Application NBER Digital Economics and AI Tutorial: **Romain Rossello** (HEC Paris)

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Background

I am a fifth year PhD student in the Finance department of HEC Paris. I work under the supervision of Pr. Bruno Biais and my main research interests are Decentralized Finance (DeFi), cryptocurrencies and applications of AI in Finance. My thesis is entitled "***Three essays on Decentralized Finance and Cryptocurrencies***" and my committee is composed of Bruno Biais, Johan Hombert and Paul Voss. Prior to being a Finance PhD student, I got a Master of Science in Deep Learning and Statistical Modelling from Télécom SudParis (IP Paris) which taught me how to implement Machine Learning algorithms from Deep Learning models to NLP algorithms which I use in my research.

Coursework

I started my PhD in 2021 and during my first and second year as a PhD student I followed general courses in economics and financial economics such as Microeconomics, Game Theory, Macroeconomics, Econometrics, Corporate Finance (theory and empirical), Asset Pricing (theory and empirical), Social Choice and voting, Market Microstructure and Dynamic Corporate Finance. I also took more specialized classes aligned with my research interests such as "Economics of Blockchain" given by Pr. Bruno Biais or a Decentralized Finance and stablecoins by Pr. Simon Mayer.

After the coursework phase of my program, I attended summer schools more specific to my research interests. In order to learn about AI applications to finance I followed the 2023 CEMFI Summer school on Machine Learning in finance given by Pr. Ansgar Walther. I also attended the 2024 and 2025 summer schools given by the Crypto and Blockchain Economics Research Forum (CBER) both organized by Pr. Agostino Capponi and Pr. Fahad Saleh. These summer schools allowed me to grasp what research was being done at the frontier by the key researchers in the Blockchain economics and DeFi literature.

Research agenda and current projects:

Since its inception in 2009, blockchain technology has evolved into a major infrastructure system for payment settlement. Underlying blockchain technology is a shared digital ledger technology which securely tracks money transactions and ownership records. All information is available online at any time and cannot be changed. These characteristics make blockchains highly trustworthy and particularly valuable for financial intermediation services such as trading, lending, and borrowing. The financial intermediation services which use the blockchain infrastructure are also known as Decentralized Finance (DeFi). Estimates by the Boston Consulting Group suggest that the DeFi market currently has a $600 billion market size, and it is predicted to grow to $16 trillion by 2030. A key particularity, which stems from the fact that DeFi is implemented on blockchains, is that it provides novel, high frequency and extremely granular data which goes beyond what is normally observable in financial economics.

My thesis seeks to give an answer the following research questions:

1. *How are DeFi organizations different from traditional finance firms?*
2. *Can newly available DeFi data help us answer financial economics research questions?*

One major difference between DeFi organizations and traditional finance firms which I study in my thesis are their governance structures. Most DeFi organizations are organized as Decentralized Autonomous Organizations (DAOs). Through the emission of a governance token (alike shares), those platforms aim to have their users extremely involved in their governance. In other words, this new form of digital governance aim to heavily reduce management delegation. As opposed to traditional corporate governance, DeFi DAOs' governance proposals are very high frequency, easily accessible through a website by tokenholders, and address a very wide array of subjects from developers compensation to marketing campaigns, from mergers and partnerships to whether audits should be conducted. Even though this digital governance structure is designed differently, the objective remains the same as in traditional finance: maximizing profits. Although digital governance may improve minority tokenholders representation in governance, it is however unclear whether, without any regulation, it does not also enhance agency conflicts in governance, which would greatly hinder those benefits.

In the first chapter of my thesis, **"Blockholders and strategic voting in DeFi DAOs' governance"**, I ask whether we can identify vote level evidence of agency conflicts in DeFi DAOs and whether these agency conflicts affect the DeFi DAOs values. By gathering highly granular vote level data and using a triple difference-in-difference identification strategy, I causally show that agency conflicts negatively affect the DeFi DAOs value. The first times there are strategic voting occurrences trigger an -8% to -12% drop in weekly cumulative abnormal returns of the DeFi organizations' tokens. Notably, the mechanism behind these events are information releases about potential conflicts of interests in governance as those negative returns are only seen following first occurrences of strategic voting (and not subsequent occurrences). I also show that votes from blockholders are associated with positive abnormal returns, a finding which resonates with what is expected from corporate governance theory (Edmans 2014). Lastly, I use NLP algorithms (namely aspect based sentiment analysis which is sentiment analysis focused on the local context specific to certain words in a given text) in order to show that information release about agency conflicts in DeFi DAOs which advertised decentralization and righteous management in their governance text have an exacerbated negative effect on returns. Overall I bring forward that, although the governance structure of DeFi organizations is very different from the governance of traditional finance firms, the agency conflicts present in these new DeFi DAOs are reminiscent of what is predicted by traditional corporate governance theory. One additional finding of this first chapter is that DeFi DAOs governance data are actually a valid laboratory to study corporate governance, and this laboratory benefits from highly granular high frequency data with more variation than traditional corporate governance datasets. It can therefore be used to give a first answer to corporate governance theories which otherwise could not be tested. It is also a great counterfactual environment in which there is no regulation and complete freedom to contract among tokenholders.

In the second chapter of my thesis, **"Voting Delegation, Agency Conflicts and Market for Corporate Control in Digital Governance"**, with co-authors Michele Fabi and Valerie Laturnus we develop a dynamic model of governance for decentralized platforms which we plan to structurally estimate in the later steps of the paper. These decentralized platforms may be DeFi DAOs as discussed earlier but also blockchains or Fintech firms for which the governance structure is an indirect shareholder democracy. The literature on Tokenomics has focused on why would agents hold governance token in the first place, putting forward two reasons: cashflow rights of the tokens or convenience yields of the tokens when using the platforms. However the voting right aspect of holding tokens has been neglected. Although this is still a nascent project, the contribution of this paper is to explicitly and thoroughly model voting in digital governance

through a voting subgame. Our paper aims at highlighting the two frictions which undermine the efficiency of DAOs' governance when it is organized as indirect shareholder democracy, namely, adverse selection of new voting delegates which can be malicious and attack the platform as well as the hidden actions of the voting delegates which can increase the probability of attack when their compensation are not an increasing function of their effort. We put forward important hurdles which decentralized platforms encounter in having an efficient market for corporate control. Our model also generates key stylized facts from the data on voting delegation in Blockchain DAOs such as cyclicality of the platforms productivity growth and counter intuitive effects of high initial effort by voting delegates.

My two other projects are respectively on decentralized stablecoin issuers and their allocation of revenue, and on the value of voting rights that governance token may have depending on the governance proposals which is to be voted on. In addition to using new extremely granular DeFi data with, these projects will also use AI methods, respectively reinforcement learning and LLMs which I currently am learning to implement for broader use in answering financial economics research questions.

I am really looking forward to learn more about digital economics and AI through this tutorial and the conference as well as engaging with professors and researchers which are really at the frontier of these new research subjects.

Thank you in advance for considering my application,

Romain Rossello