AI BASED PERSONAL FINANCE AND INVESTMENT CALCULATOR

EFFECT OF COMPUTERS ON THEORETICAL ECONOMIC MODELS

A Thesis Prospectus
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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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General Research Problem: Validity and Application of Theoretical Economic Models

Can advancements in computing increase our confidence in economic models used in critical decision making?

Economists are generally concerned with understanding human behavior regarding the production and consumption of resources. Understanding the motivations, patterns, and effects of this behavior can help inform policy, corporate decision making, and effective personal finance. Quality of life for many people, especially low- and medium-income individuals in capitalist economies such as the United States, is inextricably linked to their material circumstances. Those who understand investment, economic growth, movement of money, assets, debt, and equity, may be able to improve their relationship with money and thus maximize their financial quality of life. The general topic of this prospectus is to analyze how technology, specifically computing, has impacted this understanding, and how this understanding impacts the real world.

Computing capabilities have advanced exponentially since the advent of personal computing, the internet, and our new world of interconnectedness. This drastic change in our technology has had major impacts on the theoretical models of many fields, including biology, physics, and chemistry. The impact of computing advancements on social sciences, such as psychology, sociology, and economics, is not as immediately clear. Understanding how computing has impacted the field of theoretical economics, specifically in the development and perception of theoretical models, provides more context as to how the field has evolved recently, how the validity of these models has been challenged, and how they've responded. This is the topic that my STS research paper will seek to address.

More confidence in the models that are applied to personal finance, such as models concerning returns in the stock market, gives us more confidence in the outcomes of personal finance related decisions. This allows us to make better decisions to achieve the outcomes we want. Thus, if computing can be used to further validate and verify crucial economic and financial models, these models can then be more confidently used by computer algorithms to reduce poor financial planning and improve decision making for humans. My technical project will be an attempted application of this idea by using AI and applied economic and financial models to offer personal finance advice.

Technical Research Question: AI Based Personal Finance and Investment Calculator

How can algorithms based on economics models be used to improve human personal finance decision making?

Personal finance is often a source of anxiety for individuals. In 2023, for every age group, there were more respondents claiming they were worse off financially compared to a year ago than respondents claiming they were better off (YouGov, 2023). Of all countries in the world, the United States has the highest price-adjusted median disposable income (OECD, 2023). However, attitudes about personal finance remain negative and most Americans are living paycheck-to-paycheck (Wronski, 2023). The extensive reasons for this are outside the scope of this project, but finance decision making appears to be one of them. Americans have extremely high levels of average credit card debt compared to other countries (Kumok, 2023) and only 61% of Americans own any form of stock, including through retirement accounts; this number is much lower for people of color and less educated, lower-income, and younger individuals (Jones, 2023). The

motivation of this project is to simplify the human decision-making process regarding personal finance and reduce the enigma of money to something approachable, understandable, and easy.

Currently, personal finance software exists in abundance. These apps have positive outcomes, allowing individuals to better track and maintain their finances. For example, Mint, one of the most popular personal finance apps, can aggregate information from various bank accounts, loan notes, and income sources and combine this with budgeting tools, visualizations, and lists of investment and loan firms. However, these apps generally only aggregate information without offering decision making help (such as which securities to purchase, or if it's the right time to buy a house). This is a gap in the current personal finance software space that my project will attempt to fill.

My app will provide more specific "advice" based on the user's financial situation: income, expenses, long term goals, investment horizon, and current portfolio. This advice, to be as objective as possible, will be well-researched and based on existing economic and financial models, such as the Capital Asset Pricing Model (which relates expected return to risk) or the Efficient Market Hypothesis (which addresses portfolio returns compared to the whole stock market). Specifically, the app will start by allowing users to specify an investment budget, assets and liabilities, and employer information (mainly income, taxes, and retirement benefits). This will help the app build a picture of the user's financial situation and capabilities. Then, the user will enter information about planned retirement age, medium and long-term financial goals, and risk tolerance. Finally, the app will build an investment plan. This will include timelines for paying off debt, building savings, and investing in stocks or bonds. Machine learning (an AI technique that trains a computer to recognize patterns) will be used to analyze and predict the risk and return of various securities for use in advice, and a large language model (an AI model that can act as a chat bot) will be used to allow the user to ask questions about the advice they've been given. I will judge the success of my project based on how confident the users of the app are in the advice given to them, and whether that advice creates a tangible improvement in users' financial situations.

To build this app, I will work within a Git repository. I will use Python to write the logic and the web application will be built using Django, a Python web framework. I will start by building the app such that it runs in a terminal window, without building the web page. This will allow me to focus on how the app collects and processes user information without worrying about the specifics of the frontend user interface. I will develop first the initial collection of user information, followed by developing the machine learning model to be used for determining recommended securities, followed by an integration of ChatGPT's API to talk to the user. I will then finish by building the Django web app, which will take all the technical aspects of the project that I've built and put it in a clean user display. Over the course of development, I will work in two-week sprints, attempting to finish a major feature every two weeks. The specific features will be determined at the start of each sprint, but this will force me to develop the project within a reasonable timeline.

Effect of Computers on Theoretical Economic Models

To what extent have better computing capabilities impacted the development and perception of economic and financial theories?

Understanding how better computing capabilities have impacted the development and perception of economic and financial theories will allow us to analyze which models will further benefit from more computing capabilities, and what we can do to apply our advanced computing

capabilities to other economic models to further verify them. This will increase our overall understanding of the true nature of the economy in the long run and allow us to more accurately use these models to inform our behavior. These models are critically important because economic models are used by central banks to set important monetary policy (like setting interest rates and printing money) that affects the whole world, and private financial institutions use them to make decisions about what to do with our money. The perception of these models is also important to understand because institutions will only apply models that they believe in, and the economy is well known to be a "self-fulfilling prophecy" in which the perception of the economy affects its performance (Petalas et al, 2017). In this paper, I will explore how and to what extent the perception, development, and application of different fields of theoretical economics in different areas of society has changed because of advancing computing technology.

While modern versions of what we would consider computers were invented in the mid-20th century, practical large-scale computing didn't take off until the 1980s and 1990s. Before this large-scale computing was popular and available, economists were either hand-crunching economic models or using punch cards with basic computation machines. Many computationally intense models at the time, like Keynesian and General Equilibrium models, lost popularity after computing took off (Backhouse, 2017). However, some other models became popular in the 90s and early 2000s that did benefit from having large-scale computing: agent-based modeling and game theory. Agent-based modeling is an approach to economic models that, rather than attempting to model the general system, attempts to model the individual actors in the system and aggregates their behaviors and interactions with each other to deduce the overall behavior of the system. Game theory is a similar field of theoretical economics that attempts to model real-world scenarios as a "game," and economists attempt to find equilibriums and optimal strategies in these economic scenarios that dictate behaviors. Game theory and agent-based modeling are both limited by the power of computing, so advancing computation has contributed to the popularity and effectiveness of these models.

The current academic literature surrounding the impact of computers on economics has primarily concerned applied economics. This is significant because applied economics will use computers differently: primarily for data analysis. For example, an NBER journal discusses the impact of machine learning on economics (Athey, 2019), and primarily focuses on estimating the impact of policies in the economy, new methods of analyzing text and images, and its use in economic statistics. While computing's impact on applied economics is an interesting topic on its own, it is heavily studied already and the relationship is more obvious, so this paper will instead focus on theoretical economics.

However, some literature exists covering theoretical economics as well. "It's Computers, Stupid!" (Backhouse, 2017) covers both theoretical and applied economics and makes some important points about the impact of computers on theoretical economics: namely that computers have transformed applied work significantly more than theoretical work. However, this source does not consider any social factors, like different actors or networks, that might contribute to an uneven adoption of computing in economic theory. This source also fails to cover in-depth the general reasons that computing has had a limited impact on theoretical economics, which I will attempt to cover. Other sources, such as "Computational social science: Obstacles and opportunities," (Lazer et al, 2020) do go more in depth as to the causes of the failure of computing to transform social sciences. This paper does not cover economics specifically, but some of the issues and recommendations can be applied to economics. However, it does not discuss in depth the aspects of theoretical economics that *have* been transformed by computation,

like game theory and agent-based modeling. This is an important context that my paper will include.

Thus, the current gap in the literature is a comprehensive understanding of the parts of theoretical economics that were transformed by computation and the parts that weren't and the specific reasons that some fields were transformed while others were not. Additionally, the existing literature does not consider the social actors that mutually shape and are changed by the advancement in computing technology or how the change in perception and application of these models might be different across social groups like academia, the public, and regulatory bodies. This paper will attempt to address these concepts to analyze the social shaping of technology and economic theory.

I will make use of some existing theoretical frameworks to do this. A descriptive lens through which to view the social implications is through the diffusion of technologies (Rogers, 1962). This framework can be applied to analyze the rate at which new technology spreads to different parts of society. I will try to use this framework to analyze how certain theoretical fields, like biology and chemistry, have been impacted more by advancing computation than social science fields like economics. I will also try to use actor-network theory (Rodger et al, 2009) in my analysis of how different social groups (such as academics, the public, and government bodies) interact with each other, computers, and theoretical economics.

My method to research and write this paper is to look at literature over the last 50 years and identify to what extent advanced computing power has played a part in the research done and policies adopted. The extent to which computing power affects different pieces of research will be determined by the nature of the theoretical research done and to what extent this research could have been done without the advancement of computing. The last 50 years will be analyzed because computing was initially created slightly before this, and large-scale computing didn't take off until the 1990s, so this range of time will allow me to analyze how the research has transformed during the development of computing. To limit the scope of the paper, only select papers will be covered from each era, and they will be selected by how well they appear to represent the economic theoretical research done around that time.

Conclusion

From the STS research project, I hope to shed more light on the relationship between computing technology and theoretical economics. This information will show us how we can continue to advance the field of theoretical economics using computing technology and let us learn how we can validate and verify certain economic models. This knowledge can be applied to real-world decisions and projects to maximize our financial and economic well-being, a key determinant of a nation's quality of life, by allowing us to know how much confidence to place in economic models that we rely on. This is what my technical project attempts to do: use economic and financial theories to inform financial decision making. Developing this project will be a good test of the value of applying these theoretical models to the real world. In this way, my STS research paper and technical project are two parts of a mutual sociotechnical shaping: my STS paper covers how computing technology can be applied to economic theory, and my technical project covers how we can apply economic theory and computing technology to make a societal difference. Further research can continue to build on this topic by further investigating how we can use developing technology to positively impact theoretical economics and further technical work may make use of more economic and financial theories to inform decision making in other areas, like monetary policy or corporate finance.

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