EXPERIENTIAL OVERVIEW OF DEVELOPING FINANCIAL INFRASTRUCTURE SYSTEMS TO SERVICE SYNDICATED LOANS

FINANCIAL TECHNOLOGY'S IMPLICATIONS ON CAPTIAL MARKETS, FREEDOM, AND RISK

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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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Syndicated Loans and New Financial Intermediaries

Large organizations like governments and corporations constantly require funding for new projects and existing operations. A company may be looking to undertake a new promising, yet costly, research initiative or a government may be in need of financing for construction of a new bridge or other piece of infrastructure. Alternatively, a business may be in a down period and need funding simply to cover its operating costs. Often these organizations receive this funding in the form of a *syndicated loan*, a lending agreement whereby a group of lenders, called a syndicate, pools together their money and lends to a single borrower so as to distribute the risk of borrower default across the syndicate. As a consequence of the reduced risk, syndicated loans tend to involve very large sums of money in each transaction (Segal, 2023). These loans comprise a significant portion of the borrowing activity of organizations and thus the financing available in the United States. The Shared National Credit Program, an interagency program between several government regulators to review syndicated loan activity, reports that in 2022 syndicate loan commitments amounted to $5.9 trillion (Shared National Credit Program, 2023). Consequently, the financial intermediaries which orchestrate and issue these loans play a powerful role in determining economic, technological, and societal development, as they decide which investment opportunities get to use society's savings (Beck, Levine, & Loayza, 2000). Furthermore, research has shown that financial development is greatly correlated with economic growth (Morck, Deniz Yavuz, & Yeung 2011).

Because of the complex, pooled structure of syndicated loans, one member of the syndicate acts as the administrative leader, the *agent*, by collecting interest payments from the borrower and distributing them among the lenders in proportion to their commitment. Agenting these syndicated loans over the course of their often long maturity requires a large and sophisticated

software system and associated database to track payments and commitments. As one of the largest commercial banks in the world, J.P. Morgan Chase & Co. frequently acts as the agent on syndicated lending transactions. To effectively perform this role, the bank uses a software system called Loan IQ, which is developed and maintained by financial software company Finastra. Though the core software is external, the bank develops and utilizes many proprietary software add-ons to Loan IQ. For each syndicated loan deal that J.P. Morgan agents, the credit agreement, the contract that lays out the terms of the loan, is input into Loan IQ. As interest accrues and other routine events occur over the life of the loan, Loan IQ updates its database, reports income to the accounting system, and prepares payments to be distributed to other lenders. For a variety of reasons, loans may need to be updated in the system to reflect changes in the agreements between the borrower and lenders. Such updates frequently causes issues with the system, which, when discovered, are resolved by J.P. Morgan's Loan IQ users team.

Yet, recently the prominence of traditional banking activities has declined in favor of alternative methods of saving and investing (Allen & Santomero, 2001). Financial technology (FinTech) companies like the commission-free stock trading and investing app Robinhood, have arisen as new financial intermediaries. These companies often claim to "democratize" finance, yet they tend to use dubious business practices and obfuscate financial risks to their users (Tan, 2021). Thus, the infrastructure and practices of both novel and traditional financial intermediaries deserve thorough consideration for both their wide-reaching impact on societal growth and their influence on the freedom and risk of individuals.

Developing a Software System for Financial Infrastructure

This technical project analyzes the development and implementation of a software tool to identify and report errors in J.P. Morgan Chases's Loan IQ database that prevent the software from accruing interest on syndicated loans. The tool was developed to replace an existing but unutilized functionality within Loan IQ with the goal of reporting system errors to the users that resolve them in the form of a convenient and clear dashboard. As a result, the system had several requirements. Primarily, the software needed to present the comprehensive list of database errors, as those not included in the dashboard would go unresolved and potentially result in significant losses for the bank. By its nature, the software system needed to inferface extensively with the LoanIQ database to detect errors and it needed to update periodically to reflect the frequent changes to the database. Finally, it needed to present the errors it detected in an easily readable format that would provide sufficient information for resolution.

The software system was constructed to replace and overhaul a functionality of Loan IQ known as the accrual exceptions report. Loan IQ generated this report as apart of its interest accrual process, adding an error message to the report file each time it encountered a loan that it failed to accrue interest for. However, the formatting and design of both the error messages and the report itself made it virtually unusable for the purpose of correcting the errors in the database. Loan IQ published the report in the form of a comma-separated values file, which simply contains data values separated by commas, with the error message and the time the error occurred. The errors messages themselves were opaque and difficult to parse, as they provided only very basic information regarding the error-causing data and its location in the database. Moreover, very little documentation detailing the behavior of the report was available, which is a common challenge with legacy software (Srinivas, Ramakrishna, Rao, & Babu, 2016). Yet, this

report still proved useful, as to develop the new software system the methodology of *White-Box Modernization*, which involves understanding and restructuring an existing system to preserve its functionality in a new system while augmenting other attributes, was utilized. This methodology allowed the new system to maintain the comprehensiveness of the report, while redesigning its lacking aspects (Comella-Dorda, Wallnau, Seacord, & Robert, 2000).

The familiarity of users with existing technology factors greatly in their willingness and ability to adopt new technologies (Zhao & Nakatani, 2023). Thus, the new software tool was designed to reflect existing tools and to fit in with users' workflows. Because Tableau, a business analytics software, was already well understood by users, it was used to implement the dashboard. Furthermore, the dashboard was embedded directly into the web page that users employ for much of their activity. These choices allow for easier adoption of the tool, as they do not require users to go out of their way to access and learn the software.

At a high level the purpose of the software is to shield J.P. Morgan Chase and its stakeholders from the risk of losing money and standing as a result of operational errors. Beyond the bank and its stakeholders, operational errors may negatively impact financial markets as a whole, as research has shown that agent bank reputation in the syndicated lending market influences the costs of loans to borrowers (Godlewski, Sanditov, & Burger-Helmchen, 2012). As FinTech companies continue to play larger roles as financial intermediaries, they are presented with additional responsibilities to their stakeholders and broader markets.

FinTech and Technological Citizenship

Despite rapid growth and wide-reaching impact, many people doubt the trustworthiness and practices of FinTech companies (Aitken et al., 2020). This phenomenon can be analyzed

through the lens of *technological citizenship,* a framework developed by Philip Frankenfeld which extends the traditional concepts of the social contract and citizenship to technology. In his article *Practicing Technological Citizenship,* Clinton J. Andrews (2006) states that some of the rights of technological citizens include "access to knowledge," "informed constent," and "reasonable levels of risk exposure." He also lists some associated duties: "achieving technological literacy," "engaging with the problems of the day," and "protecting the civic good." He supports these assertions by referring to the work of Rousseau and the American founding fathers about the rights and duties of citizenship and providing examples of how technological citizenship is simply the application of those ideas to the new domains established by technology.

FinTech companies engage in practices that confront the rights and responsibilities of technological citizens. For instance, Robinhood requires no minimum deposit to open a trade and provides a free stock for signing up to the platform, which encourages inexperienced consumers to invest, perhaps while unaware of the associated risks (Mao, 2021). Furthermore, Robinhood receives compensation for routing client orders to asset wholesalers in a practice known as *payment for order flow,* which may incentivize Robinhood to encourage its consumers to trade more than is in their best interests (Bryzgalova, Pavlova, & Sikorskaya, 2022). This incentive also extends to options contracts, an even riskier form of investment that has been shown to offer poor returns to individual investors (Bauer, Cosemans, & Eichholtz, 2009). With these practices, Robinhood could be exposing its users to greater risk than they are aware of and in doing so violating their rights as technological citizens to informed constent and reasonable levels of risk exposure.

Many FinTech companies engage artificial intelligence and data analytics as core aspects of their business model, however usage of these methods requires vast amounts of data. Therefore, these companies must monitor and extract data from their consumers in order for their business to operate (Cao, Yang, & Yu, 2021). Sadowski (2019) argues that the nature of data causes such data extraction to be performed without regard for ethical concerns. In the context of technological citizenship, an individuals right to informed consent may be violated by the mining of their data without their knowledge of its potential usage.

FinTech companies also provide services that can be seen to facilitate and support the rights and duties of technological citizens. By providing access to financial markets to many new retail investors, Robinhood provides opportunities for individuals to learn about finance and trading that previously proved too expensive. Technological citizenship affords individuals the right of access to knowledge and in researching retail investors, Fjesme (2020) found that they tend to receive better returns as they grow in experience, indicating that they are gaining knowledge through engaging with markets. Moreover, Fisch (2022) argues that engaging with capital markets encourages citizens to engage with civic issues like corporate accountability and regulation.

Research Question and Methods

The impacts of FinTech's growth on individuals and retail investors are reflected in the financial markets to which FinTech companies connect consumers. With this logic, the question follows: how has the proliferation of financial technology among consumers influenced capital markets by altering the financial freedom and risk taking behavior of individuals in the United States?

The United States's equity markets (the stock market) are the among the most liquid and efficient markets in the world, thus changes to the assets being traded or the investors trading them are quickly reflected (Kolchin, Podziemska, & Song, 2023). Therefore, FinTech's influence on retail investors' behavior should be reflected materially in the stock market. To explore this connection, I will perform correlation analysis on the Chicago Board Options Exchange's Volatility index, known as the *VIX*, and monthly active users data reported by Robinhood to determine effect of the introduction of FinTech-influenced retail investors in the stock market on expectations of stock market volatility. The VIX is an index created by the Chicago Board Options Exchange to represent the stock market's expectations of the size near-term price changes. Consequently, the VIX gauges stock market sentiment for volatility in the next 30 days and measures fear or flightiness of investors (Kuepper, 2023). Should FinTech promote hidden and excessive risk among novice investors, this volatility measure would be expected to increase as those investors participate more in the market. Along with its quarterly financial results, Robinhood reports its active monthly users, which I will use as a measure of the influence of FinTech on retail investor behavior. FinTech and its practices impacting the volatility of capital markets demonstrates the influence of FinTech on individual investors and as a result the financial system as a whole. Better understanding how FinTech influences these areas could assist in potential regulation of the industry and its practices.

Conclusion

Financial infrastructure and systems have wide reaching impacts on the economy and individuals. The expansion of financial technology companies has altered the way many consumers interact with financial markets, and, as a result, influenced the way financial practices

should be understood with respect to an individual's rights. Yet, regulation has not yet adapted to these changes. I expect my research to show that FinTech's opening of financial markets to inexperienced retail investors and its practices encouraging excessive uninformed risk-taking have increased the volatility of capital markets. In any case, however, more research will certainly be necessary to identify the specific practices and business models that cause FinTech's influence or lack thereof that my research identifies.

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