

THE ROLE OF THEORY IN FINANCE RESEARCH

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OUTLINE

- 1. Theory, Empirics, and Mathematical Formalism**
- 2. The Success of Mathematical Formalism in Finance: Four Examples**
- 3. Critiques and Challenges**
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THEORY, EMPIRICS, AND MATHEMATICAL FORMALISM



THEORY VS. EMPIRICS

- We tend to divide research in finance into two categories:
Empirical and theoretical
- With this in mind, questions often arise whether theory is useful
- But I find the tension to be false in many ways
 - There are strong complementarities between the two
 - The importance of theory is not really disputed by anyone
 - It would be difficult to think of empirical papers that are not motivated by theory or interpret the results based on theory
 - Everyone who writes and thinks about finance – including policy makers, legal scholars, journalists, and commentators – has theories
 - No one bases their view of the world only on empirical facts
- What is distinctive of our theories is the **mathematical formalism**
- Hence, the real question to ask is whether mathematical formalism has been helpful in the development of finance theory

WHY DID THE DISCIPLINE EVOLVE TO MATHEMATICAL FORMALISM

- Mathematical modeling is a language to explore questions in economic and finance
- Compared to verbal arguments, in a formal mathematical framework, there are clear **assumptions and rules**
- These are aimed at making the **analysis more precise** and providing **finite answers** using mathematical proofs
 - There is less hand waving...
- Of course, model conclusions can be challenged with a different model, e.g., by extending the framework or changing the assumptions
- Still, the precision and clarity of each model's conclusions is maintained

WHAT ARE MATHEMATICAL MODELS TRYING TO ACHIEVE

- Models are meant to be **simplified versions** of the real world
 - The real world is too complicated and cannot be captured in a model
- Models try to make a point, develop an insight, in a setup that is:
 - Simple enough to convey the clarity of the insight
 - Rich enough so that the analysis feels relevant
- Hence, models are by definition limited
 - Simplifying and focusing are considered important attributes
 - Even if they take us away from the real world
- After some evolution, models can also be **connected more naturally to the data**



THE SUCCESS OF MATHEMATICAL FORMALISM IN FINANCE: FOUR EXAMPLES



MODIGLIANI-MILLER

- In a frictionless world, **capital structure is irrelevant**, that is, the total value of the firm does not depend on how it finances itself, and in particular not on the choice of debt and equity
- This result **overturned common intuitions**
 - Many used to say that firms benefit from having debt because debt is cheaper than equity
 - Indeed, cost of debt is lower than the cost of equity since debt is less risky
 - But, what matters is the overall cost of capital, and it turns out that, absent frictions, it is independent of the capital structure
 - The key is that there is an opposite force that exactly offsets the first one, according to which higher debt will increase the risk of equity (and existing debt) and their costs

MODIGLIANI-MILLER – CONT'D

- Merton Miller explained the intuition as follows:
 - “If you take money out of your left pocket and put it in your right pocket, you’re no richer. Reporters would say, you mean they gave you guys a Nobel Prize for something as obvious as that? And I’d add, Yes, but remember, we proved it rigorously.”
- This is not very flattering to mathematical formalism in finance
- But the result is actually a remarkable example of the importance of mathematical formalism
- Without mathematical analysis it was not clear that the two effects offset each other
- Many did (and still do) believe that debt is beneficial because it is cheaper
- **Mathematical analysis proves this intuition to be wrong**

MODIGLIANI-MILLER AS A BENCHMARK

- Various assumptions behind these path breaking results:
 - Investors and firms can trade the same set of securities at competitive market prices equal to the present value of their future cash flows
 - There are no taxes, transaction costs, or issuance costs associated with security trading
 - A firm's financing decisions do not change the cash flows generated by its investments, nor do they reveal new information about them
 - There are no bankruptcy costs
- If assumptions are unrealistic, why is this interesting?
 - **It is a benchmark**
 - It shows us how basic intuition is misleading
 - It forces us to think what factors make capital structure relevant

CAPM

- The CAPM is based on two premises, which are well understood:
 - There is a tradeoff between risk and return
 - Diversification reduces risk for a given return
- It is the combination of these premises in an equilibrium framework that yields an unexpected insight:
 - The expected return on an asset should depend only on the sensitivity of the asset to the market portfolio (**beta**)
- When we analyze returns, we can ignore many things and focus on beta, which is a **sufficient statistic** for determining an asset expected return
 - This is an early example of the use of the sufficient statistic approach in finance

CAPM – CONT'D

- The CAPM theory had and continues to have huge impact on the field of finance
 - It impacted decades of empirical studies in asset pricing and also the practice of investment management and corporate finance
- Like the Modigliani-Miller theory, the CAPM is based on various assumptions that preclude frictions
 - Hence, it is well accepted as a benchmark
- It has also been shown repeatedly in the data that it is partial and misses many factors that affect return
- But despite these issues, CAPM is still widely used for evaluating stock returns and cost of capital
 - Partly because it is a **simple and intuitive approach**

BANKING AND BANK RUNS



A run on American Union Bank, 1931

BANKING AND BANK RUNS

- Diamond and Dybvig provided a framework to help us understand **why banks exist and why they are fragile**
 - Even though banks and bank runs have been around for many years, the answers to these questions were elusive
- In the model
 - Banks allow economic agents to benefit from the fruits of long-term illiquid investments while having access to short term liquidity
 - Hence, they provide **risk sharing** among agents who do not know if they are going to need early liquidity
 - The problem is that in order to do that banks' balance sheets must exhibit a **liquidity mismatch**
 - Then, if people think that others will run, they should run as well
 - This generates self-fulfilling runs in equilibrium, also known as **panic**

BANKING AND BANK RUNS— CONT'D

- The power of this model is that it provides a **tractable framework that captures these forces**, using the logic of game theory
 - Formalizing the preferences for liquidity and generating a precise notion of panic run as a bad equilibrium where people run because others run
- This formalization allowed researchers to study the forces behind bank runs in a more disciplined way and gave rise to many follow-up papers that pushed the framework to understand different questions about banks, bank runs, and the policies surrounding them
- In 2023, this has been recognized by the Nobel prize, and the background material described their contribution as follows:
 - “Diamond and Dybvig’s theoretical insights about the importance of banks and their inherent vulnerability provide the **foundation for modern bank regulation**, that aims to create a stable financial system.”

INFORMATION AND TRADING

- Papers by Grossman and Stiglitz or Kyle provided frameworks to help us think through the **trading process in financial markets**
 - How are prices formed? How does information get into prices? How informative prices are?
- These are critical questions that come up when we acknowledge frictions in financial markets: asymmetric information, strategic behavior of traders, etc.
- Grossman and Stiglitz formalized an equilibrium where:
 - Some traders are informed and some are learning from prices
 - Prices are only partly informative due to the presence of noise, and so informed traders have an advantage that justifies the cost of information production
 - The **equilibrium level of informativeness** can be analyzed as a function of parameters
 - They provide an alternative to the dominating notion at the time that markets are efficient

INFORMATION AND TRADING – CONT'D

- Kyle uses a game-theoretic approach that
 - Formalizes price setting by market makers
 - Analyzes strategic trading by speculators who wish to maximize their profit from information
- His work lays the foundation for **market microstructure literature**
 - It is known for providing a **measure of liquidity**, Kyle's Lambda, that has direct empirical counterpart
 - Hence, there are many empirical follow-ups building on this framework
 - It is also widely used in practice among market participants and policymakers

SO WHAT DID WE ACHIEVE WITH MATHEMATICAL FORMALISM?

- **Modigliani and Miller:** precise result about capital structure that overturns common intuitions
- **CAPM:** sufficient statistic for expected returns with direct implications for measurement
- **Banking and Bank Runs:** models capturing the notions of liquidity provision and panic and guiding financial policies
- **Information and Trading:** models analyzing market liquidity and price informativeness and guiding market practice
- Overall,
 - Formalism in finance research is widely accepted, and there is no real attempt to go back to verbal analysis
 - Yet, we should perhaps emphasize the benefits more clearly...



CRITIQUES AND CHALLENGES



THE PRETENSE OF KNOWLEDGE

- Caballero (2010): “Macroeconomics after the Crisis: Time to Deal with the Pretense-of-Knowledge Syndrome”
 - *“What does concern me about my discipline, however, is that its current core—by which I mainly mean the so-called dynamic stochastic general equilibrium approach—has become so mesmerized with its own internal logic that it has begun to confuse the precision it has achieved about its own world with the precision that it has about the real one.”*
- Criticism against macroeconomic framework “**fine tuning**” quantitative predictions instead of engaging in “**broad exploration**”
- Good news: Corporate finance models are considered “broad exploration”

CHAMELEONS

- Pfleiderer (2020): “Chameleons: The Misuse of Theoretical Models in Finance and Economics”
 - *“A model becomes a chameleon when it is built on assumptions with dubious connections to the real world but nevertheless has conclusions that are uncritically (or not critically enough) applied to understanding our economy. As will be discussed below, I call these models chameleons because they change colours in order to avoid having their assumptions subjected to appropriate scrutiny.”*
- Theory is very flexible and many models can be written; which one should we believe?
- People might overuse some models to make their favorite points, not conducting proper assessments of **how plausible their ingredients are**

REFLECTING ON CRITIQUES

- Do we have an issue with **pretense of knowledge** in the literatures of corporate finance, financial intermediation, financial markets?
- Possibly Yes. While these models are more about mechanisms, ideas and intuitions and less about magnitudes, once we stick to a paradigm we tend to get too obsessed with its internal rules and logic, and then **forget about the real world**
 - When this happens, the models might become chameleons
- Some thoughts:
 - Perhaps not all compensation practices need to be explained with optimal contracting approach
 - Or existing market mechanisms are not necessarily coming out of a mechanism design approach
 - We should consider the plausibility of the ingredients that go into the models
 - We should consider deviations, new equilibrium concepts, behavioral biases, bounded rationality

HOW TO JUDGE A THEORY PAPER

- There are three dimensions to evaluating a theory paper
- **Assumptions**
 - Are the assumptions plausible? Do they correspond to what we know about the behavior of people or the structure of institutions?
- **Analysis**
 - Is there value added from the analysis? Is there distance between assumptions and results? Is there a clear intuition?
- **Predictions**
 - Are the predictions coming out of the model plausible? Do they match evidence we have from the real world?
- It is great if a paper scores high on all three dimensions, but that might be difficult

HOW TO JUDGE A THEORY PAPER – CONT'D

- There is a tendency to put a large weight on the third dimension and insist the results are empirically validated
 - Friedman's view that a theory is successful if it predicts what we see in the real world
- But this can generate very bad theories
 - **Reverse engineering** leads to assumptions that are implausible
 - **Minimal distance** between assumptions and results
- I would vote for **plausible assumptions and insightful analysis**
 - Plausible assumptions: why start from something different?
 - Insightful analysis: why have a model otherwise?
- If the results seem counterfactual, we need to think why
 - Maybe they capture a truth that is covered by other things
 - Maybe there is a puzzle that opens the door for more explorations

THE MYTH OF EMPIRICAL IMPLICATIONS

- Empirical implications are overweighted in the evaluation process
- Instead, theorists should argue for **empirical relevance**, which is a broader concept
- Even if papers are **not immediately testable** or not immediately consistent with empirical facts, the logic they convey can be valuable
 - Especially if the paper passes the test of plausible assumptions and value added from the analysis
- New avenues for empirical testing can be revealed in the future
 - The burden should not be on the author of the theory paper to come up with such avenues

THE CHALLENGE WITH THEORY PAPERS

- Theorists often feel there is a **paradox in demonstrating the value of a theory paper**
 - If the intuition is clear, then why do we need a model?
 - If the intuition is not clear, then the model has a problem
- There is truth to that: there is a delicate balance in developing a new good paper
- But it is **not less difficult to innovate in empirical work**
 - Burden of showing a new empirical result
 - Identification challenges
 - Internal validity vs. external validity
 - The grass is not necessarily greener on the other side...



OPPORTUNITIES FOR THEORY RESEARCH



BANK RUNS ARE BACK



Silicon Valley Bank, Twitter-Fueled Bank Run, 2023

RESPONDING TO NEW DEVELOPMENTS OF FAMILIAR PHENOMENA

- New developments of familiar phenomena provide new questions for researchers
- Suppose that in the wake of Silicon-Valley-Bank run you want to understand the new developments
 - For example, is Twitter really making banks more fragile?
- One avenue for research is to **get data and do empirical analysis**
 - Not that easy: limitations on data availability, no exogenous source of variation
- Another avenue is to go to **existing modeling frameworks** and **introduce new ingredients** in them to try and understand emerging phenomena

SOME NEW PHENOMENA APPEAR TO TRANSFORM THE WORLD

- There is intense public interest in several issues with significant implications for finance
- Understanding them requires new theories, either building on existing frameworks or coming up with new ones
- Understanding modelling innovation is always a challenge
- **Artificial Intelligence (AI)**
 - How are markets going to change when machines take over?
 - But what is the difference in a model between humans and machines?
- **Big Data**
 - How does the change in information technology affect financial-market dynamics?
 - But how do we model new information technology? In a model, a signal is just a signal...
- **ESG**
 - How are ESG investors different from traditional ones?

SOME OLD PHENOMENA STILL STRUGGLE FOR FORMALISM

- Different concepts are widely discussed in practice, but capturing them in a theory model is difficult
- For example:
 - **Corporate culture**
 - **Trust**
- Creative approaches to formalizing such notions can go a long way to improve our understanding of them, analyze them, and guide the empirical work
- Think about how theories of financial panics, market liquidity, etc. elevated the discussions and analyses of these issues

THEORY IS NEEDED FOR NORMATIVE STUDIES

- We do not do enough normative analysis in finance
 - Going back to the point that what we see is not necessarily optimal
- **Normative analysis** relies crucially on theory
 - Utilizing our models to think more about normative questions provides many opportunities
- Consider the **sufficient statistic approach**
 - Using theory to tell what objects in the data are needed to measure cost and benefit of different policies
- This is a promising direction to take theories more in the direction of **real-world impact**



PERSONAL REFLECTIONS AND CONCLUSIONS



CONCLUSIONS

- Theories in finance and economics evolved to **mathematical formalism**
- This approach had **significant successes** in finance
 - Sharpening and refining intuitions
 - Guiding measurement and empirical work
 - Shaping policies and work in practice
- There are **critiques and challenges** forcing us to think about what is good theory and where we bring more value
- There are **great opportunities** ahead trying to capture new phenomena and continue the path of past achievements

REFLECTIONS FROM PERSONAL JOURNEY

- I often approached my own theory work by bringing together plausible/interesting ingredients and exploring the implications in a model
 - As opposed to building a model in order to explain an empirical phenomenon
 - For example:
 - **Financial panics and global games**
 - **Feedback from market to firms' decisions**
- I got into empirical work by thinking through simple implications of models and how they might manifest themselves in data
 - This is the comparative advantage of theorists
 - For example:
 - **Exploring investment sensitivity to stock price and how it is related to price informativeness**
 - **Exploring how liquidity mismatch in funds or banks leads to stronger response of outflows to bad performance**

FINANCE THEORY GROUP

- Finance Theory Group has been critical for the promotion of finance theory
- It is essential to have forums to meet and discuss details of models
- Relation to data is important, but should not come at the expense of advancing the craft of building and analyzing models
- The summer school has been a central development of the finance theory group, helping to bring young scholars to the frontier
- **Big thank you to the team in University of Washington for carrying it forward!**