DATA 5690: Final Project

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Introduction

Blah, blah, blah

Question 2.

Fintech is traditionally defined as a combination of finance and technology based on big data, machine learning and artificial intelligence, and cryptocurrencies and blockchain technologies. The economist Xavier Vives as defined fintech as follows:

> *"Fintech may be understood as the use of innovative information and automation technology in financial services. New digital technologies automate a wide range of financial activities and may provide new and more cost-effective products in parts of the financial sector, ranging from lending to asset management, and from portfolio advice to the payment system."*[1]

We note that the data scientist Jordan, Michael I. (2019) (see also) has argued for a definition of data science as a new and emerging engineering discipline that rests upon three foundational pillars:

- **1.** The *inferential* from probability and statistics.
- **2.** The *algorithmic* from theoretical computer science.
- **3.** The *social-institutional* from economics.

We have argued that the third pillar should be rightly conceived of as the catallactics of the exchange paradigm from the Austrian tradition of economics. Make the strongest case you can for this latter claim for fintech as a specialization of data science in the Jordan sense with obvious ties to financial markets and institutions. Why is an economic theory that focuses on

[1] https://blog.iese.edu/xvives/files/2018/02/EE_2.2017.pdf#page=99

process and which explicitly incorporates the entrepreneurial role and institutional evolution required? What are the greatest limitations for the theory of catallactics in this role? Is it possible to extend or augment catallactic theory to overcome these limitations? How?

Question 2.

Throughout this course we have argued that the focus on *market process* and the *entrepreneur-as-arbitrageur* is the key strength of callactic theory to serve as a fundamental theory underlying fintech. At the same time, we have noted that perhaps the greatest limitation of catallactics in serving this role is its weak foundation in probability theory. We have offered the subjective Bayesian derivation of probability due to Bruno de Finetti as a possible way to augment catallactic theory to provide the missing foundational probability theory. Ludwig von Mises - one of the founders of catallatics - emphasized the essential role of monetary calculation by the entrepreneur as the central driver of the market process. See Horwitz (2004) and Steven Horwitz (1998).

Discuss the possibility of Mises' monetary calculation as the necessary institutional foundations for de Finetti's derivation of subjective probability. Can we properly understand de Finetti's derivation of probability as a catallactic theory? See Nau (2001). Is the Dutch Book Theorem a catallactic theory resting upon Misesian microfoundations? See also Pressacco and Ziani (2010).

Question 3.

Christopher L. Culp and Merton H. Miller (1995b; see also Christopher L. Culp and Merton H. Miller 1995a) provide an academic defense of Metallgesellschaft Refining & Marketing's (MGRM) energy hedging strategy based upon the research of Holbrook Working. Their defense of MGRM rests on an understanding of their hedging strategy as dynamic arbitrage called *synthetic storage* as an example of what Working called *carry-charge hedging*. Outline the basics of this strategy. What financial contracts were traded? How? (*Hint:* you should know the difference between a stack-and-roll hedge vs a strip hedge and why it matters).

At the heart of MGRM's strategy was the creation and maintenance of novel long-term delivery contracts for heating oil and natural gas. Propose an interpretation of this strategy as a real-world example of what Nobelist James M. Buchanan has referred to as *creative arbitrage*. How does this strategy depend upon Misesian-Hayekian-de Finettian microfoundations? Do you find this explanation compelling? Why or why not? Defend your position with logic and evidence.

The following additional resources should be helpful (all available on Canvas):

- Christopher L. Culp and Merton H. Miller (1995b) *Metallgesellschaft and the Economics of Synthetic Storage*
- Christopher L. Culp and Merton H. Miller (1995a) *Hedging in the Theory of Corporate Finance*
- Buchanan (1964) *What Should Economists Do?*
- Buchanan (1979) *Chapter 4 - General Implications of Subjectivism in Economics*
- Buchanan (1979) *Chapter 5 - Natural and Artifactual Man*
- Buchanan (1979) *Chapter 16 - Retrospect and Prospect*
- Buchanan, James M. (1982) *Chapter 2 - The Domain of Subjective Economics: Between Predictive Science and Moral Philosophy*

Question 4.

Stephen Craig Pirrong (1997) strongly criticizes MGRM from the perspective of neoclassical (mainstream) finance theory. Pirrong's critique is based upon an understanding of hedging as exclusively defined as minimum-variance hedging for risk mitigation purposes only. Pirrong classifies MGRM's strategy as wildly "speculative" from this perspective.

- **(a)** Pirrong's argument rests on a strong econometric foundation by which an optimal minimum-variance hedge ratio is derived. His model is called *Backwardation-Adjusted GARCH* or *BAG*. Pirrong provides plots of the dynamics of the hedge ratio over time in Figures 1 – 3. Comment on these dynamics. What is the pattern?
- **(b)** Pirrong's critique rests upon the frequentist tradition of specifying a "corrrect" model for the data-generating process. Discuss this modeling philosophy. Do you find Pirrong's empirical findings compelling regarding a specification of the true model? Are there any issues such as overfit, numerical instability, unreported competing model specifications, etc that might cause you to be skeptical? Discuss (especially in light of our discussion of Leamer, Edward E. 1978 and his concept of the *Axiom of Specification*). Has Pirrong taken the *con* out of econometrics?!
- **(c)** In the conclusion of his paper Pirrong invokes Bayes' Rule (presumably via the Dutch Book Theorem) to suggest strong doubt regarding the possibility of MGRM's possession of an informational advantage to support an arbitrage view of their hedging strategy. Why do you think he does this? How does it connect to the reported (frequentist) econometric methods in the paper? Is there a Bayesian interpretation of these methods? If so, why didn't Pirrong simply provide a full Bayesian model? Do you find his argument convincing? Why or why not. Defend you answer with logic, evidence, and probability and econometric theory.

You may also find the following additional resources helpful (all available on Canvas):

- Culp (2004) *Chapter 14 - Hedge Ratios*
- Murray (1994) *The Drunk and Her Dog: An Illustration of Cointegration and Error Correction*
- Leamer, Edward E. (1978) *Chapter 1*
- Leamer, Edward E. (1983) *Let's Take the Con Out of Econometrics*
- Leamer, Edward E. (2010) *Tantalus on the Road to Asymptopia*
- Stephen Craig Pirrong (1997) *Metallgesellschaft: A Prudent Hedger Ruined, Or a Wildcatter on NYMEX?*

Question 5.

Stephen Craig Pirrong (1997) makes the compelling claim that whether or not MGRM's strategy was successful as Christopher L. Culp and Merton H. Miller (1995b) claim cannot be determined on an a priori basis but is instead an empirical question. Bollen and Whaley (1998) take this claim from Pirrong as their point of departure for their analysis. However, rather than proposing a definition of optimal hedging and imposing it upon the MGRM, Bollen & Whaley take Culp & Miller's claim at face value and evaluate the empirical success or failure of MGRM's strategy based on their own self-reported metric.

- **(a)** Is Pirrong guilty of *lecturing birds on flying*? Why or why not? Defend your position with logic, evidence, and theory.
- **(b)** Interpret Bollen & Whaley's *simulating supply* model in the light of Poirier (2011). Can you interpret Bollen's & Whaley's analysis as *approximately Bayesian*? How so? Compare and contrast this approach to Pirrong's approach. How are they similar? How are they different? Can we understand the resulting simulated profit and loss distribution of MGRM's hedging strategy as a Bayesian posterior predictive density? Interpret this in light of Pirrong's rational Bayesian. Do the empirical findings of Bollen & Whaley strengthen or challenge Pirrong's Bayesian claim?
- **(c)** Using the MLE estimates reported in Table B simulate 5k sample paths of the Bollen & Whaley model for heating oil. Plot the histogram. Discuss how to next add the hedging analysis and determine if MGRM's strategy was successful. Just describe the latter - no need to fully simulate it!

Question 6.

In this class I have made the case for an Austrian market process theory augmented by the subjective probability theory of Bruno de Finetti as the necessary economic foundations for fintech in the sense of Jordan, Michael I. (2019). In this question you will be asked to evaluate this claim.

- **(a)** De Finetti famously wrote: ***"PROBABILITY DOES NOT EXIST"***! Interpret this statement. What are the consequences for neoclassical economic theory if we take de Finetti's proposition seriously? What are the consequences for Austrian catallactic theory?
- **(b)** Buchanan and Di Pierro (1980) claim that decision theory (even in its subjective form) is too rigid and inflexible to model creative and entrepreneurial choice. In what situations do Buchanan & Di Pierro think decision theory applies? Do you agree with Buchanan & Di Pierro?
- **(c)** Explain the difference between the paradigms of parametric vs predictive inference. Why does this matter for entrepreneurial choice? What does it have to do with economic calculation?
- **(d)** Harper (2010) made a unique (Austrian!) argument for understanding numerical toolkits as economic institutions. Does this help build a bridge between the Austrians and de Finetti? Why or why not? If so, how?
- **(e)** Lachmann (1976) made the case for extending the Austrian subjectivism of Mises and Hayek to economic expectations. He suggested that G.L.S. Shackle was the one who made this case best. What if, instead of Shackle, Lachmann had chosen de Finetti as his representative of subjective expectations? How would Austrian economics have developed differently?
- **(f)** Can we make the case for *"From Mises to de Finetti?"*
- **(g)** Does probability exist?

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