap. Reforms that aim to improve the business environment are likely to have competing effects. Some will make infrastructure ventures more attractive for private financiers, others will improve public sectors' ability to raise taxes and spend efficiently.

# Green cars: is France's feebate working?

Isis Durrmeyer  
Professor, TSE - UTIC

Cars produce more than half of the transport sector's carbon emissions. At the Common Good Summit earlier this year, TSE's Isis Durrmeyer emphasized the key role of the state in reducing this huge footprint. The purchase of low-emission vehicles is encouraged in France with a rebate ('bonus') of up to €1,000, while buyers of high-emission cars are hit by a tax ('malus') of up to €2,600. Drawing on her newly published paper in 'The Economic Journal', she weighs up the effects of this 2008 'feebate' policy on car buyers, manufacturers, and the environment.

## Why is it important to consider a policy's differentiated impacts on individuals?

Policy evaluation tends to focus on the average or overall impact, but distributional effects can be crucial to public acceptance. For instance, France's "yellow vests" protests began in October 2018 in response to an increase in diesel tax that was expected to have little impact on the overall population but severely penalized suburban and rural households that rely heavily on cars. Distributional effects are especially relevant when a policy favors some individuals at the expense of others. For instance, the 2008 French feebate had a direct effect on households through the amount people spent on cars and the type of vehicles they bought. There is also an indirect effect on air quality. By targeting carbon emissions, the feebate favors diesel cars, associated with higher emissions of the most hazardous local air pollutants: nitrogen oxide (NOX) and particulate matter (PM). The increased emissions of these pollutants are a hidden cost of the policy that my evaluation accounts for.

## How do you measure the success of the French feebate?

I use a structural model to simulate the demand and supply of new automobiles in 2008 in the absence of a feebate, allowing me to predict the prices and car models that would have been purchased. My model represents consumers' preferences for the different car models available. I estimate how their choices relate to various car attributes (power, fuel costs, size, etc.) and prices. By comparing car choices with and without the policy, I can identify the impact of the feebate.

In contrast to standard models, I identify winners and losers by linking gains or losses from the feebate to households' demographic characteristics. On the supply side, I model the pricing strategies of car manufacturers and estimate the marginal costs of all cars proposed on the market. I then measure the potential gains from alternative feebate schemes that achieve the same carbon emissions reduction at the same budget cost as the 2008 feebate, identifying those

**'There is evidence of a shift in public preferences towards low-emission cars in 2008, when the feebate was introduced'**

that maximize consumer surplus, national manufacturers' profits, and the reduction of local pollutants and diesel car share.

## What are your main results?

Balancing consumer surplus and manufacturer profits with the budget cost for the government and the impact on emissions, the policy increased annual welfare by €115 to €119 million. The budget cost of €210 million necessitates an average tax of €23.9 for French households, reducing their overall surplus by €39 million. But their loss is more than offset by an increase of €158 million in the profits of French car manufacturers. If the tax is proportional to income, the feebate achieves some redistribution from the richest to the poorest households. Average carbon emissions from car purchases decrease by 1.6% but annual new car emissions increase. In monetary terms, the change in annual carbon emissions generates a loss of half a million euros. This cost can turn into a benefit when considering that extra new car sales are old car replacements.

The policy may also impact local air quality by pushing the sale of diesel cars. Average emissions of NOX and PM increased, while those of carbon monoxide (CO) and hydrocarbon (HC) decreased. NOX and PM emissions increased most in rich and dense municipalities, where they were initially the lowest, achieving another form of redistribution. However, richer municipalities are associated with

**'The French feebate almost achieves the maximum potential consumer surplus and French car manufacturer profits. Inequalities across individuals and French car manufacturers could be reduced, but at the cost of global welfare losses'**

larger decreases in average emissions of CO and HC.

## Could the policy be improved?

The 2008 feebate almost achieves the maximum potential consumer surplus and French car manufacturer profits. Inequalities across individuals and French car manufacturers could be reduced, but at the cost of global welfare losses. Alternative feebate schemes could target NOX and PM emissions by penalizing diesel. However, such feebates would increase emissions of CO and HC and decrease consumer surplus. To design the best policy, regulators must specify their objectives and the weights associated with each outcome.

I do not model the non-pecuniary side effects of the policy, such as making environmental friendliness a more salient car characteristic. In another paper (D'Haultfœuille et al., 2016), I provide evidence of a shift in preferences towards low-emission cars in 2008, but there is no direct proof that the feebate policy is responsible.

# Iron against carbon: SNCF CEO calls for investment in trains

CEO of the French rail operator, Jean-Pierre Farandou discussed the latest trends in the industry and why trains will be central to the success of the green transition. He emphasized the need for more investments to provide commuters with more options and high-quality services.

**'By taking 10% of the market share from cars and trucks, we would reduce congestion in cities, improving air quality'**

## You recently called for a massive €100bn investment in rail. Why?

The issue is related to the Paris Agreement and the commitments that we must fulfill by 2050 to decarbonize the French economy. During this summer we went through lots of wildfires and heatwaves. This is another reminder that climate emergency is intensifying. To reach our goal, we must collectively reduce CO<sub>2</sub> emissions from the sectors that emit the most, with transport accounting for the largest share (30%). The share of rail is only 0.3%.

**'A trip by TGV in France emits 50 times less CO<sub>2</sub> than one by car. The same is true for energy consumption: a TGV consumes 10 times less energy than a car, and a freight train six times less than a truck!'**

The strategy I am promoting, "iron against carbon", aims to increase the capacity of the rail network to receive more and better trains for passengers and freight. By taking 10% of the market share from cars and trucks, we would reduce congestion in cities, improving air quality. There would be many positive effects. After the TGV (name given in France for high speed train), this is a new stage in regional planning policy in support of the ecological transition.

## How can we increase the use of trains instead of more polluting modes of transport?

We are considering several solutions. First, metropolitan regional express train services could increase the number of daily trains. With a 15-minute train service to the city and its urban area, you could leave your car in the garage or even get rid of it, which would be good for consumer purchasing power. A better signaling system would allow an increase in the number of trains on very busy lines. The extension of the network of high-speed lines in the southern arc of France is relevant, especially if we consider the economic and touristic dynamism of these regions. I am

delighted that the government and local authorities are supporting the extension of the high-speed line to Toulouse. Freight transport by train is also part of the ecological transition and requires network improvements to develop. Improving rail access to ports such as Le Havre and Marseille will encourage a shift from truck to train.

## Our European neighbors have chosen to implement strong tariff incentives. Could this be a solution?

They are not the only ones! We have decided to launch our new "Avantage" card (Youth, Adult, Senior) in 2021, which combines a ceiling on the price of TGV and Intercités tickets with advantageous discounts. We are also innovating with SNCF Voyageurs, which is developing offers to win over new customers, such as the "Ouigo classic train" between Paris-Lyon and Paris-Nantes that has been available since last spring. Obviously, high-speed travel at reduced prices is key to our strategy to make the train more attractive than the road. Ouigo is a model that has been very successful in Spain. Taking the train must be competitive with road travel: this is a European trend (and a necessity).

**'We carried more passengers this summer than in the summer of 2019: 23 million in France, 28 million with Thalys and Eurostar. A new record!'**

**'With a 15-minute train service to the city and its urban area, you could leave your car in the garage or even get rid of it'**

**What kind of railway organization do you imagine for Europe in the long term?**

SNCF is involved in international transport with Eurostar and Thalys, which have now merged into the same company, creating a new European player in sustainable high-speed mobility. Thanks to Lyria for Switzerland and cooperation agreements with Germany's Deutsche Bahn and Austria's ÖBB, SNCF is putting European passenger transport on track.

**'Taking the train must be competitive with road travel: this is a European trend'**

However, we must not forget freight. Rail Logistics Europe, which combines the Group's rail freight activities, provides European connections to many countries from or through France. The development of European freight corridors is a necessary condition for the development of freight. The same is true, from Brussels, of the trans-European transport networks, which are a cornerstone for reducing CO<sub>2</sub> emissions from the transport sector. As in many areas, I would say that national expertises, based on the history and configuration of the networks, must join forces to develop a European vision.

**What are the main trends in the rail industry?**

The industry has a long term horizon, because our trains and, even more so, their infrastructure, are designed to

last. We must therefore "on-board" as many innovations as possible and look far ahead.

Rail has a strong advantage: it is greener by nature. Travelling by TGV in France is responsible for 50 times less CO<sub>2</sub> than one by car. The same is true for energy consumption: a TGV consumes 10 times less energy than a car, and a freight train six times less than a truck! At a time when we are talking about the need for energy sobriety, this is not neutral. Nevertheless, we continue to optimize energy consumption. For example, the new TGV-M will consume 25% less energy. And for regional transport, hybrid solutions, battery-powered trains and even hydrogen engines are at or near maturity.

Innovation is also based on the intelligence provided by the impressive amount of data available

when our trains are running. This data allows us to reduce breakdowns and improve maintenance and service quality. We also need to accelerate digitization of our infrastructure, particularly with centralized network control (CCR). The rail industry must aim to be greener, more "communicative" and more reliable.

**Do you expect demand to increase in the coming years?**

The summer of 2022 showed that there is a strong desire for trains in France and in Europe. We carried more passengers this summer than in the summer of 2019: 23 million in France, 28 million with Thalys and Eurostar. A new record! This is due to several factors: ecological awareness, of course; rising fuel prices that make trains competitive; and the desire to rediscover France, which I am delighted about. Without boasting, I

also see it as the result of our efforts to provide a quality service.

I don't see these various factors changing radically in the years to come, and we spend a lot of time modeling these trends to adapt our transport plan, equipment and investment decisions. This last point is key: to absorb demand, we need an efficient and reliable network. The French network is now twice as old as the German one. If we want to meet this challenge, we must invest.

**Why is economic research important to meet SNCF's challenges?**

We need to go back to simple things: understanding our customers' needs and adapting our transport offer. We conduct in-depth analyses of demands addressed to SNCF and anticipate their effect on offers to passengers.

The SNCF serves both private and corporate customers, local authorities, and the State. Our subsidiaries Keolis and Geodis, world players in passenger transport and logistics respectively, are part of the same dynamic.

In 2022, the need to understand macro-economic developments has become even more important, particularly because of the increase in the cost of supplies, which is impacting our accounts. We also need to understand and anticipate current developments. To this end, we work with external partners to benefit from the best expertise. It is precisely in this spirit that SNCF Réseau teams and a group of TSE economists are working together on the optimal way to adapt the transport offer to different types of demand, as well as on the effects of the ecological transition.

# E-commerce: can we deliver sustainably?

Accelerated by the Covid-19 crisis, the world's online shopping frenzy has swollen the logistical flows of parcels on our transport networks. How can we reconcile the benefits of e-commerce with its environmental costs? This issue was a key concern at the 11<sup>th</sup> Postal Economics Conference, held earlier this year as part of our partnership with La Poste Groupe that spans almost three decades. Here, we highlight contributions from leading decision-makers and researchers at the event.

Helmuth Cremer  
Jean-Marie Lozachmeur  
Estelle Malavolti  
TSE

Digital technology has had ambiguous effects on postal activity: email has driven down mail volumes, while e-commerce has boosted package delivery. As Eric Ballot (Mines ParisTech) pointed out during his keynote address on "E-commerce and sustainable urban logistics," e-commerce continues to scale new heights. In 2019, China's Singles' Day generated \$35 billion in revenue for Alibaba, the equivalent of 6.5 weeks of sales for a giant like Amazon. In 2021, on this day alone, Alibaba raked in \$75 billion in revenue.

The pandemic has reinforced these trends, as demonstrated by two papers presented at the conference.

TSE's Catherine Cazals, Eric Gautier and Nour Meddah, working with Antonin Arlandis (La Poste), found that the mail volumes of Deutsche Post DHL, La Poste Group and USPS would have been higher if the health crisis had not occurred, while parcel volumes would have been lower. Similarly, in a joint publication with Jonathan Pope and Soterios Soteri (Royal Mail), Catherine and her TSE colleague Thierry Magnac found that parcel volumes in the UK would have been 30-50% lower, without the pandemic.

The Covid-19 crisis has also highlighted the central importance of goods delivery services to economic

and social life. Philippe Wahl (CEO, La Poste Group) noted that Amazon is now both La Poste's top customer and its top competitor. While it has encouraged innovation in the sector, Amazon escapes the social and fiscal obligations of traditional postal operators. Laure de la Raudière (President of Arcep, the French telecoms and postal regulator) added that e-commerce platforms' distribution networks often cherry-pick profitable delivery areas.

Yufeng Huang (University of Rochester) presented her research on the more immediate consumer gains from shopping online. Using data on the Dutch clothing sector between

**'If consumers could observe the level of emissions generated by delivery of their online purchases, their "environmental awareness" would provide operators with an incentive to reduce market inefficiencies'**

2007 and 2018, during which time the share of online spending increased from 5% to 25% and the average distance consumers travel in a quarter to buy clothing fell from 25km to 10km, she estimates that online shopping for clothes represented a monthly gain of €38 for Dutch consumers: 52% of this is attributable to reduced transport costs, 45% to greater variety of products and 3% to increased purchasing power.

Yet these consumer gains seem unlikely to outweigh the environmental costs. Consumers who benefit from the convenience of e-commerce are often the first to complain about its negative externalities such as congestion, pollution, noise, accidents, and loss of natural habitats. As Eric

**'Between 1988 and 2004, the average weight of goods shipments fell from 160kg to 30kg. Today, it is closer to 5kg'**

Ballot observed, the external costs generated by EU freight amounted to €203 billion in 2016. Online shopping also often results in returns, enlarging the footprint of each unwanted parcel.

Logistics flows continue to increase and fragment in response to demand for faster delivery and the multiplication of supply chains and distribution channels. Between 1988 and 2004, the average weight of goods shipments fell from 160kg to 30kg. Today, it is closer to 5kg. Such statistics also ignore the large volumes of empty space transported. This fragmentation of flows and the race for speed have led to a sharp increase in the use of light commercial vehicles, up 69% between 1990 and 2018.

Multiplying the number of cargo bikes will not solve problems on this scale, warned Eric Ballot: more industrial solutions must be implemented. To reach net-zero objectives, we must change the way we consume and transport goods. This requires improving our knowledge of the flow of goods; using technology wisely ("smart deliveries", exploitation of real-time data via high-performance algorithms, development of new

delivery solutions); and seeking economies of scale and synergies by consolidating flows and interconnecting networks.

Several papers presented at the Toulouse event also emphasized the need to increase consumers' awareness of the environmental impact of their decisions and, if necessary, to take measures to change their behavior. Consumer information is particularly important, TSE's Helmuth Cremer, Jean-Marie Lozachmeur and Estelle Malavolti suggest in a joint publication with La Poste economists Claire Borsenberger and Denis Joram. If consumers can observe the level of emissions generated by delivery of their online purchases, their "environmental awareness" provides operators with an incentive to reduce market inefficiencies. Regulatory intervention is therefore unnecessary – except possibly to guarantee the transmission of reliable information on emission levels – if consumers value the environmental damage generated by their consumption. Then, an emissions tax will be needed to reflect the marginal social harm that consumers underestimate.

# Wishful thinking

Roland Bénabou  
on our motivated biases



**‘There are identifiable situations when organizations faced with a bad situation will make it worse, and even ultimately fail, through collective, contagious denial’**

Roland Bénabou is the 2021 laureate of the Jean-Jacques Laffont Prize in Economics, organized annually by TSE and the Mairie de Toulouse. Before receiving the award at Toulouse city hall, the Princeton professor gave a lecture at TSE explaining how people are prone to motivated biases, setting us apart from purely rational beings, but also from imperfect automata. Here, he discusses his work with TSE Mag.

## Why do humans indulge in wishful thinking?

“Wishful thinking” is related to psychological concepts including motivated beliefs, motivated reasoning or motivated cognition. It refers to a set of belief and decision distortions that are not primarily the result of the brain being an imperfect computer, or humans being imperfect statisticians and strategists.

Instead, it arises because certain beliefs carry either a hedonic value (being pleasant or unpleasant), or an instrumental value that allows us to achieve some further goals. As a result, people want or do not want to believe certain things, depending on

how reassuring or scary, productive or unproductive, those beliefs are for them. The theories I have been working on, and the many experiments being done by others in this area, can help identify the different strategies that we engage in to arrive at those subjective beliefs, as well as the underlying motives.

## When facing a catastrophe, why do some groups enter into denial?

It doesn't always happen, of course, but the “groupthink” model I wrote about points to conditions under which individual denial is more likely to become socially contagious. Let us start from the evidence that there are situations in which a person may want to look away from the

facts, or even put their head in the sand. Whether these attitudes are contagious or not depends critically on how I am impacted when others around me adopt them, and in particular ignore warning signals.

For example, if you and I are engaged in a collective project and there is some bad news about its likely return that you ignore or downplay, you will keep working and investing in it. If your effort remains a public good from which I still benefit, this makes a not-so-great reality easier for me to face. If, on the contrary, your blind perseverance is a public bad, because it magnifies my expected losses or risks, then facing that reality



becomes so scary and demoralizing that I will instead join you in denial. The moral of the story is that there are identifiable situations when organizations faced with a bad situation will make it worse, and even ultimately fail, through collective, contagious denial. This is more likely to happen when actors' stakes are interdependent and exit is difficult, so that it is hard for anyone to avoid the negative consequences of others' delusions. A closely related situation is when membership in an organization, or participation in a market, involves very illiquid assets, be they social or financial.

**This collective denial you're talking about brings the anti-vax movement to mind?**

Motivated beliefs are clearly at play here at the individual level, and most likely collectively. Symptoms of such distorted cognitive strategies include

an asymmetric and often "heated" response to good versus bad news, or just an unwillingness to look at any real data. Both movements are replete with such attitudes.

We even see a strong association between anti-vax beliefs and political extremism, mostly on the right in the US, but from both right and left in Europe. There is denial of evidence,

**'If you read economics journals today, there are numerous theoretical, empirical and experimental papers in which agents display major departures from classical notions of rationality'**

unwillingness to look at data, unjustified discounting of scientific expertise, and conversely extreme trust in fake news and quacks. Thus, motivated beliefs are clearly intertwined with motivated political beliefs at the individual level.

Regarding vaccines, for instance, the more people deny that Covid is real, the more it and variants will spread, so the more likely I am to be affected even if I take precautions. This is a clear-cut case where the delusions of some harm everyone else, because of the externality. If you are surrounded by Covid deniers, you are fairly likely to catch it no matter what, and you may not like to think much about that objective risk. The alternative is to wishfully believe that Covid isn't real. But as a result, you also don't take precautions, don't get vaccinated, etc. This increases the hard-to-mitigate risks for others around you, pushing them to also

**'If you are surrounded by Covid deniers, you are fairly likely to catch it no matter what, and you may not like to think much about that objective risk'**

deny that Covid is real, and so on. So not just the virus, but also denial of its reality becomes contagious. We see the same logic at work regarding global warming. If enough citizens think it's not a big problem, then nothing gets done politically, and since there is little anyone can do on their own, the problem keeps worsening. So either you reconcile yourself to a very bleak future for you and your children on this Earth, or you "choose" to believe that it's not real, or not such a dramatic issue. The more people embrace that belief, the scarier and more ineluctable climate-change prospects and the associated costs become. Hence, again, the greater the temptation to ignore and deny that bleak reality.

**Why have these biases only recently been analyzed in economics?**

In the mid-1970s, the prevailing framework was that people are rational, both in micro and in macroeconomics. This premise remains broadly dominant, but since

the late 1980s the "behavioral" view has become increasingly influential, as evidence from multiple domains continues to accumulate. If you read economics journals today, there are numerous theoretical, empirical and experimental papers in which agents display major departures from classical notions of rationality.

Within that behavioral literature itself, a lot of the emphasis was first placed on "cold" biases and heuristics, reflecting pure cognitive limitations and largely unrelated to psychological needs and desires. Because of our brain's very limited capacity for mathematical computation, we make systematic mistakes in reasoning probabilistically and strategically, mis-applying Bayes' rule in particular, and we often use convenient mental shortcuts that can sometimes go very wrong.

More recently, there has been a growing focus on motivated thinking and biases: distortions that happen because, consciously or unconsciously,



**'Jean-Jacques Laffont was an intellectual giant. We are all walking in his footsteps'**

people seek beliefs that can help them achieve certain goals, or feel better in the short run, or both.

**What does it mean to you to receive the 2021 Jean-Jacques Laffont Prize?**

It is, first, incredibly humbling: Jean-Jacques was an intellectual giant. We are all walking in his footsteps, including in the extensive use of information economics and incentive theory throughout this "second wave" of behavioral economics, and in always closely linking formal theory with empirical relevance. Second, it has a very deep personal resonance. Jean-Jacques' visionary institution-building made possible the years I spent visiting Toulouse, during which my research agenda with Jean Tirole on these and other topics started and grew. It is also during those Toulouse years that Jean-Jacques and Colette became wonderful friends of our family, and these memories will last forever.

# The power of AI

César Hidalgo  
Center for Collective  
LEARNIng Director,  
ANITI



César Hidalgo has been working on applied machine learning for 15 years, unlocking the power of data to better understand economic development. The Chilean-Spanish-American researcher pioneered the field of 'economic complexity', arguing that prosperous societies are those able to make more sophisticated products. After nine years as head of MIT's Collective Learning group, he now leads the Center for Collective Learning at the Artificial and Natural Intelligence Institute (ANITI) in Toulouse.

**'When judging machines, we're more harsh regarding accidents involving physical harm, and more forgiving in some key moral decisions, such as those involving fairness or discrimination'**

**Your latest book 'How Humans Judge Machines' examines the ethics of artificial minds. What are the main conclusions?**

The book asks how we judge machines compared to humans. One of the key differences is that we use different moral philosophies to judge machines and humans. We use a philosophy focused on outcomes, for machines, and one combining outcomes and intentions for humans. That's why we tend to judge machines more harshly in accidents involving physical harm, and also, are a little bit more forgiving of machines in some key moral decisions, such as those involving fairness or discrimination.

**How do you see artificial intelligence (AI) evolving in the coming years?**

The development of AI today involves relatively specialized applications. This year alone, we have seen several new language models and multiple image generation demos. These models are large and complex to

develop, and thus, involve a new business model of AI as a service (AlaaS). This is because these models are hard to replicate but easy to sell through the web. This also includes less flashy examples where some of the same providers develop private AI solutions for banking and real estate. So the way I see AI in the coming years is through the development, validation, and scaling of various application niches.

**In 2018, you talked about the possibility of AI-backed digital democracy. How do you expect that to evolve in the future?**

I proposed the idea of augmenting citizens through AI so they could participate directly in a larger number of democratic decisions. If we know enough about someone's political preferences, we can build a representative avatar that could augment democratic participation. That idea seemed very futuristic at the time but sometimes things happen faster than expected and there have been a few interesting

developments since then. For example, in 2019, during the Chilean and Lebanese revolutions, we launched online participation platforms that allowed people to collaborate in organic direct democracy exercises. With Carlos Navarrete, who is now a PhD student at ANITI in Toulouse, we collected more than seven million preferences from over 100,000 people that we have been using to explore the mathematics of augmented participation.

**What can you tell us about the work of ANITI in Toulouse?**

The Institute has an interesting perspective on AI, focusing on a hybrid approach combining statistical approaches with formal logic and mathematics. The Institute's perspective adds diversity to the AI research ecosystem and might provide solutions that are hard to get through statistical approaches. The key challenge is to be able to build bridges between the different ways to think about AI.