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Career Competencies: Infusion in the Undergraduate Economics Courses

Natalia V. Smirnova*

ABSTRACT

This paper addresses the integration of big data analysis with the exploration of career choice decisions at a college level. The instructional module which consists of two assignments that could be implemented as classwork or as homework in any undergraduate course is shared. This module was piloted in several undergraduate economics courses. The results from the pilot show that (1) the module helped students navigate their career path by making meaningful data-driven decisions; and (2) students (a) gained confidence in working with big data, and (b) utilized data-driven approach for career choice exploration.

INTRODUCTION

National Alumni Career Mobility (NACM) Annual Report 2022 states that significant career mobility equity gaps exist in the categories of race, gender, first generation, and age. (NACM, 2022, 5). The evidence shows that 82% of respondents decided on their career during college or after graduating. Yet only 47% agreed that their institution helped prepare them for their career and only 21% agreed that their institution invested in their career. (NACM 2022, 5) This data indicates a disconnect between respondents' career decision making processes, and the availability and utilization of campus resources to assist with career decision making and preparation. (NACM 2022, 5)

Receiving helpful career advice during an undergraduate degree is a significant contributor to educational satisfaction as well as to career pathway preparation. It plays an important role in economic mobility and career satisfaction. The first step in career preparation is understanding the skills and competencies that are desired in the workplace. The National Association of Colleges and Employers (NACE) developed eight career competencies that are adopted nationally. These competencies are career and self-development, communication, critical thinking, equity and inclusion, leadership, professionalism, teamwork, and technology.

Competency development is essential for students as they prepare for a successful transition from college to career. The extent to which students hone competencies has real-life implications on equitable outcomes. Recent NACE (2021) data point to employers hiring decisions emphasizing competency proficiency, more so than GPA when considering who to hire. Therefore, there is a need to integrate competencies into students' experiences.

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Currently, colleges and universities are advocating intentional infusion of competency-based student learning into the curriculum and co-curriculum—all with the goal of fostering student success and career readiness. (NACE, 2021)

One of the sources of career advice for students is faculty. According to the NACM survey (2022), 89% of respondents reported faculty’s advice as being helpful to their careers. This is much higher than “receiving helpful career advice from career services” and “networking with employers”, which was mentioned by 75% of respondent and 41% of respondents respectfully. (NACM 2022, p.17.)

Faculty also can intentionally integrate career readiness in their courses’ student learning outcomes. Therefore, faculty emerges as a high impact leader in helping students bring skills from the classroom to the marketplace.

This paper shares the instructional module that was used, as a pilot, in several Economics courses at a state university. Using data from the Bureau of Labor Statistics (BLS) Occupational Outlook Handbook, students explore their major and career choice. Since this module can be implemented in any classroom at any institution, the importance and versatility of this research cannot be overestimated.

LITERATURE REVIEW: PROBLEMS AND SOLUTIONS

NACM Career Mobility Annual Report (2022) identifies Six High Impact Career Practices which significantly positively impact career mobility and equity. (NACM 2022, p. 5). Table 1 demonstrates that “Learning critical thinking” and “Receiving helpful career advice from faculty” are reported to be the most helpful to the career progression by around 90% of respondents. (NACM 2022, p.17)

Table 1: Engagement in High Impact Career Practices

<i>NACM High Impact Career Practices</i>	<i>Percent of Respondents Reporting It Being Helpful to their Careers</i>
Helpful career advice from employer	92%
Learn critical thinking	90%
Helpful career advice from faculty	89%
Receiving helpful career advice overall	83%
Helpful career advice from career services	75%
Internship related to current career	61%
Understanding career opportunities	54%
Networking with employers	41%
Creating a career plan	40%

Source: NACM 2022, p.17.

From the evidence presented in Table 1, faculty emerges as a high impact leader in helping students bring skills from the classroom to the marketplace. There are many ways that career competencies could be integrated into coursework. The competencies could be match with learning objectives, assignments, lectures, and field experiences. The main goal is to deliberately make and articulate connections between the curriculum and the skills that are being built through it.

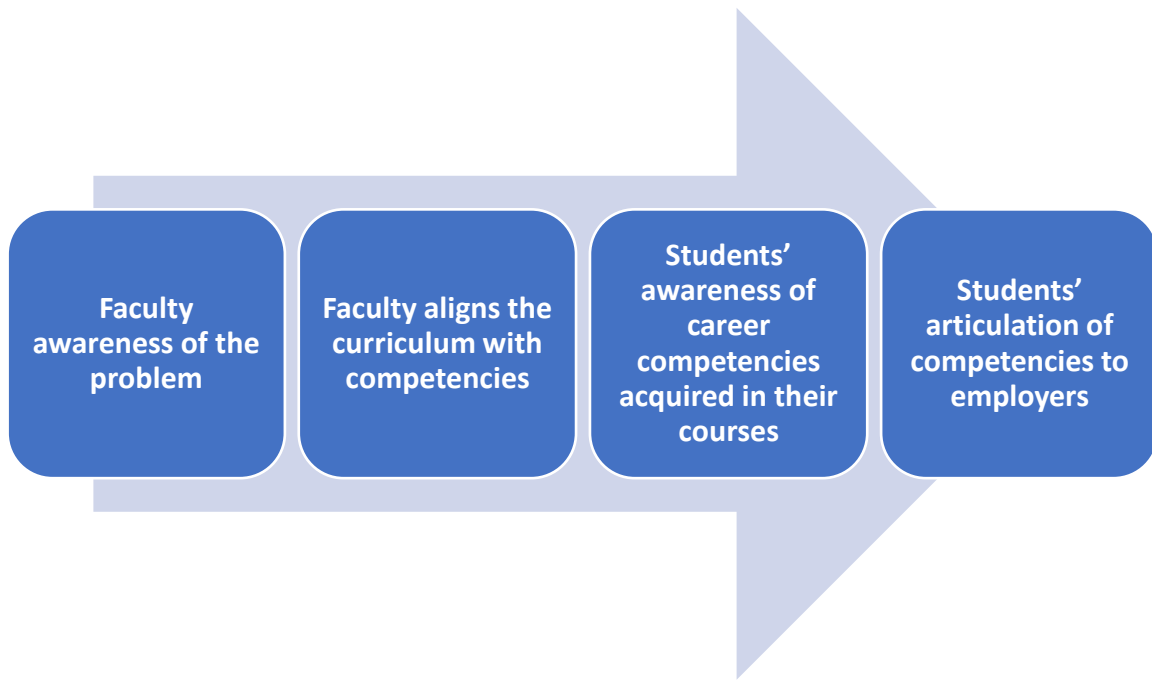
American Association of State Colleges and Universities (AASCU) (2021) research suggests that faculty work on embedding career competencies and skills into curriculum has a substantial positive impact on the long-term wellbeing and career mobility of students as well as on equitable outcomes. (AASCU, 2021, pp. 7, 24, 38).

Based on the understanding that faculty plays a significant role in influencing students through their coursework and that there are constraints on faculty time and on class time, this project suggests that institutions develop a gentle approach to asking faculty to integrate competencies in their courses. This paper suggests the following process (showcased in Figure 1): 1) faculty becomes aware of career competencies; 2) faculty aligns the competencies with their courses' learning objectives based on the existing curriculum for their courses and articulates aligned career competencies to their students; 3) students become aware of career competencies; 4) students become able to articulate their competencies. We call this process "4 A's" – "awareness, alignment, awareness, articulation".

NACM (2022) identifies the list of Critical Integration Components which help institutions achieve the highest possible impact on students' post-graduation outcomes. "Instruction & Curriculum", one of the critical components, calls for "embedding career development stages into current and new curricula and instructional activities". (NACM 2022, p. 45)

Based on the evidence presented at the national level, and on identified high impact strategies, this paper proposes a "Career Competencies Module" that could be easily integrated in undergraduate courses in any field of study.

Figure 2: Awareness – Alignment – Awareness -- Articulation Process



CAREER COMPETENCIES MODULE

We created a pilot “Career Competencies Module” consisting of two assignments that ask students to use data of the Bureau of Labor Statistics (BLS) Occupational Outlook Handbook to explore their major and career choice.

The use of the BLS data on occupations as a base for major and career choice exploration is an innovative approach to teaching Principles courses. The assignment integrates data analysis skills with critical thinking about one’s potential career choice trajectory as well as writing skills for assignment completion. The aim of the exercise is to develop several competencies for career readiness identified by the National Association of Colleges and Employers such as Career & Self Development, Critical Thinking, Equity & Inclusion, Technology, and Communication. (NACE 2021)

The first assignment introduces students to the BLS Occupational Outlook Handbook database and asks them to research basic information about their selected career choice based on their academic major. The undecided students are free to research any career path, which could potentially nudge them towards the major selection.

Assignment #1 focuses on obtaining information on training, education, expected growth, salaries, work conditions, etc. Students are asked to identify and extract information related to their chosen occupation to analyze the current job market situation. (Assignment #1 is presented in Appendix 1.)

The second assignment deepens the data exploration and requires analytical and critical thinking skills as students concentrate location preferences and geographical differences in wages for their future occupation. Additionally, students are asked to identify an ideal company to work for in their desired location.

Assignment #2 focused on obtaining information on Occupational Employment and Wages Statistics, observing location and wage differentials’ maps, comparing and contrasting information from various states, Metropolitan Statistics Areas (MSA), counties, and cities.

Based on location differentials, students are asked to identify a company that they would like to work at and research that company’s mission, vision, values, and other important information. A reflection on suitability of the company and the selected job post for student’s career aspirations concludes the assignment. (Assignment #2 is presented in Appendix 2.)

Incorporating learning objectives of each assignment, Career Competencies Module develops students’ data literacy, analytical, and critical thinking skills, as well as communication, and career and self-development competencies.

RESULTS FROM THE PILOT

This “Career Competencies Module” was used successfully as a pilot in the Principles of Economics course at R1 Public University. The results show that students (a) gained confidence in working with big data, (b) applied (and developed further) critical thinking and analytical skills, and (c) utilized a data-driven approach for career choice exploration.

This paper presents results of Principles of Microeconomics class offered in the Fall 2021: Table 2 shows demographic information of the class composition; Table 3 presents students' self-identification of the level of data analysis they possess; and Table 4 shows the changes that students self-documented after they completed the Career Competencies Module.

Table 2. Data Description – Principles of Microeconomics- Fall 2021 (N = 32)

	<i>Enrolled</i>	<i>Completed Both Assignments</i>
Students	40	32 (80%)
Demographics	Number	Percent
First Generation	30	36.7%
Freshmen	18	45%
Sophomore	19	47.5%
Junior	3	7.5%

Table 3. Level of Data Analysis Skills (N=32)

<i>Self-Identified Level</i>	<i>PRE-</i>	<i>POST-</i>
No previous experience	13%	6%
Beginner	34%	13%
Intermediate	53%	78%
Expert	0%	3%

Table 4. Results (N= 32)

	<i>Change</i>	<i>No Change</i>
Know where to find information	53%	47%
Confident with career choice	56%	31%
Can explain the situation in the job market	84%	16%
Satisfied with Career Choice Knowledge	69%	31%
	Strongly Agree	Agree
Assignment 1 was helpful in learning about career choice	59%	41%
Assignments 2 was helpful in learning about my career choice	41%	53%

As evident from the results (Table 4), the exercise helped students navigate their career path by making meaningful data-driven decisions. Students utilized a data-driven approach for career choice exploration and became aware of the situation in the labor market.

This Module can be implemented in any classroom at any institution. It could be assigned at any level of undergraduate education. It utilizes the public database which is available free of charge and can be

accessed from anywhere anytime. The database is updated regularly. These factors make this Module a versatile technique of integrating career competences in the undergraduate curriculum.

REFLECTION QUESTIONS: STUDENTS' COMMENTS

After the Module was administered, the survey was sent to students asking them to reflect on their experiences. Table 5 presents the reflection questions of the post-module survey.

Table 5. Post-Module Reflection Questions

Questions	Answer Choices
What worked for you and what was confusing?	Open ended
Do you feel more comfortable now working with a large database?	Yes or No - Explain
Do you feel these exercises helped you to use data in your career selection?	Yes or No - Explain
Do you feel these exercises helped you to use data in your company choice?	Yes or No - Explain
What did you learn overall?	Open ended

Table 6. Selected Students' Answers to the Question: "What did you learn overall?"

Themes	Comments
Insightful Information	I found the vast amount of information presented on the BLS to be not only very insightful, but it cleared up some of the questions I had about my career choice. ...One of the most prominent statistics I found in the BLS was the amount of employment and salaries given to people in this position across the nation. It was not surprising to see that New York/New Jersey had the highest employment level and salary, but I was happy to see that there are similar options in the West Coast because I would like to eventually move out there. I felt like this process worked for me because I was someone who didn't know exactly which direction I wanted to go in my future career. After looking around and researching important information regarding multiple career choices, I found one that really aligned well with what I was looking for overall. ... I do feel more comfortable after these activities using a larger database.
Many Career Paths	Overall, I learned that my career as a whole has many different paths to take, as well as many different areas to specify in. Because of this, there are also many paths that can be taken to enter said career. I also learned the average salaries as a whole, as well as the salaries for each specification within the jobs themselves. All of this information is valuable and important to know when choosing this career to pursue, and it will undoubtedly help my success within this field in the future. As a whole, these two assignments were quite beneficial in helping choose a career.
Comfortable with Data	I can confidently say that I feel more comfortable now working with a large database and I feel these exercises helped you to use data in your career selection or gave me a better understanding of where I could go to develop an idea. I do definitely feel these exercises helped you to use data in your career selection company choice even if it isn't my exact trajectory, I now know how I can lower my options and narrow my locations.
My Field Information	Overall, I learned many things. I learned that it is important to know as much as possible when it comes to your career field, because that is what you will spend the majority of your life doing. Also, I learned that there are even more sectors of jobs in finance than what I previously thought. I also learned about how to use the database websites, I learned more about the specifics of the jobs that I am interested in, and I also learned more about the best locations for my job, and what is required for me to get jobs in finance.

CONCLUSION

The results of the pilot integration of Career Competencies Module into Principles of Economics class show that students were satisfied with how their work with data has enlightened their career choice. They were curious about deepening the exploration of job market situation in their prospective field.

Since more than a third of the class were first-generation students, this exercise might be the first one to expose students to career opportunities. First-generation students lack access to the network of professionals and/or family members who could provide guidance and structure for their career exploration.

NACM (2022) identified significant career mobility equity gaps in the categories of race, gender, first generation, and age. Understanding career opportunities was named as one of the strategies to address these equity gaps (NACM 2022, 36). This assignment exposes students to data about various occupations and careers, providing, in many cases, the first look at the career paths that could be pursued after their undergraduate studies.

The versatility of the Career Competencies Module allows for an easy integration of it in any course. It could be used as a self-standing assignment, as homework, as class work, or as an exam question. It could be used online or in in-person format. The learning objectives of any course could be augmented to include a career exploration goal.

The intention of the author is to continue collecting data on the impact of this Module on students' career choice knowledge acquisition by administering these assignments in more classes and in different levels of the undergraduate courses.

If you want to join the effort of helping students understand their career choice by using a large public database (such as BLS), please contact the author and we will start collaborating.

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APPENDIX

Appendix 1.

Assignment # 1 Exploring your Career Choice

Total = 100 points

Learning objectives:

1. Explain the current situation in the job market based on the career path of interest.
2. Identify and extract valuable data for analysis using databases.
3. Make meaningful inferences based on the data extracted from the database.
4. Reflect on your experience with data analysis and connect it to your personal goals in your career trajectory.

Steps:

1. Research the current situation in the job market for your chosen occupation. Go to U.S. Bureau of Labor Statistics (BLS): <https://www.bls.gov/ooh/>. This is the Occupational Outlook Handbook. The handbook will provide you with information (training, education, expected growth, salaries, work conditions, etc.) on a variety of topics related to hundreds of occupations.
2. Identify and extract information related to your chosen occupation in order to analyze the current job market situation.
3. Write a one-page report (**at least 500 words**) making meaningful inferences based on the information you obtained through your research. **(75 points)**
4. Reflect on your experience with this research and data analysis. Write another couple of paragraphs (**at least 200 words**) connecting the results of this research to your personal goals in your career trajectory. Would you continue to pursue this career? Would you change your mind? Explain your reasoning. **(25 points)**

Note: do not forget to include **Bibliography** at the end of your essay. Make sure that the Bibliography is in the Chicago-Author-Date format.

5. Upload your report as a pdf to the Assignment # 1 prompt located on the left-hand-side of our class's LMS site.

Appendix 2.

Assignment # 2

Exploring Data in Support of Your Career Choice

Total = 100 points

Learning objectives:

1. Explain the current situation in the job market by state based on the career path of interest.
2. Identify and extract valuable data for analysis using databases.
3. Make meaningful inferences based on the data extracted from the database regarding the location of your potential employer.
4. Reflect on your experience with data analysis and connect it to your personal goals in your career trajectory.

Summary: You will continue researching the current situation in the job market for your chosen occupation. In this assignment, you will research (1) desirable location(s) of your future occupation; (2) average wages based on your selected location(s); (3) your ideal company to work for in your desired location. After you extract the information related to your chosen occupation, you will write an essay analyzing your potential employment in a company of your choice.

Steps:

1. Go to the U.S. Bureau of Labor Statistics (BLS) web site: <https://www.bls.gov>
2. At the top of the page, select "Subjects" → "Employment by Occupation" → scroll down to "OEWS Data" → "Occupation Profiles".
3. Select the major group of occupations that is closest to your career choice.
4. When you arrive at the page "Occupational Employment and Wages" for your selected occupation, stay on this page and research the information in order to answer the following questions (take notes!):

Part 1: Industries:

What are the main industries that employ people with your selected occupation?

Part 2: States:

What are the states with the highest level of employment of this occupation?

What are the states with the highest concentration (location quotient) for this occupation?

What are the states that pay the most for this occupation?

5. Based on the information in Step 4, think about which state you would like to work in. (Take notes!)
6. Using your preferred location and occupation, do your own search on the internet to identify a company that you would like to work at within this state. (Take notes!)

7. Go to your selected company website. Research your company's mission, vision, values, and other important information you can get from their website. The important information could be their social responsibility strategy, their environmental impact strategy, or other initiatives that **you value** in a company. (Take notes! You will need to write a couple of paragraphs describing what aspects of this company's corporate culture appeal to you.)
8. At your selected company website, locate a job opening which could be potentially suitable for you to apply after graduation or is your dream position to obtain after graduation (under "Careers" or "Job Openings" pages). Research that job opening and take notes! You will write a paragraph describing why this company and this job are the best fit for you. (If there are no job openings for your desired position, then do a search for another company (i.e. repeat Step 7)).

Assignment:

Write an essay containing the following parts:

Part 1: My occupation's employment and wages (minimum 250 words). This part should contain **your reflection** on your research in Step 4 and Step 5. Remember, you took notes there about your preferred location (state) based on the employment and wages of your occupation.

Part 2: My choice of a company to work for (minimum 250 words). This part should contain **your reflection** on your research in Step 6 and Step 7. Remember, you took notes there about your preferences for the company's location (state) and on aspects of this company's corporate culture that appeal to you.

Part 3: Why is this company the best fit for me (minimum 250 words). This part should contain **your reflection** on your research in Step 8. Remember, you took notes there about why this company and this job are the best fit for you.

Note: do not forget to include ***Bibliography*** at the end of your essay. Make sure that the Bibliography is in the Chicago-Author-Date format.

Upload your report as a pdf to the **Assignment # 2 prompt** located on the left-hand- side of this class's LMS site.

Food Insecurity and Child Health in India: Concerns and Solutions

Babita Srivastava, Ph.D

ABSTRACT

Food security is a very critical global issue. It is especially an issue in India. With a population of 1.4 billion, India faces immense pressure to ensure adequate food production and distribution to offset the current food demand. This paper explores the multifaceted causes of child hunger, the outcomes of inadequate nutrition on physical, mental, and emotional development, and proposes evidence-based solutions to address this pressing concern. Through an analysis of its current statistics, economic models, and existing interventions, it seeks to contribute to the ongoing discourse on improving food security and child health outcomes in India and beyond.

INTRODUCTION

Based on the 1996 World Food Summit, food security is:

“When all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.”

According to the Food and Agriculture Organization (FAO) (2006), food security refers to a consistent access to adequate quantities of appropriately safe and nutritious food, which is a right, and an essential precondition for sustainable development. Food security has four key dimensions, namely:

- a. Food availability: This dimension relates to the physical availability of food stocks in a given society. It is highly correlated with the extent to which food is procured or prepared within or transported to the region.
- b. Food accessibility: A society may be rich in food production but lacks food security if people cannot get what they want. Real food security entails capacity by individuals to access sufficient quantities of nutrient-rich foods.
- c. Food utilization: Food is not the same and thus it does not offer the same nutritional benefits. Food security hence requires that the available food meet the energy and nutritional requirements of the people.
- d. Food stability: This aspect relates to sustaining optimal levels of food availability, accessibility, and quality. This means that it is important to avoid any situations that may disrupt this consistency. These could be in the form of natural disasters, climate change, social unrest, and other economic factors such as changes in prices.

UN's Sustainable Development Goals (SDGs), especially SDG 2: Zero Hunger and SDG 3: Good Health and Well-being, highlight the world's vision of ending hunger and ensuring healthy lives for all

(United Nations, 2023). Nevertheless, continuing food insecurity in India, which has recently become one of the fastest-growing economies, indicates that various factors are involved in this process. This manuscript seeks to offer a detailed discussion on the issue of food insecurity and the effects on children in India. It aims to provide an understanding of why children go hungry, what happens to them when they are hungry, and how to help hungry children in order to help constructively address the problem of child hunger in India.

FOOD SECURITY IN INDIA: CURRENT STATUS AND CHALLENGES

According to the United Nations (2023), India's population in April 2023 was estimated to be 1,425,775,850 and was projected to be higher than that of the mainland China. This rapid population growth puts much pressure on food stocks and hence enhances food production and distribution. With the increasing rate of urbanization, the task of feeding the people becomes more challenging and requires enhanced techniques of farming, means of transporting food, and ways of preserving the food products.

India's GDP expanded by 7.8 percent in Q1 2024, above the forecasted 6.7 percent (Trading Economics, n.d). This strong performance supports India's status as the world's fastest-growing large economy. The increase was attributed to significant enhancements in parts like manufacturing, construction, mining, and public administration. However, these economic growth prospects have not been accompanied by a proportional enhancement of food security and nutrition status in India. Although urban centers may get an economic boost, rural areas stay in the periphery, often struggling with food insecurity, disease, and illiteracy, leading to poverty and malnutrition.

Undernutrition among children continues to be a significant problem in India as the country ranks among the worst in the world. Even more shockingly, one in every three undernourished children globally is from India. The NFHS 5 conducted by the Indian government shows that children under 5 years of age are in a very poor nutritional state. Acute malnutrition is seen in 19% of such children while 36% are stunted, 32% are underweight and 3% are overweight (Feeding India, 2022). These statistics point to the continued difficulty of food insecurity and its effects on children in India. Solving this problem necessitates the enhancement of maternal health, access to quality health care and nutrition, as well as the provision of relevant intervention programs for at-risk groups.

CAUSES OF CHILD HUNGER IN INDIA

There are several reasons why children in India are still hungry. It is therefore, important to appreciate the complex nature of child hunger to facilitate the identification of appropriate interventions. The following factors contribute significantly to food insecurity among children in India: poverty and economic inequality, unemployment and low wages, food price inflation, food insecurity, natural

disasters and climate change, insufficient social protection and knowledge as well as inadequate access to water, sanitation and hygiene (WASH). These factors are explained further in the sections below.

Poverty and Economic Inequality

Poverty has been identified as one of the main causes of food insecurity. This is made worse by economic disparity where resource allocation is still a preserve of the rich hence access to balanced diets by the needy is still a dream (Drèze & Sen, 2013). These inequalities are reflected in educational attainment, health care, and employment opportunities and thus perpetuate poverty. Tackling these disparities entails policies that address issues of equitable distribution of wealth, access to essential services, and social protection for the vulnerable population in society.

Unemployment and Low Wages

Poor employment opportunities and low wages are major causes of low food access in households. The COVID-19 pandemic has only worsened this situation, with unemployment peaking at 23.5% in April 2020 (Centre for Monitoring Indian Economy, 2020). People lost their sources of income and a significant number of households were plunged into poverty. The high unemployment rate and the increase in the number of low-wage and informal jobs indicate that the employed population cannot afford basic needs like affordable and healthy foods. Sustainable solutions involve strong economic policies that can foster long term employment and decent wages for employees.

Food Price Inflation

Increase in food prices puts a lot of pressure on low-income earners by leading to a decrease in their purchasing power hence inability to afford quality food. According to the Reserve Bank of India (2021), the average food inflation rate in India between the year 2012 and 2021 was 6.7%. This persistent increase in food prices means that poor families are unable to afford adequate foods and this results to malnutrition and other diseases. Implementing strategies to control food prices encompasses not only the management of food price inflation through policy measures but also enhancing food production and distribution systems to make foods affordable to all population groups.

Food Insecurity

Food deserts in rural and urban areas reduce accessibility of diverse nutrient-rich foods due to inequalities in geographical distribution of food (Pingali et al., 2017). These areas do not have adequate grocery stores or markets and those who reside here have to depend on the convenience stores that sell poor quality and unhealthy foods. However, poor infrastructure, lack of transport, and other logistical problems also add to the problem. To this effect, it is critical to design specific preventive measures aimed at strengthening food delivery systems, promoting local farming, and addressing transportation bottlenecks to guarantee equal access to healthy foods for all population groups.

Natural Disasters and Climate Change

India's vulnerability to natural disasters and the impacts of climate change disrupts food production and distribution systems, exacerbating food insecurity (Arora, 2019). The country faces a diverse range of climate-related challenges, including erratic monsoons, droughts, floods, and cyclones, which significantly impact agricultural productivity and food availability.

Climate change is projected to reduce yields of major crops like rice and wheat in India, potentially by 10-40% by 2100 (Venkateswarlu, 2012). This decline in crop yields, coupled with population growth, could severely strain food systems and increase malnutrition rates, particularly among children in vulnerable regions.

Moreover, extreme weather events can damage infrastructure, disrupt supply chains, and lead to price volatility in food markets, further compromising food access for low-income households (Birtal et al., 2015). The resulting food shortages and economic stress can force families to adopt negative coping strategies, such as reducing meal frequency or diversity, which disproportionately affect children's nutritional status.

Insufficient social protection & poor nutrition knowledge

Although India has adopted several food security policies, including PDS and ICDS, issues of implementation and access still exist. Lack of adequate knowledge on appropriate diet and nutrition among the caregivers leads to poor feeding and food selection (Jaiswal, 2022). These areas of knowledge deficit include the following: Poor understanding of the nutritional needs of children at various stages of development (Nguyen et al., 2017), belief systems and attitudes towards certain foods can greatly affect their consumption, little knowledge on how foods should be prepared and stored, little knowledge on the long term effects of malnutrition.

WASH Problems

Inadequate access to water, sanitation and hygiene (WASH) further exacerbates the issue of malnutrition as it heightens the possibility of contracting waterborne diseases and affects nutrient assimilation (Shrestha et al., 2020). In India, where the problem of open defecation still persists in many regions, children easily get infected with environmental enteropathy, which is a subclinical disease that leads to the decrease in the ability of the intestine to absorb nutrients and the increase in permeability to pathogens (Humphrey, 2009).

There is a complex interconnection between WASH and nutrition. Diarrheal diseases due to poor hygiene are recurrent and result in loss of nutrients and appetite thereby worsening malnutrition. In addition, WASH related parasitic infections, which are prevalent in young children, may also compete for nutrients and thus negatively affect growth and cognitive development. The time used by families, especially women and girls to travel long distances in search of water can affect nutrition by denying

time for child care and food preparation (Geere & Cortobius, 2017). Also, the consumption of contaminated water in food preparation brings pathogens that also affect nutritional status.

CONSEQUENCES OF CHILD MALNUTRITION

The effects of food insecurity on child health are numerous and can lead to poor development physically, socially, and economically in the future. Poor nutrition results in stunting, where 35.5% of children under 5 years are affected in India (NFHS-5, 2019-21). The consequences of stunting include poor cognitive development, reduced physical strength, and vulnerability to diseases (Black et al., 2013). Wasting which is prevalent in 19.3% of children under five in India in NFHS-5, 2019-21 increases the risk of mortality and morbidity from infections (Olofin et al., 2013).

Dietary deficiencies at certain developmental stages can result in learning disabilities, impaired memory, and poor academic performance (Grantham-McGregor et al., 2007). Research has revealed that children with poor nutritional status are prone to early school enrollment, grade repetition, and low levels of education.

Food insecurity over time results in stress, anxiety and depression among mothers and behavioral challenges in the children (Whitaker et al., 2006). Such emotional issues can hinder social competence and relationship building, which are essential to health and success in adult life (Jyoti et al., 2005). In addition, these emotional and social problems may continue into adulthood, influencing future psychological and economic well-being.

Malnutrition during the early years of life is also a risk factor for non-communicable diseases such as obesity, diabetes, and cardiovascular diseases in later life (Victora et al., 2008). This “double burden” of malnutrition is a major problem for the Indian public health system and economy.

ENHANCING SOCIAL PROTECTIONS AND OTHER SOLUTIONS

As a result of malnutrition and the consequences of it, it is therefore important to build on and strengthen existing food security programs. The ICDS and MDMS have been found to have positive effects on child nutrition (Chakrabarti et al., 2019). Nevertheless, enhancing the implementation, coverage, and quality of these programs is crucial in order to optimize their impact.

Poverty and unemployment are the core issues that need to be addressed in order to enhance food security. The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) has demonstrated the ability to offer employment guarantee and income support to rural households (Breitkreuz et al., 2017). Extension of MGNREGA to urban areas and increasing investment in skill development programs could improve the household income and food purchasing capacity.

It is crucial to enhance the knowledge of proper nutrition and feeding habits to combat the problem of malnutrition. Nutrition education-based community interventions have been effective in enhancing the child feeding practices and dietary diversity (Bhutta et al., 2013). For this initiative, there is the need

to launch a nutrition education campaign across the country that will address pregnant women, new mothers, and caregivers through community health workers, and technology-supported interventions.

Promoting variety, availability and accessibility of nutrient dense foods can enhance the nutritional status of consumers. Supporting initiatives like kitchen gardens or community agriculture can improve access to fresh produce (Carney et al., 2012). To do this, it is necessary to introduce nutrition-sensitive agriculture interventions into current rural development programs, supporting the production of micronutrient-rich crops and small-scale livestock farming.

WASH issues must be addressed so that the best nutritional results can be achieved. The Swachh Bharat Mission has gone far in increasing sanitation access, but there are concerns in the areas of usage changes and sustainability (Dandabathula et al., 2019). There is a need to reinforce WASH initiative by enhancing nutrition programs and WASH interventions in behavior change communication and infrastructure development. Micronutrient deficiencies common among Indian children can be managed through food fortification and bio fortification. That is why mandatory fortification of staple foods has been proven to be effective in decreasing the level of anemia and other micronutrient deficiencies (Bhutta et al., 2013). To strengthen food fortification and biofortification, there is a need to increase the mandatory levels of biofortification of staple foods and encourage the production and consumption of biofortified crops including pearl millet rich in iron and wheat rich in zinc.

It is crucial to strengthen the ability of health systems to identify, prevent, and manage malnutrition. The Poshan Abhiyaan or the National Nutrition Mission seeks to enhance nutrition outcomes through convergence, technology, and innovation (NITI, 2018). For improving health systems and nutrition surveillance, the utilization of new technologies of real time monitoring of children's nutritional status for prompt intercession and program modification should be promoted.

CONCLUSION

Hunger and its effects on children are still major ongoing issues in India even with its economic progress. This problem is not only complex but also requires interdisciplinary intervention to address both short-term and long-term root causes. It is therefore important that India strengthens social protection, tackles poverty, nutrition messaging and WASH as well as invest in health systems to significantly reduce child malnutrition and its lifelong impacts. The application of these strategies demands political commitment, multisectoral cooperation, and community participation.

More studies should be conducted to estimate the sustainability of integrated nutrition interventions, examine feasible options for expanding successful programs, and identify targeted approaches for various segments of the population in India. Redressing food insecurity and enhancing the quality of food consumed by children is not only a matter of the right thing to do but also a smart thing to do for India's future human and economic capital. Focusing on such concerns will help India work towards the

achievement of the Sustainable Development Goals and provide children with a healthier and prosperous future.

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Sanctions and Civil Conflict: An Empirical Analysis

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ABSTRACT

Using a panel dataset of 3584 observations of 128 countries during the period of 1990-2017, I analyze the impact of US sanctions on the level of internal conflict within the target countries. After obtaining robust standard errors through clustering, arms, trade, and financial sanctions along with military aid were found to be significant while travel and other sanctions were not. Arms and financial sanctions have a negative impact on internal conflict, trade sanctions and military aid have a positive impact, and trade sanctions proved to be the most significant and impactful of all.

INTRODUCTION

February 24, 2023 marked the one year anniversary of Russia's invasion of Ukraine, and in that time over 12,000 sanctions have been issued against Russia in addition to the over 2,000 issued after Russia's 2014 invasion of the Crimean Peninsula (Castellum.AI, 2023). Spearheaded by the United States with support from an international coalition of 30 of its allies and partners, the sanctions regime ranges from restricting Russian banks' access to the SWIFT financial system and sovereign debt to price capping Russian oil and placing export controls on various goods and services, including oil, semiconductors, and steel. As a result, Russia has seen a decline in its defense industry and fighting power due to production shutdowns, equipment and component shortages, atrophied market size for defense exports, and an increased reliance on inferior technology (US Department of the Treasury, 2023). Russia has also seen a notable decline in its airline, automotive, energy, and financial industries, significant business retreat, and rising deficits alongside forecasts for continued economic decline, industrial statism, and public discontent (Snegovaya, 2023; Sonnenfeld, 2022; US Department of the Treasury, 2023). Still, the war in Ukraine continues and shows no sign of an endgame, leading to skepticism on whether sanctions will have a significant impact on the conflict itself.

Sanctions have become a popular tool of coercive statecraft for enforcing a strict international order and are usually threatened and implemented with the intention of preventing or ending conflict without resorting to more warfare. Their modern usage originated with the success of sanctions by the Allied Powers blocking German supply lines during the First World War, causing a famine that was decisive in Germany's surrender, even though subsequent sanctions against Italy and Japan failed to bring about peace, the latter leading to even greater conflict (Fuelling, 2022; Morgan et. al., 2023). Since the end of the world wars, the US has become the chief sanctioning power through both unilateral implementation and leading multilateral efforts, including being a key player in UN led sanctions (Kirilakha et. al., 2021). The post-cold war era and the 21st century brought about changes to the nature of sanctions, namely the rise of "smart" (financial and travel) and targeted sanctions over broad based embargoes, and the rise of civil conflict leading to sanctions

implemented for the named purpose of settling intrastate conflict, including conflict involving civil war, democracy, human rights, and terrorism (Cordesman, 2015; Morgan et. al, 2023).

As most literature measuring the impact of sanctions on intrastate conflicts utilizes the Threat and Imposition of Sanctions (TIES) dataset, the limitations lead to an emphasis on the cold war period and barely can break into the 21st century at all (Clifford, 2014). In this paper, I study the relationship between a country's level of internal conflict and the presence of US sanctions during the period of 1990 to 2017. I utilize the Global Sanctions Database (GSDB) to get further into the 21st century and to analyze the impact of various types of sanctions; arms, trade, financial, travel, and other, as well as military aid (Felbermayr, 2021). I also use the International Country Risk Guide's multidimensional measure for internal conflict, comprising of civil war/coup threats, terrorism/political violence, and civil disorder (The PRS Group, 2023).

My hypothesis is that US sanctions overall will reduce a country's level of internal conflict, but that arms and trade sanctions will have the most significant role in doing so. The literature that is elaborated on in the next section has generally found arms sanctions to be instrumental in shortening conflict duration and resulting in peaceful outcomes.

LITERATURE REVIEW

In this section, I distinguish between the impact of sanctions in terms of its effects on a country's economy and the actual stated goal being achieved or not.

Economic Impact

Consensus exists among economists that sanctions have a significant and negative impact on the target country's economy overall, as well as the performance of specific sectors and firms and the well-being of individuals in the target country. These impacts also commonly last for years after the sanctions have been lifted. Afesorgbor (2019), Dai et. al. (2021), and Kohl (2021) have all found that imposed sanctions lead to a reduction of international trade for the target country. Afesorgbor (2021) specifically found that, like the case of Germany in WWI mentioned previously, financial and trade sanctions working in conjunction causes increased food insecurity in targeted countries. Neuenkirch & Neumeier (2015) found that imposed sanctions have a negative impact on the GDP growth of targeted countries. Afesorgbor & Mahadevan (2016) and Neuenkirch & Neumeier (2016) respectively found that sanctions have a deleterious impact on the level of income inequality and poverty within the target country.

Impact on Internal Conflict

Strandow (2006) was one of the earliest empirical studies into how sanctions impact intrastate conflict, particularly civil war. Analyzing the cases of the First Liberian Civil War and the First Ivorian Civil War, he found that arms sanctions were the most likely to be successful in moving the warring parties towards

conflict resolution. Escribà-Folch (2010) used a sample of 87 civil wars to study the impact of sanctions on their duration, finding that imposed sanctions reduce the duration of civil conflict. He additionally found that sanctions imposed by international institutions are more likely to end conflicts in negotiation while sanctions not imposed by them are more likely to end conflicts with military victory. Total economic embargoes are the most effective at ending conflict quicker and with either outcome, while arms embargoes are more likely to end a conflict in negotiation over military victory.

Hultman & Peksen (2015) studied civil conflicts in Africa, and how economic sanctions and arms embargoes impact fatalities in those conflicts. Threats of both were found to increase the intensity of violence in the conflicts, but only the imposition of economic sanctions were found to escalate conflict while the imposition of arms sanctions were found to reduce violence by limiting the military capacity of warring parties. Lektzian & Regan (2016) argue that once a violent civil conflict has begun, sanctions alone are unlikely to have any notable impact. They find that sanctions are most likely to be successful at shortening the duration of civil conflicts if they're part of a multilateral international response that also includes the use of military intervention. Lv & Xu (2016) found that imposed sanctions have a negative impact on ethnically diverse nations, as ethnic violence increases with the presence of sanctions as a way of distracting from or placing blame for the negative economic impacts of sanctions.

Hasan & Lahiri (2017) studied civil wars from 1960-2008 and found that their duration is reduced by both unilateral and multilateral sanctions, but that only total economic embargo and arms sanctions are effective at this while trade sanctions, aid suspension, and other types of sanctions are ineffective. Radtke & Jo (2018) studied the impact of UN sanctions against rebel groups during civil wars, and they found more adaptable groups can only be weakened by sanctions while less adaptable groups are more likely to suffer battle defeats and territorial losses that lead to a quicker end to conflict.

While most of the literature has found that sanctions can reduce civil conflict, the economic impacts and staying power of these impacts can potentially lead to more conflict in the future.

EMPIRICAL ANALYSIS

To measure the relationship between internal conflict and sanctions, I use OLS regression to model the panel data. Data for the dependent variable, internal conflict, comes from the International Country Risk Guide. This measures on a scale of 0 to 12 the amount of political violence within a country and its actual or potential impact on governance (The PRS Group, 2023). A 12 is a country with no armed or civil opposition to the government alongside the government not committing acts of arbitrary violence against its people, and a 0 is a country embroiled in full civil war. Internal conflict's subcomponents include civil war/coup threats, terrorism/political violence, and civil disorder.

Data for the independent variable of interest, US sanctions, comes from the Global Sanctions Database. For the purposes of this analysis, the database allows us to separate sanctions by type, which

are arms, trade, financial, travel, and other. The dataset also includes a variable for military aid, another form of intervention.

The control variables include the various economic, political, and regional factors that impact a country's level of internal conflict. Included in the economic factors are GDP per capita, GDP growth, and country income classification, which all come from the World Bank's World Development Indicators. Income classification is measured by a country's GNI per capita in USD, adjusted for inflation via the Special Drawing Rights (SDR) Inflation. A country with a GNI per capita of less than \$1,045 is considered low income, between \$1,046 and \$4,095 lower-middle, between \$4,096 and \$12,695 upper-middle, and above \$12,695 high income.

The political factors are comprised of corruption, democracy, ethnic tension, globalization, and religious tension. Democracy comes from the Polity V dataset where a -10 is a country with a fully autocratic government while a +10 is a country with a fully democratic government. Globalization is measured using the KOF Globalization Index, an aggregated score made up of economic, political, and social globalization levels. Corruption, ethnic tension, and religious tension are from the International Country Risk Guide, and like internal conflict, are measured on a scale of 0 to 6 where a higher number means a lower amount is present within the country. Ethnic and religious tension measure the dominance of single ethnic or religious groups in a country that seeks to exclude other groups from the political and social process in order to stay dominant.

The regional factors include forest area as a percentage of total land area, mineral and oil rents as percentage of GDP, water stress, population, and country region classification (East Asia & Pacific, Europe & Central Asia, Latin America & the Caribbean, Middle East and North Africa, North America, South Asia, and Sub-Saharan Africa). Region classification comes from the World Bank while all the others come from the World Development Indicators. Mineral and oil rents are the difference between the value of mineral and oil production at regional prices and the total costs of production, which measures the abundance of minerals and oil within a country. Water stress is the ratio between total freshwater withdrawals by all major sectors in a country and the total renewable freshwater resources, and so measures how scarce a country is in terms of freshwater.

The model for this regression is represented by $Internal.Conflict_{it} = \beta_{it}Arms_{it} + \beta_{it}X_{it} + \varepsilon_{it}$. As this model uses panel data, i represents the observed group, country, while t represents the time of observation, annually. $Internal.Conflict_{it}$ is the level of internal conflict for a country i during year t . $Arms_{it}$ is whether the US has implemented arms sanctions on country i during year t . X_{it} is a vector of the remaining sanctions variables alongside the economic, political, and regional control variables, and β_{it} are their respective coefficients. ε_{it} represents the error term in the model. This is a fixed effects model; the Hausman test precludes using random effects.

Table 1. Descriptive Statistics

Statistic	Min	Median	St. Dev.	Mean	Max
Internal Conflict	0	9.250	2.095	9.036	12.000
Arms (Dummy)	0	0	0.342	0.135	1
Military Aid (Dummy)	0	0	0.440	0.262	1
Trade (Dummy)	0	0	0.440	0.262	1
Financial (Dummy)	0	0	0.264	0.075	1
Other (Dummy)	0	0	0.185	0.035	1
GDP per Capita	22.850	3,438.927	16,622.570	10,931.020	123,678.700
GDP Growth	-64.047	3.810	5.492	3.626	86.827
Population	381,850	11,176,277	153,381,060	48,144,590	1,396,215,000
Forest Area (% of total Land Area)	0	29.853	22.375	31.363	94.499
Oil Rents (% of GDP)	0	0.056	10.777	4.791	66.685
Mineral Rents (% of GDP)	0	0.024	2.120	0.757	23.145
Water Stress	0.025	11.961	276.194	73.162	3,850.500
Globalization	22.374	56.881	16.019	58.153	91.070
Democracy	-10	6	6.423	3.781	10
Corruption	0	2.500	1.275	2.850	6
Ethnic Tension	0	4	1.338	4.024	6
Religious Tension	0	5	1.504	4.444	6
East Asia Pacific (Dummy)	0	0	0.450	0.281	1
Europe & Central Asia (Dummy)	0	0	0.348	0.141	1
Latin American & Caribbean (Dummy)	0	0	0.384	0.180	1
Middle East & North Africa (Dummy)	0	0	0.312	0.109	1
North America (Dummy)	0	0	0.174	0.031	1
South America (Dummy)	0	0	0.458	0.242	1
Sub-Saharan Africa (Dummy)	0	0	0.124	0.016	1
Low Income (Dummy)	0	0	0.458	0.300	1
Lower-Middle Income (Dummy)	0	0	0.449	0.280	1
Upper-Middle Income (Dummy)	0	0	0.387	0.183	1
High Income (Dummy)	0	0	0.426	0.237	1

Table 1 provides summary statistics of the data. The dataset consists of 3584 observations of 128 countries during the period of 1990 to 2017. Some of the variables, notably GDP Per Capita and Population, are included in natural log form in the regression as they're quite large.

Table 2. Regression Results

Dependent Variable:			
Internal Conflict			
Arms			-0.598 (0.350) *
Military Aid			0.234 (0.104) **
Trade			0.605 (0.203) ***
Financial			-0.425 (0.204) **
Travel			0.214 (0.248)
Other			-0.169 (0.385)
Ln (GDP per Capita)			-0.073 (0.146)
GDP Growth			0.024 (0.007) ***
Ln (Population)			-0.116 (0.472)
Forest Area (% of total Land Area)			-0.062 (0.040)
Oil Rents (% of GDP)			0.013 (0.012)
Mineral Rents (% of GDP)			-0.025 (0.025)
Water Stress			-0.002 (0.0005) ***
Globalization			0.021 (0.021) *
Democracy			0.047 (0.023) **
Corruption			0.164 (0.085) *
Ethnic Tension			0.986 (0.094) ***
Religious Tension			0.081 (0.051)
Low Income			0.024 (0.302)
Lower-Middle Income			0.431 (0.234) *
Upper-Middle Income			0.458 (0.165) ***
Obsvs: 3,584	R ² : 0.302	Adj. R ² : 0.272	F-Stat: 70.718*** (df = 21; 3435)
Note: * p<0.1; **P<0.05; ***p<0.01			

Table 2 provides the estimators from the fixed effects regression with robust standard errors. As the data are structured within groups of countries, the standard errors have been made robust through clustering. Additionally, results from the Breusch-Pagan test for heteroskedasticity and the Breusch-Godfrey test for autocorrelation found that both are present within-cluster in the fixed effects model, which clustering the standard errors has accounted for.

Arms and financial sanctions are demonstrated to have causality with an increase in a country's level of internal conflict; the presence of arms sanctions decreases a country's internal conflict score by 0.598 points while financial sanctions decrease the score by 0.425 points. The deleterious impact of arms sanctions detracts evidence from the hypothesis and contradicts the previous literature on the impact of arms sanctions (Escribà-Folch, 2010; Hultman & Peksen, 2015; Strandow, 2006). On the other hand, trade sanctions and military aid are shown to decrease a country's level of internal conflict, as their presence increases a country's internal conflict score by 0.605 and 0.234 points respectively. Travel and other sanctions are completely insignificant, arms sanctions are significant at the 10% level, military aid and financial sanctions are significant at the 5% level, and trade sanctions are significant at the 1% level. Overall, trade sanctions are the most significant and have the greatest impact on a country's level of internal conflict.

GDP growth, water stress, ethnic tension, and upper-middle income classification are the most significant of the control variables, all at the 1% level. Democracy is significant at the 5% level while globalization, corruption, and lower-middle income classification are significant at the 10% level. GDP growth, globalization, democracy, and the aforementioned income classifications all have a positive impact on a country's level of internal conflict. The income classifications also demonstrate that higher income levels have a greater and more significant impact on internal conflict, though the estimators also demonstrate the returns may be diminishing. Water stress, corruption, and ethnic tensions all have a negative impact on a country's level of internal conflict.

Reverse causality between sanctions and internal conflict remains a concern. Countries with a higher level of internal conflict are more likely to be the target of sanctions.

CONCLUSION

The popular use of sanctions as a tool of statecraft and the prominence of sanctions in popular discussion due to Russia's invasion of Ukraine prompts the need for an evaluation of whether sanctions are significant in impacting conflict and measuring what that impact is. Data limitations prevented prior research from analyzing the function of sanctions in the modern day, but the Global Sanctions Database allows research to focus much closer on recent applications of sanctions relating to conflict.

Using a panel dataset of 3584 observations of 128 countries during the period of 1990-2017, I analyze the impact of US sanctions on the level of internal conflict within the target countries. After obtaining robust standard errors through clustering, arms, trade, and financial sanctions along with military aid were found to be significant while travel and other sanctions were not. Arms and financial sanctions have a negative impact on internal conflict, trade sanctions and military aid have a positive impact, and trade sanctions proved to be the most significant and impactful of all.

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Structural Equation Modeling Versus Instrumental Variables: An Example

Ossama Elhadary

ABSTRACT

In this paper, I demonstrate how to use Structural Equation Modeling (SEM) to address Endogeneity. To deal with endogeneity, two approaches can be used: 1) Instrumental variables, and 2) Structural Equation Modelling. To use instrumental variables, one must find a set of instruments that have a causal effect on only one of the potential endogenous variables at a time but not on the other ones. Because of the difficulty in finding such instruments, I am presenting Structural Equation Modeling as an alternative that can achieve the same objective. In this paper, I quantify the effect of European colonialism on human development in former colonies using regression. I then test the model for endogeneity and show that the proposed model has an endogeneity problem, and then proceed to adjust and re-estimate the model.

INTRODUCTION AND THE MODEL:

To demonstrate the use of Structure Equation Models, I will build a model of the factors that drive human development in former colonies and try to demonstrate that European colonialism was not beneficial to the development of these counties. Unlike other research, I use the Human Development Index (HDI) and two of its components: the Education, and the Life Expectancy Indexes, as the dependent variables because I believe that these indexes provide a better measure of the overall progress a former colony makes after independence since they do not only focus on the economy but also on education and health attainment.

In this model I use the duration of colonization (ColonizationYears) as an independent variable hypothesizing that the longer the colonization duration the deeper the roots of the established colonial institutions and policies, and the more difficult it will be to change or dismantle them. I also add a variable for the length of time a former colony spends under military dictatorships (MilitaryYears) after independence as an exogenous independent variable. This variable will help test the hypothesis that military dictatorship tends to interrupt the improvements made because of independence and sets a former colony on a lower development trajectory. Assuming that large and small former colonies have different development trajectories, I also add a dummy variable (Size) for former colonies with population sizes greater than 1 million inhabitants. These trajectories can easily be seen in the data as the average HDI for small countries (population is less than 1 million) is .716 (and the standard deviation is .1) compared to larger countries that have an average HDI of .64 and standard deviation is .14. I also add a dummy variable representing countries with an abundance of natural resources (for example, Kuwait, United Arab Emirates, Brunei, etc.). Finally, the I add dummy variables for British, French, or Spanish colonies. The model then consists of the following equation with the Human Development as the dependent variable.

$$HDI = \alpha + \beta_1 * ColonizationYears + \beta_2 * IndependenceYears + \beta_3 * MilitaryYears + \beta_4 * Size + \beta_5 * Resources + \beta_6 * English + \beta_7 * French + \beta_8 * Spanish + \varepsilon \quad (1)$$

THE DATA

In this research, I compile data for 104 former colonies from various sources. I then calculate the number of years a former colony was colonized, number of years under military rule, and the number of years since independence. For every former colony, I note the colonizer as England, France, Spain, or other (including mix of colonizers like in the case of the Maldives or Guyana). The following table shows the number of former colonies, and the average and median (in parenthesis) of the 2018 HDI value, number of colonization years, number of independence years, number of years under military rule, and population size.

TABLE 1
DESCRIPTIVE STATISTICS PER COLONIZER

	England	France	Spain	Other
Number of Colonies	33	24	17	30
Former Colonies HDI (2018)	.676 (.149)	.543 (.116)	.743 (.066)	0.686 (0.01)
ColonizationYears	113.6 (84.8)	88.1 (54.8)	282 (44.1)	260.2 (146.1)
IndependenceYears	59.1 (14.7)	67.8 (32.5)	194.9 (19.1)	61.6 (34)
MilitaryRuleYears	5.3 (10.6)	10.1 (11.4)	32.7 (17.9)	7.5 (13.1)
Population (in Millions)	30.1 (52.4)	22.2 (24.5)	23.9 (30.6)	72.7 (259)

A dummy variable (Resources) representing a former colony with abundance of resources is also added. This variable takes the value of 1 for Brazil, Brunei, Oman, Qatar, Congo, Angola, Algeria, United Arab Emirates, Iraq, Venezuela, and Kuwait, and 0 for all other countries. The following table shows the number of former colonies, and the average and median (in parenthesis) of the 2018 HDI value, number of colonization years, number of independence years, number of years under military rule, and population size for low and high-resource countries.

TABLE 2
DESCRIPTIVE STATISTICS FOR LOW AND HIGH RESOURCES FORMER COLONIES

	Low Resources	High Resources
Number of Former Colonies	93	11
Human Development Index	0.647 (0.134)	0.757 (0.098)
ColonizationYears	179 (127)	151.3 (125.8)
IndependenceYears	84 (55.8)	82.7 (58.8)
MilitaryRuleYears	11.4 (16)	12.6 (16)
Population (in Millions)	39.6 (148)	35.1 (61)

I also add a dummy variable (Size) for countries with population larger than 1 million (there are 22

countries with population smaller than 1 million and 82 with population larger than 1 million). The following table shows the number of former colonies, and the average and median (in parenthesis) of the 2018 HDI value, number of colonization years, number of independence years, number of years under military rule, and population size for low and high-population countries.

TABLE 3
DESCRIPTIVE STATISTICS FOR LOW AND HIGH POPULATION FORMER COLONIES

	Low Population	High Population
Number of Former Colonies	22	82
Human Development Index	0.716 (0.1)	.644 (0.14)
ColonizationYears	208.1 (110.1)	167.5 (129.9)
IndependenceYears	44.9 (6)	94.5 (58.5)
MilitaryRuleYears	1.6 (4.8)	14.2 (16.8)
Population (in Millions)	.39 (.30)	49.6 (157)

THE RESULTS - FACTORS AFFECTING THE HUMAN DEVELOPMENT INDEX

By running regression equation 1 one gets the following results (R²= 0.43, and Adjusted R²= 0.38):

TABLE 4
REGRESSION RESULTS WITH HDI AS THE DEPENDENT VARIABLE

	Coefficient	t	P
ColonizationYears	.00011	2.05	.043
IndependenceYears	.00041	.9	.368
MilitaryRuleYears	-.0021	-2.3	.024
French	-.088	-2.52	.013
English	-.0051	-.16	.87
Spanish	.067	1.06	.291
Resources	.1212	3.48	.001
Size	-.065	-2.19	.031
Constant	.658	15.77	0
R ²	.43		
Adj R ²	.38		

Since the coefficients of both the English and Spanish colonies Dummy variables are statistically insignificant, those two variables are removed from the equation and the regression is rerun.

The results in table 5 show that the colonization and independence durations both have positive and statistically significant effects on human development. As expected, the military rule duration was found to have a negative and statistically significant effect on human development. The dummy variable representing former colonies with a population of more than 1 million people also was found to be negatively correlated with human development. French colonization was also found to have a negative and statistically significant impact on human development. Abundance of resources was also found to have a positive and statistically significant effect on human development.

TABLE 5
MODEL REGRESSION RESULTS AFTER REMOVING ENGLISH AND SPANISH

	Coefficient	t	p
ColonizationYears	.00024	2.49	.014
IndependenceYears	.0008	2.88	.005
MilitaryRuleYears	-.00198	-2.24	.028
French	-.0891	-3.27	.001
Resources	.1157	3.38	.001
Size	-.0704	-2.43	.017
Constant	.636	20.89	0
R ²	.42		
Adj R ²	.39		

For robustness, I replace the 2018 HDI value as the dependent variable in the above equation with the 5-, 10-, and 15-years average of HDI as well as the median of HDI (from 1990 to 2018). The regression results are shown in table 6.

TABLE 6
MODEL REGRESSION RESULTS WITH HDI, AVERAGE AND MEDIAN HDI

	(a)	(b)	(c)	(d)	(e)
Dependent Variable	HDI (2018)	5 years HDI average	10 years HDI average	15 years HDI average	Median HDI (1990-2018)
ColonizationYears	0.00024 (2.5)	0.00023 (2.2)	0.00022 (2.1)	0.00022 (2)	0.00023 (2.04)
IndependenceYears	0.0008 (2.9)	0.00079 (2.6)	0.0008 (2.6)	0.00082 (2.6)	0.0008 (2.4)
MilitaryRuleYears	-0.00198 (-2.2)	-.00183 (-2)	-0.00178 (-1.9)	-0.0017 (-1.7)	-0.0014 (-1.38)
French	-0.0891 (-3.3)	-0.07011 (-2.4)	-0.0686 (-2.3)	-0.0678 (-2.2)	-0.0616 (-1.9)
Resources	0.1157 (3.4)	0.13127 (3.5)	0.13065 (3.4)	0.13187 (3.3)	0.14678 (3.5)
Size	-0.0717 (-2.5)	-0.07924 (-2.6)	-0.08342 (-2.7)	-0.0906 (-2.8)	-0.1191 (-3.5)
Constant	0.63343 (20.6)	0.63228 (19.5)	0.62494 (18.8)	0.61554 (18)	0.59901 (16.8)
R ²	0.42	0.37	0.36	0.35	0.36
Adj R ²	0.39	0.33	0.32	0.31	0.32

One can see from the above table that the results have not considerably changed. The colonization and independence durations as well as the resources variable continue to have a positive and statistically significant effect on all the HDI variables. French colonization and colony size on the other hand continued to have a negative and statistically significant effect on all the HDI variables (albeit the French colonization

variables was only significant at the 10% confidence level when the median HDI variable was used as the dependent variable). The duration of the Military rule on the other hand had a negative impact on all HDI variables but was significant at the 5% and 10% confidence levels only in panels a, b, and c. Overall though, one can clearly conclude that this robustness test corroborates the results obtained in table 5.

ADDRESSING POTENTIAL ENDOGENEITY ISSUES

One might argue that some other relationships between the variables need to be examined otherwise our results might be biased. The identity of the colonizer, country resources, or Population size variables, for example, might influence the colonization, independence, or military rule durations. Similarly, the colonization, independence, and military rule durations might in turn influence each other. To deal with this potential endogeneity problem, two approaches can be used: 1) Instrumental variables, and 2) Structural Equation Modelling

To use instrumental variables, one must find a set of instruments that have a causal effect on only one of the potential endogenous variables at a time but not on the other two. Because of the difficulty in finding such instruments, the instrumental variable approach will not be used in this research.

STRUCTURAL EQUATION MODELLING

In this research I use the Structure Equation Modeling (SEM) technique, which is a second-generation multivariate technique (Bollen, 1989, Fornell, 1982) that allows us to deal with a number of regression equations simultaneously. The same variable may represent a dependent variable in one equation and an independent variable in another equation. A major characteristic of SEM is that the coefficients for each structural equation are calculated with the other variances considered. Accordingly, for all endogenous variables, coefficients are calculated simultaneously and not sequentially as in multiple regression models.

SEM is a confirmatory (i.e., hypothesis-testing) approach that is able to analyze the relationships between both latent and observable variables and is also able explain the relationships between complex constructs and the multiple variables that underlie these constructs.

Assuming Gaussian distribution, Kaplan (2000) explains, that “structural equation modeling can perhaps best be defined as a class of methodologies that seeks to represent hypotheses about the means, variances and covariances of observed data in terms of a smaller number of ‘structural’ parameters defined by a hypothesized underlying model”. SEM “takes a confirmatory (i.e., hypothesis-testing) approach to the multivariate analysis of structural theory bearing on some phenomenon” (Byrne, 1998).

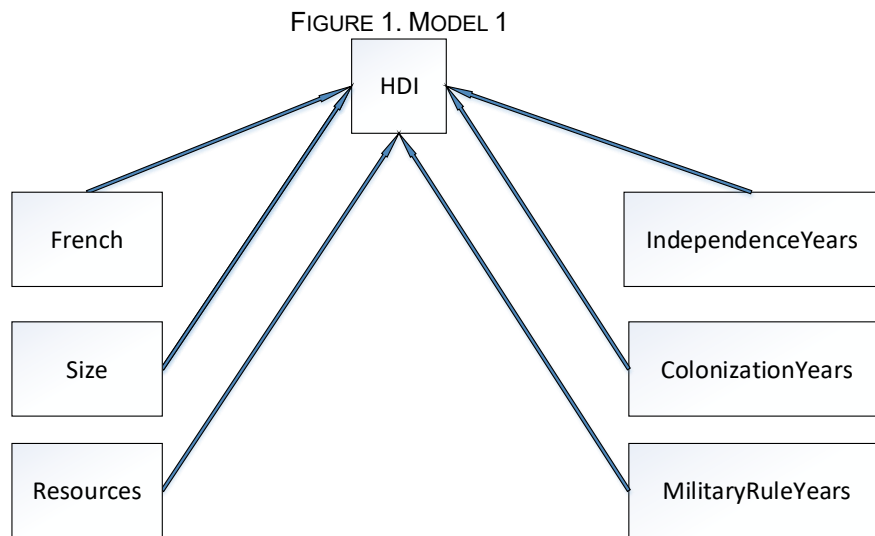
SEM is comprised of a measurement model (a model of the observed and latent variables) and a structural model (a model representing the relationship between the latent variables). The measurement model must be adjusted and fixed prior to examination of the structural model. The model is further tested for goodness of fit (in which the validity of a hypothesis is tested without the specification of an alternate hypothesis) and modified again so that the best fitting model can be used for the final tests (the model has to be justified from a substantive perspective and not only a statistical one).

In Stata, the `sem` and `gsem` commands fit these models where `sem` fits standard linear SEMs, and `gsem` fits generalized SEMs. In `sem`, the responses are continuous, and the models are linear regression. In `gsem` on the other hand, responses are continuous or binary, ordinal, count, or multinomial, and the models are linear regression, gamma regression, logit, probit, ordinal logit, ordinal probit, Poisson, negative binomial, multinomial logit, and more.

If the model being fit with SEM has K observed variables, then the data contain $K(K + 1)/2$ second-order moments, and thus p , the number of parameters based on second-order moments that can be estimated, cannot exceed $K(K + 1)/2$. Every path in your model contributes 1 to p unless the parameter is constrained to a specific value, and then it does not contribute at all. If two parameters are constrained to be equal, the two parameters count as one.

MODEL 1:

In this section, the model represents the results in table 5 (all the variables are exogenous except for the HDI variable). The results of the goodness of fit tests (see table 12) indicate that the model has zero degrees of freedom which explains why some tests showed perfect fit (RMSEA, CFI, TLI, SRMR) while others showed poor fit (χ^2 and $p > \chi^2$). Because of this, this model will be rejected.



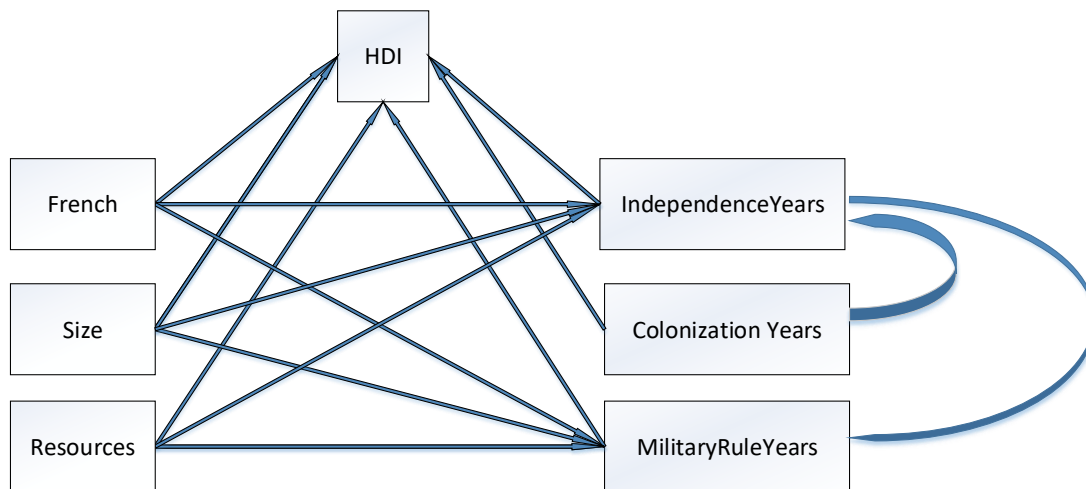
MODEL 2:

In this model, I start with the results in table 5 and then I add the following assumptions:

- The independence, and military rule durations are endogenous variables and are influenced by the Resources, Size, and French Occupier variables.
- The military rule duration is also a function of the independence duration, so the longer a country is independent, the higher the chance and accordingly the duration of military rule.
- The independence duration is also a function of the colonization duration, which implies that countries

that have been occupied the longest, also have been independent the longest. This is especially evident in Latin American former colonies that have been occupied for hundreds of years but have gained their independence around 200 years ago.

FIGURE 2. MODEL 2



The results of the model fitting are shown in table 7 and the goodness of fit results in table 8.

TABLE 7
MODEL FITTING RESULTS

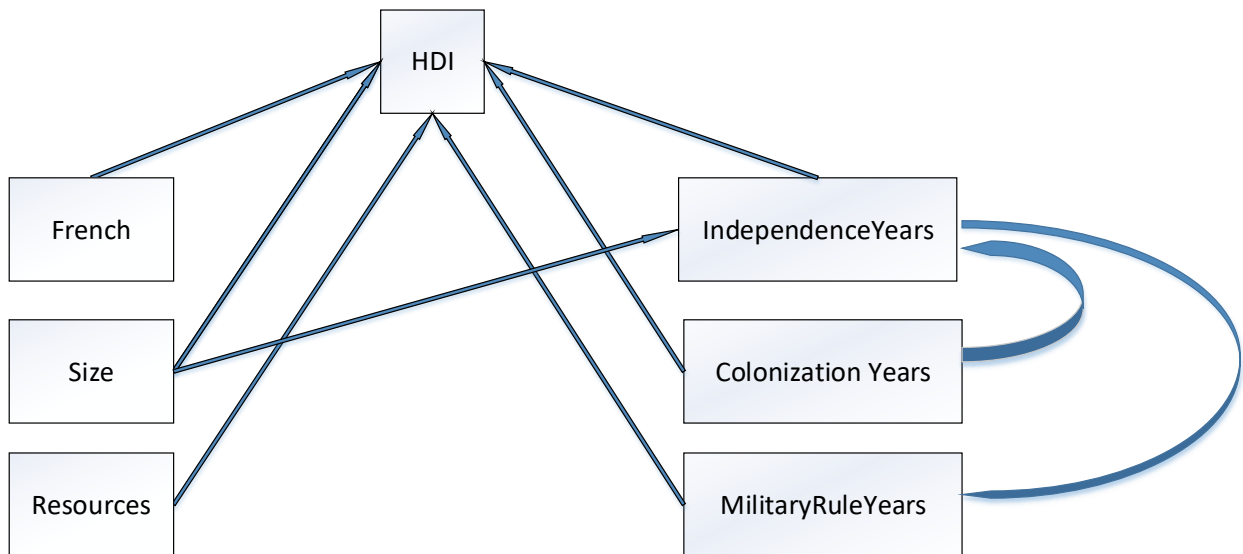
Independent Variable	Variable	Estimate	z
HDI	ColonizationYears	.00026	2.82
	IndependenceYears	.00086	3.19
	MilitaryRuleYears	-0.00196	-2.29
	French	-0.0796	-3.10
	Resources	0.1137	3.57
	Size	-0.08354	-2.99
	Constant	.63393	22.14
	IndependenceYears	ColonizationYears	.00026	2.82
Size		59.283	5.24
Resources		-7.444	-.51
French		-13.228	11.67
Constant		14.2993	1.11
MilitaryRuleYears	ColonizationYears	-.01231	-1.18
	IndependenceYears	.19109	7.78
	French	.22039	.07
	Resources	1.01788	.28
	Size	2.6307	.83
	Constant	-4.606	-1.42

Like model 1, the results of the Goodness of Fit tests are inconclusive because the number of degrees of freedom is equal to zero and so this model can be rejected.

MODEL 3:

In this model, I drop all the statistically insignificant relationships between the variables and then re-estimate the model.

FIGURE 3. MODEL 3



The results of the model fitting are shown in table 8 and the goodness of fit results in table 9.

TABLE 8
MODEL FITTING RESULTS

Independent Variable	Variable	Estimate	z
HDI	ColonizationYears	.000258	2.82
	IndependenceYears	.00086	3.19
	MilitaryRuleYears	-0.00196	-2.29
	French	-0.0796	-3.10
	Resources	0.11366	3.57
	Size	-0.08354	-2.99
	Constant	.63393	22.14
IndependenceYears	ColonizationYears	.1712	4.65
	Size	56.749	5.08
	Constant	9.679	.78
MilitaryRuleYears	IndependenceYears	.1888	9.02
	Constant	-4.3654	-2.07

In this model, CFI and TLI are greater than .95 which according to Schumacher and Lomax (2004)

indicate very good fit. SRMR is less than .05 which according to Pituch and Stevens (2016) indicate close fit. RMSEA is also less than .05 which according to Pituch and Stevens (2016) again indicate close fit. Finally, Chi squared is insignificant again indicating good fit. Based on these results, one can accept this model (see table 9).

TABLE 9
GOODNESS OF FIT RESULTS FOR MODELS 1-3

	Model 1	Model 2	Model 3
Chi ²	0	0	4.764
p> Chi ²	-	.	.574
RMSEA	0	0	0
Prob RMSEA <= .05	1	1	.713
AIC	3303	3329	3322
BIC	3324	3385	3361
CFI	1	1	1
TLI	1	1	1.022
SRMR	0	0	.034
CD	.422	.56	.542
Degrees of Freedom (DF)	0	0	6

CONCLUSION

In this paper, I demonstrated how to use Structural Equation Modeling (SEM) to address Endogeneity. An alternative to SEM would have been to use Instrumental Variables, but for that, one must find a set of instruments that have a causal effect on only one of the potential endogenous variables at a time but not on the other ones which is sometimes difficult to achieve. In this paper, I quantified the effect of European colonialism on human development in former colonies using regression. I then tested the model for endogeneity and showed that the proposed model had an endogeneity problem, and then proceeded to adjust and re-estimated the model accordingly.

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Foreign Aid and Economic Growth Nexus

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ABSTRACT

The purpose of this paper is to determine whether the United States' current government spending on foreign assistance is efficient for the economic development of the recipient countries. The relationship between foreign aid and economic growth is a highly debated topic. My study concluded that there is a positive influence on the economic growth of receiving countries via U.S. foreign assistance, however, this level of influence may be promoted or impeded by institutional quality. Further research in low income, lower-middle income, and upper-middle income subgroups showed that certain institutional quality factors may affect a society more than others.

INTRODUCTION

Is economic foreign aid an effective tool for promoting economic growth in developing nations? The effectiveness of U.S. foreign aid has always been a source of debate. The Marshall Plan, which was a U.S. initiative to aid in the reconstruction of Europe after WWII, was considered successful in restoring the physical and economic infrastructure of the region (National Archives and Records Administration, 1948). However, subsequent efforts to replicate this success since the Marshall Plan have yielded mixed results. Many studies have found that the effectiveness of foreign aid is closely tied to the institutional quality of the recipient country. For example, Burnside and Dollar (2000), Collier and Dollar (2002), Easterly (2006), Galiani, Knack, Xu, and Zou (2017), Tang and Bundhoo (2017), Yahyaoui and Bouchoucha (2020), and Abate (2022) have all argued that foreign aid is most effective when there is a good institutional environment that can promote the effective use of monetary assistance. On the other hand, some studies have refuted this idea. These studies show that institutional quality may not matter as much as other factors, such as overall policymaking in foreign aid disbursement. For instance, Jensen and Paldam (2003), Arndt, Jones, and Tarp (2010), and Adusei (2020) have all challenged the notion, first established by Burnside and Dollar, that institutional quality is a necessary prerequisite for the efficiency of foreign aid.

In my study, I analyze country-level panel data from a sample of developing countries to understand the effect of United States economic foreign aid on recipient countries' economic growth. Using a linear panel regression, I fit the model using feasible generalized least squares to address violations of OLS. FGLS fits this model by estimating a weighted version of the OLS equation, where the weights are chosen to minimize the variance of the estimated parameters. With this model, I analyze two things: first, I determine the overall efficiency of U.S. economic foreign assistance programs. Secondly, I examine the relationship between institutional quality and the effectiveness of U.S. foreign assistance programs, drawing on previous research that suggests institutional quality may be an important explanatory variable. The results of my study show

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that overall, foreign aid helps in the development of an economy in terms of GDP per capita. Additionally, institutional quality plays an important role in the economic growth of a nation. However, dividing the countries into three income levels according to the World Bank classification [low, lower-middle, and upper-middle] shows that this effect is significant in low- and lower-middle-income countries but not in upper-middle-income countries.

This study contributes to the existing literature by establishing another connection between foreign aid and economic growth, as well as the impact of institutional quality on economic growth. Understanding these two connections can allow researchers to further explore the foreign aid–economic growth nexus by identifying factors that may impede or accelerate the growth of modern developing economies. However, my model does not consider the relationship between foreign aid and institutional quality, as their interactions proved to be insignificant.

This paper proceeds as follows: First, I will expand on the existing literature that has developed the roots of my hypothesis, which posits that institutional quality is an important determinant of foreign aid's effectiveness. Then, I will describe my empirical model and estimation techniques, as well as the data that I will be using and its measurements. Finally, I will present my regression results, explain their connection to past studies, and conclude.

2. LITERATURE REVIEW

A significant amount of research has been conducted on the foreign aid–economic growth nexus, yet there has been no conclusive result from these studies. Due to variations in timeframes, countries sampled, methodologies, and factors such as international wars, civil wars, and political regime changes, it is difficult to draw a single consensus from the conducted studies. There are two basic claims regarding foreign aid derived from empirical studies: (1) Foreign aid is only effective under certain qualitative conditions, and (2) foreign aid does not depend on qualitative conditions for its effectiveness.

2.1 THEORETICAL BACKGROUND

It is important to know where this research started. Harrod (1939) and Domar (1946) stated that the rate of economic growth is dependent on the level of savings and the capital-output ratio (or the level of imports and exports). Their ideas created the Harrod-Domar model in development economics, which declared that an economy needed this savings gap to be filled by foreign aid to accelerate its economic growth. Later, Chenery and Strout (1966) and Papanek (1973) extended this investigation into the role of foreign aid in economic growth and concluded that foreign aid helps reduce the foreign exchange gap, which can be seen through modern technology, managerial skills, and grants that create better access to foreign markets. Chenery and Strout's idea created the Dual-Gap Model in development economics, which is still used today. Here, there are two gaps: the savings gap and the foreign exchange gap, which must be filled by foreign aid to accelerate an economy.

2.2 FOREIGN AID DEPENDS ON QUALITATIVE FACTORS

To begin, we look at the idea that the success of foreign aid is dependent on qualitative factors. Studies have shown that foreign aid can only work when the institutional quality within the developing country is stable enough to encourage growth; otherwise, foreign aid cannot make a difference in that society. We see this initially through Burnside and Dollar (2000), who found that there is no significant relationship between growth and aid. They outlined the idea that aid may have a more robust impact on developing nations if funds were systematically allocated towards good policy environments. Something they noted specifically is that the climate for effective aid is improving (1993 thereof) while the amount of aid spent diminishes. In 2002, Collier and Dollar proved this theory again with new data. They concluded that the effect of aid on poverty, specifically, depends on the quality of policies. As well, Collier and Dollar find that aid is allocated inefficiently with respect to poverty reduction. Furthermore, they use theoretical reasoning to explain that a pattern is developed in which aid is targeted at weak policy environments because the allocation of aid is used for historical and "strategic" reasons. A study by Veiderpass and Andersson (2007), which focused on sixty countries from 1995 to 2000, found that foreign aid on economic growth has little to no effect. Here, Veiderpass and Andersson used factors such as energy use, labor force, capital, and GDP to analyze the influence of production efficiency on the effectiveness of aid. It was found that there is a relationship between the two variables and that it should be considered when dealing with foreign aid studies. However, they state explicitly in their study that longer time periods and a more extensive dataset are crucial for coming to more concise conclusions. Ndambenida and Njoupouognigni (2010) use 36 sub-Saharan African countries from 1980–2007. They find that a country's growth is dependent on domestic policies and institutions. Meaning that using a country's indigenous resources is far more crucial to the development of a nation than external factors such as foreign aid to boost economic growth in Sub-Saharan Africa. Galiani, Knack, Xu, and Zou (2016) used 35 countries from 1987 to 2010 in their study to attest that foreign aid is effective only when there is a sound institutional environment that may promote the effective use of received foreign aid. However, they disclaim the long-term effects of this study, proclaiming that this is only the short-term result of aid and that there is the possibility that long-term effects may vary. Tang and Bundhoo (2017), Yahyaoui and Bouchoucha (2020), and Abate (2022) all use separate regions of the world: Southeast Asia, Africa, and developing nations, respectively. Yet each of these studies came to the same conclusion: aid can only be effective if the policy environment in which it exists allows it to be effective. Or that it is not up to the money that is received, but rather how that money is used when it is received. Easterly, Levine, and Roodman (2004) attested that foreign aid may only contribute to growth where economic politics are favorable. Bovard (1986) stated specifically that American foreign aid has often harmed the poor in the Third World instead of aiding in development. This sort of sentiment can be seen in studies such as Nyoni and Bonga (2017), who were able to show that all together, aid has a positive effect on growth, but that countries with bad governments and rampant corruption may be covering up the ineffectiveness of the aid received to make their countries seem better off than they are. Erixon (2005) and Deaton (2013) state bluntly that foreign aid does more harm than good because it prevents a country from growing internally and relies on foreign aid to make progress. Finally, there are Werker,

Faisal, and Cohen (2009), who showed that aid affects most components of GDP but cannot substitute for the savings of a developing country.

2.3 FOREIGN AID DOES NOT DEPEND ON QUALITATIVE FACTORS

Still, there exist studies that concur with the opposite of the above literature. Rajan and Subramanian (2010) proved that there was little robust evidence of a positive (or negative) relationship between aid inflows and economic growth. Rajan and Subramanian claimed that there is no evidence that aid is more efficient in countries with better policies or geographical environments or that certain forms of aid are better than others. In 2003, Jensen and Paldam disproved Collier and Dollar's findings that foreign aid is dependent on good institutional quality. They found that aid does increase growth rates and that it is not conditional on good policy. Arndt, Jones, and Tarp (2010) confirm that aid has a positive effect; however, their regression itself shows that institutional quality is not significant in their model. Wamboye (2012), Gyimah-Brempong, and Racine (2014) identify that foreign aid's effect on economic growth exists in a U-shape. Meaning that foreign aid may not prove to be effective in the short run but is essential for the growth of a developing country in the long run, regardless of institutional quality. Adusei (2020) states similar sentiments when they conclude that the impact of foreign aid in sub-Saharan Africa is positive. However, they leaned into the institutional quality debate to argue that institutional quality alone does not mediate the effectiveness of aid on economic growth. Altogether, inconclusive results can be seen in Yiew and Lau (2018), who factored in the importance of FDI (foreign direct investment) and POP (population) in their models. They explained that while aid may or may not affect economic growth in developing countries, we should look more directly at factors such as foreign direct investment and population growth as factors that may help improve a developing nation.

3. EMPIRICAL MODEL AND ESTIMATION

3.1 EMPIRICAL MODEL

My empirical model is a linear panel regression in double-log form. It is meant to show the overall effect of U.S. disbursed economic aid on the economic growth of the receiving country by using control variables of economic growth. I arrived at the final model of my equation after running various regressions for interactions, logarithms, semi-logs, and polynomials. Initially, I had included the dummy variables li and lmi to interact with aid and institutional quality. However, every variation thereof proved to be insignificant. As well, li as a dummy variable alone was insignificant. So, for my final model, there are neither li nor lmi dummy variables. In the end, I arrived at the following equation:

$$\ln gdp_c = \beta_0 + \beta_1 \ln aid_{it} + \beta_2 \ln exp_{it} + \beta_3 \ln lfi_{it} + \beta_4 iq_{it} + \varepsilon_{it}$$

In order to determine the answer to question number two, I took my primary regression and ran it as three sub-regressions: low-income, lower-middle income, and upper-middle income with the use of dummy variables. Here, I deconstructed the mean of the institutional quality variable and used each indicator separately to analyze their individual impacts. Those indicators include: control of corruption [cc], government effectiveness [ge], political stability and absence of violence/terrorism [ps], regulatory quality [rq], rule of law [rl], and voice and accountability [va]. Those final regressions were developed as so;

$$LI: \ln gdp_c = \beta_0 + \beta_1 \ln aid_{it} + \beta_2 \ln exp_{it} + \beta_3 \ln lf_{it} + \beta_4 va_{it} + \varepsilon_{it}$$

$$LMI: \ln gdp_c = \beta_0 + \beta_1 \ln aid_{it} + \beta_2 \ln exp_{it} + \beta_3 \ln lf_{it} + \beta_4 rl_{it} + \varepsilon_{it}$$

$$UMI: \ln gdp_c = \beta_0 + \beta_1 \ln aid_{it} + \beta_2 \ln exp_{it} + \beta_3 \ln lf_{it} + \beta_4 ps_{it} + \beta_5 cc_{it} + \varepsilon_{it}$$

The variables used to create all four regressions are as follows:

Table 1. Variable Definitions and Sources

VARIABLE	MEASUREMENT/PROXY	SOURCE
Economic Growth (gdpc)	GDP Per Capita	World Bank
Economic Aid (+aid)	U.S. Foreign Aid disbursed in inflation adjusted US\$	U.S. Agency for International Development
Labor Force (+lf)	Labor force, total	World Bank
Exports (+exp)	Export of goods and services in current US\$	World Bank
Institutional Quality (+iq)	Mean of six indicators (% from 0 to 100)	World Governance Indicators
Low Income (li / dummy)	Countries making GNI of =<\$1,085	World Bank
Low Middle Income (lmi / dummy)	Countries making GNI of \$1,086 to \$4,255	World Bank
Upper Middle Income (umi / dummy)	Countries making GNI of \$4,256 to \$13,205	World Bank

The third dummy variable listed above is to show the difference in income-levels. Only two dummy variables will be employed: if $li==1$, it is a low-income country, if $li==0$, it is not a low-income country; if $lmi==1$, it is a lower-middle income country, if $lmi==0$, it is an upper-middle income country.

3.2 ESTIMATION

In this model, our dependent variable is GDP per capita. Aid, institutional quality, exports, and the labor force are independent variables.

Since my model contains panel data, I began my estimation with the use of the random effects model [-xtreg, re-] and the fixed effects model [-xtreg, fe]. Here, I used the Hausman test [-hausman fe re-] to determine what the preferred model will be by testing whether the unique errors are correlated with the regressors. Here, the null hypothesis is that the individual effects are not correlated with the presented X-it's. In my case, I could not reject the null hypothesis of the Hausman test, meaning that the fixed effects model is the better model.

After the Hausman test, I developed my regression equation to be the best attainable model. Then, I tested the model for heteroskedasticity using the Wald statistic for groupwise heteroskedasticity in a fixed effect regression model [-xttest3- Stata 17]. This test is used to determine whether the independent variables may be "significant" in the model—that is, whether they add an independent explanation to the dependent variable. If the model's $\text{Prob}>\chi^2$ (the probability of obtaining the chi-square statistic given that the null hypothesis is true) is above 0.10, then the null hypothesis would not be rejected, or the model does not contain heteroskedasticity. In my model, $\text{Prob}>\chi^2$ is below 0.10, which indicates heteroskedasticity is present in my model.

I also tested for autocorrelation using the Wooldridge test for panel data [-xtserial- Stata 17]. Autocorrelation is the degree of similarity that exists between a time series and a lagged version of itself. This test checks the autocorrelation for unbalanced panel data. If the test results in a $\text{Prob}>\chi^2$ that is over 0.05, we can reject the notion of autocorrelation. In my model, my $\text{Prob}>\chi^2$ was below 0.05, so I must infer that my model has autocorrelation.

I tested my model for multicollinearity by using VIF, or variance inflation factor [-vif- Stata 17]. VIF is able to determine the strength of the correlation between independent variables. As a rule of thumb, if the VIF of any independent variable is above 10, then you must search the model for existing multicollinearity. My model was very low, and therefore, no multicollinearity existed within my model.

However, with the presence of both autocorrelation and heteroskedasticity, I had to fit my model to these biases. Therefore, I engaged a Huber/White/sandwich estimator in which a robust version of my fixed effects model was created [-vce(r)- Stata 17]. This robust estimator made my independent variable of aid entirely insignificant. Since I wanted to analyze the effects of this variable on my dependent variable, I tried another approach to my regression.

I used feasible generalized least squares because my model had both heteroskedasticity and autocorrelation that could not be solved through a robust fixed effects model. This command accounts for the presence of autocorrelation, AR(1), within panels and heteroskedasticity across panels, panels(hetero). This ended up being my final model used to interpret the results of my unbalanced panel data.

4. DATA

4.1 DATA SOURCE

This study employed an unbalanced dataset of 34 of the United States highest-aid receiving countries from 2002 to 2021. However, with unavailable data for some of the top 34 countries, they were replaced with the next available high-aid receiving country. These 34 countries include 16 low income, 11 lower-middle income, and 7 upper-middle income countries. The data comes from World Bank, OECD, World Bank Governance Indicators, WITS World Bank, UN data, and USAID's foreignassistance.gov. The list of countries used can be found in the appendix.

4.2 VARIABLES

GDP per capita (gdpc) is current US\$ derived from the World Bank national accounts data and OECD National Accounts data files. This is a weighted average and is representative of the country's gross domestic product divided by the midyear population. This is calculated as the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. As well, it is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources (The World Bank 2023).

U.S. economic foreign aid (aid+) disbursed in each fiscal year from 2002 to 2021 is represented by a whole of all economic related activities and is expected to grow alongside GDP per capita. This data is retrieved from the U.S. ForeignAssistance.gov website as part of their promise to further the agencies' (USAID and Department of State) value of transparency, participation, and collaboration in tangible ways that benefit the American people. Disbursements of aid are the funds paid/outlaid by the U.S. government agencies, by cash or cash equivalent, during the fiscal year to liquidate government obligations (The World Bank 2023).

Exports (exp+) come from the World Bank and are represented in current US\$. It is written in economic theory that when the level of exports rises, so should GDP and GDP per capita. The figures are sourced from World Bank national accounts data and OECD National Accounts data files. Here, the exports of goods and services include the value of all goods and services provided to the rest of the world. This may include: value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services such as communication, construction, financial, information, business, personal, and government services. This does not include compensation of employees and investment income and transfer payments (The World Bank 2023).

Labor force (lf+) is taken from the World Bank and sources from the World Bank and World Bank Development indicators databases. Estimates are based on data obtained from the International Labour Organization and United Nations Population Division. When the labor force participation increases, it means that there are more people to create goods and enact services, therefore, GDP per capita should rise with labor force. It is composed of people ages 15 and older who supply labor for the production of goods and services during a specified period. This includes people who are currently employed and people who are unemployed but seeking work as well as first-time job-seekers. Unpaid workers, family workers, students, and those in the armed forces are sometimes omitted from this “total” but may vary across countries. Years 2020 and 2021 are subject to substantial uncertainty because of scarcity of relevant data due to the COVID-19 pandemic (The World Bank 2023).

Institutional quality (iq+) is the mean of six indicators [control of corruption, government effectiveness, political stability and absence of violence/terrorism, regulatory quality, rule of law, and voice and accountability] represented in a total of 0 to 100 percent. 0 represents complete corruptness and 100 represents no form of corruption.

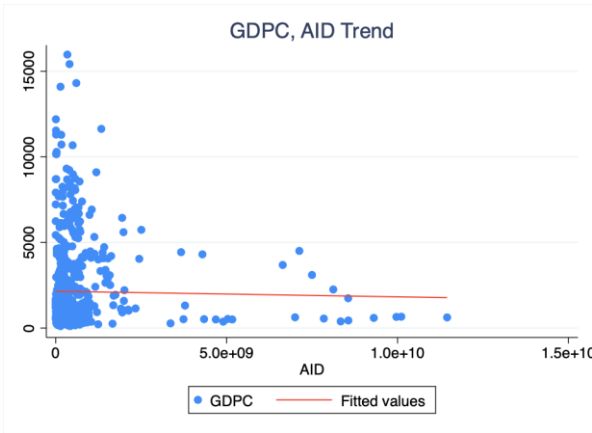
$$\mu = cc_1 + ge_2 + ps_3 + rq_4 + rl_5 + va_6$$

These indicators come from the World Bank Worldwide Governance Indicators. Hypothesized by previous literature is the idea that when institutional quality rises, so should the GDP per capita because it means that a country is engaging in more conduct considered to be “democratic”, “correct”, or simply “uncorrupt”. Therefore, the economy can flourish.

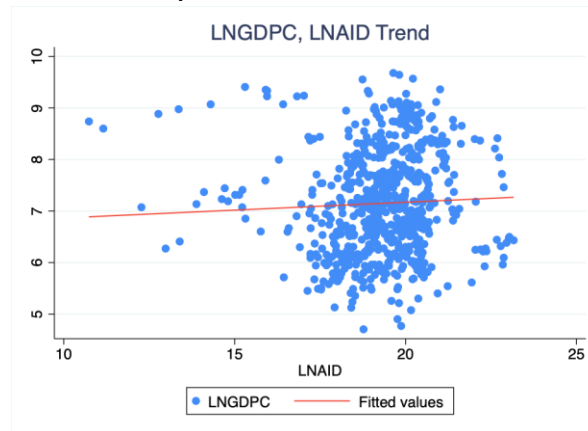
4.3 DESCRIPTIVE DATA

Upon gathering the data, I wanted to view the initial relationship between GDP per capita and foreign aid. This relationship can be seen through Graph 1 and Graph 2. Graph 1 is representative of the organic nature of the two variables where Graph 2 is the logarithmic form of the two variables. I applied the logarithms to get a better fit of the data. We can see that initially there appears to be a negative trend between the variables, or that they do not move together. Adding the logarithms, we can see that GDP per capita and aid tend to move in an upward pattern together. As well, we can notice quite a few outliers in this set, indicating the presence of heteroskedasticity.

Graph 1. GDPC and AID Trend



Graph 2. LNGDPC and LNAID Trend



Looking at the correlation matrix, we can understand the correlation between GDP per capita and aid. It is important to note here that GDP per capita and aid have a very weak correlation. This means that while the variables may move in response to one another, their overall relationship is not very strong. However, institutional quality and GDP per capita have a strong positive relationship with one another. Another interesting point to see is that aid and institutional quality are negatively correlated with one another, suggesting that as institutional quality rises, we will see a decrease in aid, or as aid rises, institutional quality will be lower. This is what the literature on foreign aid’s effectiveness being dependent on institutional quality has inferred. However, this relationship also appears to be weak.

Table 2. Correlation Matrix

Correlation Matrix							
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) GDP per capita	1.000						
(2) Aid	0.0457	1.000					
(3) Exports	0.7513*	0.115*	1.000				
(4) Labor force	0.1576*	0.2059*	0.6090*	1.000			
(5) Institutional quality	0.3925*	-0.0554	0.3603*	0.1313*	1.000		
(6) Low income	-0.6041*	-0.0930*	-0.6436*	-0.3312*	-0.3460	1.000	
(7) Lower-middle income	0.0667	-0.0325	0.2948*	0.3362*	0.1178	-0.6628*	1.000

* $p > 0.05$

The descriptive statistics follow. Here, we can see that the panel data is slightly unbalanced, with five observations missing from aid and eight missing from institutional quality. The variables gdp per capita, aid, exports, and labor force are presented in logarithmic terms in this table. This is because of the large difference that existed between each variable. With the log, we can get a better fit for the model.

Table 3. Descriptive Statistics

Descriptive Statistics

Variable	obs	mean	std. dev	min	max
GDP per capita	700	7.1474	1.0039	4.7047	9.67876
Aid	695	19.2952	1.5028	10.7364	23.1612
Exports	700	22.7016	1.7543	18.0067	27.1105
Labor force	700	16.2209	1.1075	14.0549	18.7436
Institutional quality	692	-0.8361	0.5727	-2.41	0.39
Low income	700	0.4571	0.4985	0	1
Lower-middle income	700	0.3429	0.4750	0	1

Lastly, I checked the model for stationarity with a panel unit-root test. This is because unit-roots may cause problems in statistical inferences. I used the Fisher type for my model because of the presence of unbalanced data. As well, Dickey Fuller was implemented to test for unit-roots on each panel. For my model, we can see through the results that there may be some countries without a unit-root. Next, I tested for cointegration and received good results [Table 4]. Here, we can see that my data analyzed by my regression is able to move together, which is what we look for as this indicates a correlation between the variables in the long term.

Table 4. Unit Root Test

Fisher-type Unit-root Test

H0: All panels contain unit roots

Ha: At least one panel is stationary

		Statistic	P-value
Inverse chi-squared (70)	P	136.9647	0.000
Inverse normal	Z	-4.7760	0.000
Inverse logit t (179)	L*	-4.8337	0.000
Modified inv. Chi-squared	Pm	5.6596	0.000

Table 5. Cointegration Test

Kao test for cointegration

H0: No cointegration

Ha: All panels are cointegrated

		Statistics	P-value
Modified Dickey-Fuller t		-1.5494	0.0606
Dickey-Fuller t		-2.4818	0.0065
Augmented Dickey-Fuller t	-2.3689		0.0089
Unadjusted modified Dickey-Fuller t		-2.0218	0.0216
Unadjusted Dickey-Fuller t	-2.7457		0.0030

5. EMPIRICAL RESULTS

5.1 MAIN REGRESSION

I ran my regression where GDP per capita is logged as the dependent variable, aid is logged as an independent variable, exports are logged as an independent variable, labor force is logged as an independent variable, and institutional quality is an independent variable.

Table 6. Fixed Effect Regression Model

Fixed Effect Model		
Variables	Coefficient	P-value
Ln_aid	.0324506	0.005
Ln_exp	.3911383	0.000
Ln_lf	.9468174	0.000
lq	.6235697	0.000
_cons	-17.21109	0.000
R-squared: 72.24%		
Observations: 691		
rho: 0.9719759		

Table 7. Random Effect Regression Model

Random Effect Model

Variables	Coefficient	P-value
Ln_aid	.079287	0.000
Ln_exp	.4743222	0.000
Ln_lf	.1501187	0.026
lq	.5439422	0.000
_cons	-7.12983	0.000

R-squared: 49.48%

Observations: 691

rho: 0.76600224

Table 8. Hausman Test

Hausman (1978) Specification Test
Chi2(4) = 133.73
Prob > chi2 = 0.0000

My initial results, without being fit for potential biases, showed that aid was effective at the 5 percent level. Here, we can infer that, while holding all other factors constant, the value of GDP per capita will increase by around 3 percent for each percentage increase in aid. A positive relationship. As well, in this fixed effect model, we can see that all other variables are entirely significant at the five-percent level. We see that the labor force may have the most effect on GDP per capita, followed by institutional quality. We can see that as the labor force increases, so does GDP per capita. As exports increase, so does GDP per capita. As institutional quality increases, so does GDP per capita. The literature holds up in this model, indicating a correlation between aid and economic growth as well as institutional quality and economic growth. Overall, the model was significant at 72.26 percent, meaning that we can explain 72.26 percent of the results with a total of 691 observations.

The second model ran was the random effects model. This model was similar to the fixed effects model in that it portrays all variables as entirely significant at the five-percent level. However, with this regression, we can see that with every one percent increase in aid, there is likely to be around an eight percent increase in GDP per capita, up from the previous three percent. In terms of real-world application, this would be a considerable improvement in aid effectiveness. As well, in this model, we can see that the most significant variable is now institutional quality. This shows that for every one percent increase in institutional quality, we are likely to see a 54 percent increase in GDP per capita. However, in this model, the effectiveness of labor force participation went from a strong 95 percent to only 15 percent. Overall, this model contained 691 observations and was significant at 47.62 percent, meaning that 47.62 percent of our results can be explained by this model.

After these regressions were run, I used the Hausman test to determine which test I should use. Upon receiving a P-value of 0.0000, I concluded that I was using the fixed effects model as my primary model.

After I claimed the fixed effect model, I moved onto post-estimation techniques. The first of these was the modified Wald test for groupwise heteroskedasticity. Before running the test, we could be made aware of the presence of heteroskedasticity by the number of outliers present in the introduction graph [Graph 1/Graph 2]. When I initially noticed this, I tried transforming the GDP variable to GDP per capita, which is

the variable still shown in this model, but it did not make a difference in heteroskedasticity. So, with the confirmation of this inference and a P-value ≤ 0.05 , we can be made aware of the heteroskedasticity in the model.

Figure 1. Wald Test

Modified Wald test	
Ho: $\sigma(i)^2 = \sigma^2$ for all i	
Chi2(34)	3161.20
Prob>chi2	0.0000

After checking for heteroskedasticity, I moved onto the Wooldridge test for first-order autocorrelation. No first-order autocorrelation will be present if the P-value ≤ 0.05 . As we can see by the following results, my Fixed Effect model contains autocorrelation.

Figure 2. Autocorrelation Test

Wooldridge test	
Ho: no first-order autocorrelation	
F (1, 33)	84.752
Prob > F	0.0000

Lastly, I tested the model with the VIF [Variance Inflation Factor] to check for multicollinearity. This test is used to determine the strength of the correlation between the independent variables. It is predicted by taking a variable and regressing it against every other variable. All 'VIF values > 10' require investigation into the source of multicollinearity. My model contains values from 1-2; therefore, there is no strong multicollinearity present.

Figure 3. VIF

Variance Inflation Factor		
	VIF	1/VIF
lnexp	1.83	0.545472
lnlf	1.66	0.603472
iq	1.18	0.851033
lnaid	1.05	0.955367
Mean VIF	1.43	

With the presence of both heteroskedasticity and autocorrelation in my model, I had to fit my model to both. To fit this bias, I employed the robust function [robust standard errors]. In Stata, this was `-vce(r)-` and is also known as the Huber-White sandwich estimator. Here, we can see that when I employed `-vce(r)-` into my model it made my explanatory variable *aid* completely insignificant. The rest of the variables remained significant and identical to the fixed effects model.

Figure 4. Regression with Fixed Effect Robust Standard Errors

Fixed Effects Robust Model			
Variables	Coefficient	t-value	P-value
Ln_aid	.0324506	0.97	0.338
Ln_exp	.3911383	5.31	0.000
Ln_lf	.9468174	3.97	0.000
iq	.6235697	4.71	0.000
_cons	-17.21109	-5.80	0.000

R-squared: 72.26%

Observations: 691

rho: 0.9719759

Since *aid* is the variable I am trying to solve in this model, I switch from the robust function to `-xtgls-`. This model is a fit linear panel-data model using feasible generalized least squares. For small to medium-sized sample data, such as the kind presented in my study, I run the risk of being inefficient compared to OLS. However, since my model is biased and does not contain the requirements for other statistical models such as PCSE (panel-corrected standard error), GMM (generalized method of moments), or the use of Driscoll and Kraay [`-xtscc-`], I am left with the use of FGLS.

Figure 5. Regression with FGLS

Feasible Generalized Least Squares			
Variables	Coefficient	z-value	P-value
Ln_aid	.0230745	2.13	0.033
Ln_exp	.4970967	25.54	0.000
Ln_lf	-.3242202	-9.22	0.000
iq	.1512348	2.89	0.004
_cons	.7164865	1.33	0.183

Here, we can see that with every one percent increase in *aid*, we will see a 2 percent increase in GDP per capita. While the percentage seems small, it can yield significant results. For example, we can take Afghanistan, the U.S.'s highest aid recipient in 2021, and take its 2021 GDP per capita, which is \$368.75, and multiply this by two percent. This gives us around a \$7.38 increase in GDP per capita. Meaning that for each percentage increase in *aid*, we can see that each individual in society will earn around \$7.38 more every year while the foreign aid attempts to develop the nation. This can have a significant effect on the development of a low- or lower-middle-income country. However, this model also tells us that while *aid* and GDP per capita may have a positive effect, the institutional quality of a country is just as important. Institutional quality ends up being significant at 15 percent. This means that as

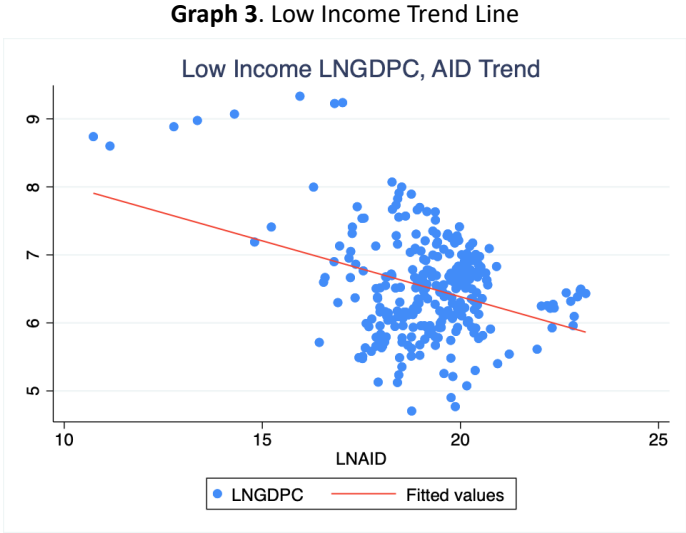
institutional quality rises, so does GDP per capita. Institutional quality is necessary for the improvement and effectiveness of aid. This maintains a similar conclusion as the works done by Burnside and Dollar (2000), Collier and Dollar (2002), Galiani, Knack, Xu, and Zou (2016), Tang and Bundhoo (2017), Yahyaoui and Bouchoucha (2020), and Abate (2022).

Therefore, my research is able to flow into an income-level study. Here, I look into what institutional quality factors can be used to explain the impact of qualitative factors on economic growth.

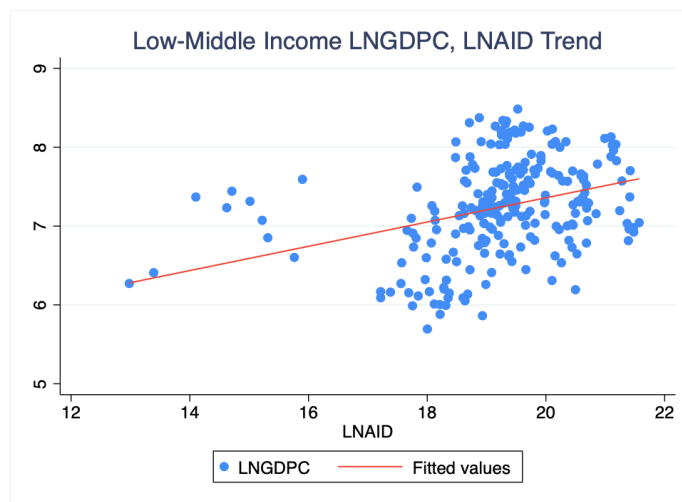
5.2 SUB-REGRESSIONS

In these sub-regressions, I adhere to past literature and the confirmation of my own and look to this idea of "institutional quality". If institutional quality is effective in increasing the economic growth of a country, these sub-regressions will show us which indicators are most important in configuring this.

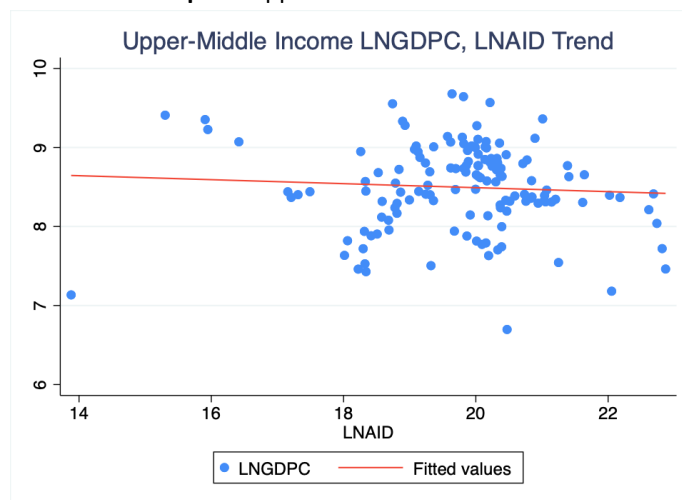
Low-income, lower-middle-income, and upper-middle-income regressions are listed below. In this model, I found a few interesting results. First, I preliminarily analyzed the results of trend graphs, as seen in Graph 3, Graph 4, and Graph 5.



Graph 4. Low-Middle Income Trend Line



Graph 5. Upper-Middle Income Trend Line



Here, we can see the effect aid may have on income levels. First, in Graph 3, we notice that aid has a negative trend with GDP per capita growth. Its overall steep decline may be explained by outliers, as we can see a sort of upward trend towards the graph's bottom. In Graph 4, we can see that low-middle income countries have the highest positive relationship between aid and economic growth. In Graph 5, upper-middle income countries are on the verge of a neutral relationship. In some cases, aid may help increase economic growth. In other cases, aid may deter economic growth. Listed in the appendix are the three regression models used to test the significance of the six indicators used to measure institutional quality. In summary, each regression held different results, which can be explained by the institutional quality indicators that proved significant at these levels.

In each of these sub-regressions, I am using a feasible generalized least square fit for existing heteroskedasticity and autocorrelation. Each model is tested for six indicators of institutional quality: control of corruption [cc], government effectiveness [ge], political stability and absence of violence or terrorism [ps], regulatory quality [rq], rule of law [rl], and voice and accountability [va].

5.2.1. LOW INCOME ANALYSIS

At the low-income level, we can see that aid maintains its effectiveness. As well, there is one institutional quality indicator that is significant at the 10 percent level in this model: voice and accountability. Voice and accountability are the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media. This regression is able to show that with a 1 percent increase in voice and accountability, this will project an 8 percent increase in GDP per capita. Meaning that the more citizens have a voice in their government and their nation, the more benefits they may reap. However, voice and accountability may reference a few sentiments found in the literature review. First, there is this idea that low-income countries tend to be corrupt: Somalia, Syria, and South Sudan. This could mean that their corruption is covered with falsified economic reports that portray their economy as developing in a way that it is actually not, so that they continue to receive aid in hopes of a more fruitful well being for the central government and not the nation as a whole (Nyoni and Bonga 2017). As well, there is the idea that while foreign aid may improve economic conditions, it is actually stunting the growth of the recipient country (Vasquez 2022). We may interpret this through the variable labor force (lf). When the labor force rises, it actually decreases the GDP per capita. This could mean that when more people become available to work and partake in society, it can lessen the amount of foreign aid received by the government and therefore lessen the economic growth that can actually be seen through receiving foreign aid. This may be due to the international donor community promising money to foreign countries with a lack of proper oversight and implementation, which creates an easy availability of money. Therefore, creating a negative incentive for the government not to enact real reforms. Valentina Finckenstein (2021) sites this in her own work about how foreign aid has played a role in keeping entrenched political structures alive. By promoting foreign assistance through

deceptive government systems, there is some gray area in which we cannot conclude for certain whether or not foreign aid is helping to develop a nation without more explanatory variables.

5.2.2. LOWER-MIDDLE INCOME ANALYSIS

At the lower-middle income level, we can see that aid maintains its effectiveness. Here, the institutional quality indicator of rule of law is most significant. Rule of law captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence (World Bank 2023). What this can tell us is that rule of law is important for lower-middle income countries to secure and maintain. For example, lower-middle income countries such as Algeria, Bangladesh, Bolivia, Egypt, Ghana, Iran, Kenya, Lebanon, Morocco, Pakistan, Ukraine, and Zimbabwe, are not entirely corrupt countries. More or less, they are countries that have tried various forms of government after becoming newly independent nations. With that being said, it would make sense that rule of law becomes the most important institutional quality factor because there is a new form of government that has not been perfected. Take the United States as an example with the Civil War or China with their own Civil War. In this regression, labor force still remains a negative factor in economic growth. Perhaps pointing to the idea that the act of producing more goods and services alone cannot necessarily impact the growth of an economy. From my regression we can see that the variable aid shows nearly a 50 percent effect on GDP per capita growth. Yet, labor doesn't. We can explain this through Indonesia, for example. They have high export levels but cannot reap the benefits of those exports because of incredibly high inflation rates (Palomba 2012). Inflation can carry a negative effect as a nation begins to accumulate more profit with no resources to support the growth. Theoretically aside, in lower-middle income countries' aid remains significant and impacts the rise in GDP per capita by four to five percent, meaning that foreign aid, in general, helps to stimulate the economy of these nations.

5.2.3. UPPER-MIDDLE INCOME ANALYSIS

It is in this regression that things take a different turn. At this income level, we can see that the variable of aid becomes an entirely insignificant factor in the economic growth of a nation. With each p-value resting between 80 percent and 90 percent, we can infer that economic foreign assistance does not have an effect on GDP per capita. As well, contrary to low-income and lower-middle income countries, upper-middle income countries have two institutional quality factors that affect them the most: political stability and control of corruption. Political stability and the absence of violence or terrorism refer to the likelihood that the government will destabilize or be overthrown by unconstitutional or violent means, including the risk of politically-motivated violence and terrorism. Control of corruption measures the extent to which public power is exercised for private gain, including both petty and grand corruption. It is at this income level where political stability and control of corruption matter most, which ends up

rendering aid insignificant. However, it is suspected that more observations are required to make a more educated decision. For political stability, we see that it has a positive effect on GDP per capita. Meaning that the more political stability exists within a nation, the more susceptible it is to an increase in economic growth. Contrary to this, we see that controlling corruption has a negative effect on GDP per capita growth. This means that the less control there is over corruption, the more GDP per capita will rise. How accurate this is, both empirically and theoretically, considering the overall importance of institutional quality, seems debatable. However, it could be inherent that the corruption of these nations is what has kept them thriving. For example, Armenia, Azerbaijan, China, Russia, Jordan, Kosovo, South Africa, and Turkey are nations that have faced well-known political instability in the past few decades. Countries such as Azerbaijan, China, Jordan, Kosovo, and South Africa have been recognized for their successful and current attempts at overturning their authoritarian governments as well as their uneven distributions of wealth. Therefore, the idea that controlling corruption would actually decrease alongside GDP per capita growth seems to make a little more sense. Tang and Bundhoo (2017) concluded that aid itself does not have a significant impact on economic growth, as aid tends to increase growth rates in a good environment (aid x policy index), a conclusion we can identify here.

6. CONCLUSION AND POLICY IMPLICATIONS

My research concludes that overall, the United States shows efficiency in promoting economic growth in developing nations to which we disburse aid. A two-percent increase in GDP per capita can vary from small to medium margins in terms of overall economic growth, but nonetheless, it implies that foreign aid is performing its described job function. "Promotes a path to recipient self-reliance and resilience. The purpose of foreign aid should be ending the need for its existence, and we provide development assistance to help partner countries on their own development journey to self-reliance, looking at ways to help lift lives, build communities, and establish self-sufficiency." (USAID history: About Us)

However, further investigation into this relationship shows that aid is not effective in every environment. Aid is effective at the low-income and lower-middle income levels. Where to draw the line between empirical and theoretical becomes hard, but we can infer that the dataset used has provided us with a positive relationship between aid and economic growth at these levels. However, aid fails to be significant at the upper-middle income level. Bringing institutional quality factors into the mix, we can see that the indicators of voice and accountability, rule of law, political stability, and control of corruption are the most influential indicators for economic foreign assistance disbursement by the United States. We can conclude that institutional quality is an important factor in determining the efficiency of aid, which gives us a lead on becoming closer to cracking the code of the highly debated foreign aid–economic growth nexus. This aligns with the literature I have reviewed under 3.2, where qualitative factors help improve the efficiency of U.S. foreign assistance spending. Similar to Burnside and Dollar (2000), Collier

and Dollar (2002), and Nyoni and Bonga (2017), we can infer that institutional quality is a determinant of the economic growth of a nation.

Through all of this, I believe this study is not yet finished. There are qualitative factors, aside from institutional quality, that can readily change the trajectory of a given economy in little to no time. We can, again, use Afghanistan as an example. Before they lost their government to the Taliban, they were already facing economic decline. With the introduction of a new oppressive government, this decline sharpened. This is something that is not considered when quantifying the effects of foreign aid on economic growth. To create an empirical model that can accurately account for factors such as existing civil wars, international wars, climate disasters, regime changes, and more, we can further analyze the efficiency of United States economic foreign aid being used to assist in the development of low-income, lower-middle income, and upper-middle income countries.

ENDNOTES

1. Regression results discussed in this paper are available from the author upon request.

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APPENDIX

1. List of Countries

Low Income	Lower-Middle Income	Upper-Middle Income
1. Afghanistan	17. Nigeria	28. Iraq
2. South Sudan	18. Kenya	29. Jordan
3. Syria	19. Pakistan	30. South Africa
4. Yemen	20. Zambia	31. Lebanon
5. DR Congo	21. Bangladesh	32. Colombia
6. Uganda	22. Indonesia	33. Guatemala
7. Tanzania	23. Ukraine	34. Russia
8. Somalia	24. Sudan	
9. Malawi	25. Ghana	
10. Mozambique	26. Egypt	
11. Ethiopia	27. Zimbabwe	
12. Haiti		
13. Liberia		
14. Mali		
15. Niger		
16. Nepal		

2. Regression Results FE, RE, Robust FE, FGLS

Regression Results				
Variables	FE Model 72.26%	RE 47.62%	Rob FE 72.26%	FGLS
Observations: 691	Coefficient P-value	Coefficient P-value	Coefficient P-value	Coefficient P-value
lnaid	.0324506 0.005	.079287 0.000	.0324506 0.338*	.0164264 0.117
lnexp	.3911383 0.000	.4743222 0.000	.3911383 0.000	.4970967 0.000
lf	.9468174 0.000	.1501187 0.026	.9468174 0.000	-.3242202 0.000
iq	.6235697 0.000	.5439422 0.000	.6235697 0.000	.1512348 0.004
li	-	-	-	-
lmi	-	-	-	-
constant	-17.21109 0.000	-7.12983 0.000	-17.21109 0.000	.7164865 0.183

3. Sub-regression Results

Lower-Income Sub-regression						
Observations: 315						
Variables	(1)	(2)	(3)	(4)	(5)	(6)
VA	.0868856 .089*	...	...	...	...	...
PS	...	.0420899 .137	...	...	...	...
GE	...	...	.0393382 .518	...	...	...
RQ	...	...	...	.0669888 .297	...	...
RL	...	...	...	...	.0954689 .124	...
CC	...	...	...	...	...	.0109055 .864
Ln_aid	.0454403 .030	.0507729 .018	.0466104 .029	.0460118 .028	.0521438 .015	.0446039 .036
Ln_exp	.3024048 .000	.3069235 .000	.3130379 .000	.3063985 .000	.3053643 .000	.3129376 .000
Ln_lf	-.1180689 .116	-.1337896 .072	-.1450976 .050	-.1344037 .068	-.1485984 .045	-.1266676 .091
Cons	.9111116 .410	.9498793 .385	1.074258 .323	1.075654 .331	1.232391 .264	.7937886 .472

Lower-Middle Income Sub-regression

Observations: 240

Variables	(1)	(2)	(3)	(4)	(5)	(6)
VA	.060046 .366	...	...	...	...	...
PS	...	.0540464 .183	...	...	...	...
GE	...	...	.0919967 .157	...	...	...
RQ	...	...	...	.0951264 .209	...	...
RL	...	...	...	...	.1734911 .026*	...
CC	...	...	...	...	...	.0814642 .192
Ln_aid	.0403316 .092	.0442429 .066	.043629 .068	.0399788 .095	.0450181 .062	.043374 .072
Ln_exp	.4969906 .000	.505912 .000	.4869562 .000	.4918592 .000	.4907916 .000	.4933538 .000
Ln_lf	-.317125 .000	-.322822 .000	-.3112864 .000	-.3190898 .000	-.2986237 .000	-.305258 .000
Cons	.1093622 .885	-.0448047 .950	.2069128 .784	.3028838 .670	-.0645351 .927	-.0338004 .964

Upper-Middle Income Sub-regression

Observations: 140

Variables	(1)	(2)	(3)	(4)	(5)	(6)
VA	.049823 .515	...	...	...	...	...
PS	...	.1029066 .029*	...	...	...	...
GE	...	...	.0462371 .499	...	...	...
RQ	...	...	...	.0911273 .173	...	...
RL	...	...	...	...	-.0263083 .695	...
CC	...	...	...	...	...	-.1102937 .089*
Ln_aid	.0014279 .914	.0030798 .820	.0018116 .890	.0004863 .971	.0035457 .798	.0060025 .672
Ln_exp	.5994599 .000	.601051 .000	.5942095 .000	.5932444 .000	.5972322 .000	.5913547 .000
Ln_lf	-.3275288 .000	-.3475514 .000	-.3338861 .000	-.3205399 .000	-.334485 .000	-.3350259 .000
Cons	-.8155619 .332	-.5129925 .470	-.6038292 .442	-.7667258 .316	-.7248128 .331	-.6622862 .352

Lights Out: Impact of Power Outages on Firm Performance in India

Mitali Pradhan¹

ABSTRACT

Firms in India indicate electricity as one of the biggest obstacles to business activity as per the World Bank Enterprise Survey (WBES). In this paper, I estimate the impact of power outages on firm sales, labor productivity and exports. I use firm-level data for India from the WBES and instrument for power outages with the region-industry average of all other firms in this group. My estimates show that bringing down the average number of monthly power outages to 0 would increase firm sales by 52% and labor productivity by 65%. In contrast, eliminating power outages is not a sufficient condition to improve export potential or magnitude. These impacts vary across regions.

INTRODUCTION

Electricity supply is one of the most critical components of the modern production process. While the industrial revolution began in the middle of 18th century, it was the commercial use of electricity that sped up production processes and enabled businesses to scale up to levels not seen before¹. Today, more than ever, electricity is critical to spur industrialization and achieve economic growth. However, according to the latest rounds of the World Bank Enterprise Survey (WBES) firms in developing and least developed countries (LDCs) cite unreliable power supply as one of their primary impediments to doing business. Electricity consumption in India has been increasing at an average rate of 8.84% and it is the highest in the industrial sector as compared to agriculture, railways, commercial and others (Tiewsoh et al., 2019). At the same time, as per the latest round of the WBES, firms in India identify electricity as one of their primary obstacles to doing business.

In this paper, using firm level data from the WBES, I analyze the causal impact of power outages on firm sales, labor productivity and exports. A primary concern in estimating such a causal impact is that power outages are endogenous to business activity. Power outages are endemic to regions with overall poor economic growth. Firms in energy intensive industries might exhibit more demand for electricity, causing an overload on the electricity grid thus leading to more power outages. Newer firms are more likely to have in place energy efficient infrastructure as compared to older firms so older firms cause a larger strain on the power grid and cause power outages. I address these endogeneity concerns in a couple of ways. First, I control for firm characteristics such as age, size, legal status, degree of private ownership and regional and industry level heterogeneity. Second, I instrument for a firm's power outages using the average power outages for the industry and region that the firm operates in. This average leaves out the power outages of

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the i^{th} firm and is called a leave-one-out or a spatial instrument. In this case, while the regional-industry average power outages are correlated with the number of power outages experienced by the firm in question, since that number is left out of the average calculation, the regional industry average will be exogenous to that firm's outcomes.

My instrument variable (IV) estimates show that power outages impact firm performance significantly by throttling sales as well as labor productivity. Each instance of power outage reduces firm sales by 2% and labor productivity by 2.5% respectively. To put this in context like Abeberese et al., (2021) do for Ghana, it is helpful to know that firms in India on average experience 26 power outages per month as per the WBES data. Reducing this number to 0 would increase sales by 52% ($26 \times 2\%$) and labor productivity by 65% ($26 \times 2.5\%$). Export potential is also marginally impacted. However, power outages do not have a statistically significant impact on the magnitude of exports, implying that uninterrupted power supply is a necessary condition for improving business performance, but perhaps not a sufficient condition to also motivate firms to export.

While the main specification controls for heterogeneity by region, I next examine if the impact of power outages is heterogeneous across geographical regions. The administrative divisions within India are called states and union territories. I compare firms located in BIMARU states, an acronym used to describe a group of states (Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh, Chhattisgarh, Jharkhand, Uttarakhand) that lag the national average in terms of several demographic indicators, to firms located outside this region. Estimates show that firms located in this region that experience power outages have lower sales, labor productivity and probability of exporting as compared to firms located outside this region.

This paper extends the current literature in an important way by to my knowledge being the first paper to present heterogeneous regional impact estimates alongside the aggregate nationwide impact of power outages on firm sales and productivity. Several cross-country studies look at power supply interruptions and the resulting effect on firm performance in the context of developing countries. Cole et al., (2018) use firm-level data for 14 countries in Sub-Saharan Africa (SSA) from the WBES database and instrument for power outages using variation in hydroelectric power generation caused by varying climatic conditions that affect water supply to the rivers. Their estimates show that reducing the level of power outages would substantially increase firm sales, and more so for firms without generators. Gupta and Singh, (2021) use cross-sectional firm-level data from the WBES for 106 countries and instrument power outages with the mean of power outages at the country-city-industry level. Their estimates show that power outages have a negative impact on firms' export orientation as measured by the decision to export and export propensity.

Country specific studies that examine the impact of power shortages on firm performance in developing and least developed countries include Adenikinju, (2005) who find that power outages impose significant costs on businesses in Nigeria and the bulk of these costs come from installing backup capacity to prevent further losses, Fisher-Vanden et al., (2015) who show that electricity scarcity from 1999 onwards led to an increase in per unit production costs for Chinese firms, and Abeberese, et al., (2021) who exploit the

variation in power outages induced by an electricity rationing program and show that eliminating outages would increase the productivity of SME enterprises in Ghana. Allcott et al., (2016) look at this impact in the context of India and find that power shortages reduce firms' revenue and producer surplus, but productivity losses are significantly smaller. However, there is a wide variation amongst Indian states in terms of major economic indicators. Hence while an aggregate estimate is important, it is also important to look at the power shortage problem specifically in the context of the BIMARU states which lag the national averages in terms of major demographic indicators like birth rate, death rate, infant mortality rate, female literacy rate and so on. This paper aims to address this gap by looking at regional heterogeneity and showing that firms experiencing power outages that are located in BIMARU states suffer more than those located outside the region in terms of lower sales, labor productivity and probability of exporting.

The sections that follow discuss data, the empirical specification used for analysis, the main results, variation in estimates by geographical regions and the conclusion. Robustness checks and heterogeneity by firm size are not included in this conference proceedings publication but are available upon request.

DATA

For this analysis, I use publicly available firm-level data from India, collected through the latest round of the World Bank Enterprise Survey. The dataset includes 9,281 firms that were surveyed during the years 2013 and 2014. The firm here implies an establishment with a physical location and independent financial books of accounts (World Bank, 2021). Survey data is collected by stratified random sampling. Stratification is done by firm size (small firms, medium firms, large firms), sector (manufacturing with further disaggregation if needed, retail, other services) and geographical location. Each country-level dataset is then standardized to match a common survey template so that these datasets can be aggregated across time, countries and regions. More details on the sampling methodology can be found in sampling note³.

The surveys include information about firm characteristics such as the size of the firm, its legal status (sole proprietorship or limited partnership or company and so on), the year in which the firm was established, number of full-time and part-time/seasonal workers employed and more. The questions also focus on different factors that affect the business environment such as physical infrastructure, regulations and taxes, corruption, crime, access to finance, workforce and firm outcomes such as revenue, trade, capacity utilization etc. (World Bank, 2017).

Of the 9,281 firms surveyed, 65% indicate that they experience power outages. After checking the dataset for outliers², summary statistics for 5,997 firms based on the WBES for India are summarized in Table 1. Panel A of the table shows firms' characteristics that are controlled for in the main specification and Panel B shows firms' outcomes. The average age of the firms in the sample is 19 years and the median firm is about 15 years old. The average number of workers is approximately 121. However, even firms in the 75th percentile have only 102 workers which implies that there aren't too many large firms in the sample. The

survey also asks firm respondents to indicate firm size based on the following four classifications – i) Micro <5 employees ii) Small ≥ 5 and ≤ 19 employees iii) Medium ≥ 20 and ≤ 99 employees and iv) Large ≥ 100 employees. No firms in the dataset have less than 5 employees. 76% of the firms fall in the small and medium categories combined. Mean private ownership indicates the percentage of the firm that is owned by private domestic individuals, companies or organizations. Mean private ownership is 99% and the median is 100% which means a majority of the firms in the dataset are privately owned.

Table 1. Summary Statistics

Panel A: Firm Characteristics						
	Mean	Median	25 th Percentile	75 th Percentile	Min	Max
Firm Age	19	15	9	25	0	150
# Workers	121	40	17	102	5	4,505
Private Ownership %	99	100	100	100	0	100
Power Outages	26	20	10	30	0	150
Observations	5,997					

Panel B: Firm Outcomes						
	Mean	Median	25 th Percentile	75 th Percentile	Min	Max
Sales (in logs)	17.7	17.6	16.2	19.1	12.6	25.3
Labor Productivity (in logs)	13.9	13.8	13.0	14.7	10.0	19.1
Export dummy	0.1	0.0	0.0	0.0	0.0	1.0
Direct Exports (% of Sales)	6.4	0.0	0.0	0.0	0.0	100.0
Observations	5,997					

Notes: Based on author's calculations. Data source: Enterprise Surveys, The World Bank, <http://www.enterprisesurveys.org>

The most important variable of interest in Panel A is the monthly average number of power outages experienced by a firm. Firms in India experience on average 26 power outages in any given month, which indicates that frequent power outages are a norm rather than an exception when doing business. This, in comparison to developed countries where the average number is 0, gives a sense of the extent of setbacks faced by firms in lower-middle-income developing countries.

Table 1, Panel B shows the four outcome variables of interest namely, natural log of sales and labor productivity, export probability and magnitude. Sales are measured in Indian Rupees, the nation's domestic currency and deflated to constant prices using the consumer price index data⁴. The average log of sales is 18. Labor productivity is calculated as sales per worker and the average log labor productivity is 14. Only 1,288 firms directly export to the international market and the average direct exports as a percentage of total sales are 6.4%. Thus, a very small subset of the firms has been able to expand the scope of their business to the international market. Detailed variable definitions are mentioned in Appendix Table A1.

EMPIRICAL SPECIFICATION

I use the following linear regression model to estimate the causal impact of power outages on firm sales, productivity and exports.

$$Y_{ij} = \beta_0 + \beta_1 \text{poweroutages}_{ij} + \gamma' X_{ij} + \delta_j + \rho_r + \epsilon_{ij}(1)$$

Y_{ij} is the vector of outcome variables for firm i in the industry j . I estimate the impact of power outages on four firm outcomes namely, firm sales, labor productivity, export potential and export magnitude. I use the natural log of sales and labor productivity which is calculated as sales per worker. To estimate the impact on export potential, I create a variable “exporter” that takes the value 1 if firm i 's direct exports as a percentage of sales is greater than 0 and 0 otherwise. I estimate the impact on export magnitude using direct exports as a percentage of sales as the dependent variable.

The main independent variable of interest is *poweroutages* which represents average monthly power outages experienced by firm i in industry j . X_{ij} represents a vector of controls for various firm characteristics such as firm age, size as indicated by the firm and also in terms of the number of temporary and permanent workers employed during a financial year, legal status and percentage of private ownership. I also include industry (δ_j) and region (ρ_r) fixed effects to control for time invariant characteristics common across firms in a specific region and industry respectively.

The main concern with using an OLS estimator here is that power outages are not random. Economically underdeveloped regions are also likely to have an inefficient electricity distribution network. A weak or poorly maintained electricity distribution grid is susceptible to voltage fluctuations, low voltage power lines both of which can lead to power losses (Doig, 1999). Firms in energy intensive industries might exhibit more demand for electricity, causing an overload on the electricity grid, thus leading to more power outages. Newer firms are more likely to have in place energy efficient infrastructure as compared to older firms so that older firms may cause a larger strain on the power grid and cause power outages. These endogeneity concerns may cause the OLS estimates to be biased. To alleviate these concerns, I use an instrumental variable (IV) estimator, where I instrument for power outages by using the industry- region average number of power outages for all firms as a proxy for any particular firm's indicated number. When calculating this average, I exclude the respective firm's number of power outages. This is called the leave-one-out or a spatial instrument and is commonly used in social sciences (see Lin, 2009, Fruehwirth et al., 2019, Caselli, 2020 for other applications). Excluding the i^{th} firm's information ensures that the created instrument which is the regional-industry average of power outages is exogenous to the main specification while being strongly correlated with the i^{th} firm's number of power outages.

RESULTS

Table 2 presents the results for the main specification as given by equation (1). The OLS estimates reported in Panel A indicate that an additional instance of power outage during a month, would reduce firm sales by 0.3% (Column 1), labor productivity by 0.2% (Column 2), probability of exporting by 0.1% (Column 3) and direct exports by 4.5% (Column 4). However, given the endogeneity concerns described in the previous section, I use the leave- one-out IV estimator to analyze the impact and these results are reported in Table 2, Panel B. After controlling for various firm characteristics and industry and region heterogeneity, an increase in the monthly average of power outages by 1, reduces the firm's sales by 2% (Column 1) and labor productivity by 2.5% (Column 2). Another way of putting these estimates in context like Abeberese et al., (2021) is to consider that the average number of power outages in a month reported by Indian firms is 26. In developed countries, the monthly average can be expected to be close to 0. So, reducing the monthly average number of power outages for firms in India from 26 to 0, would increase firm sales by 52% (26 x 2%) and labor productivity by 65% (26 x 2.5%). These results are similar to Cole et al., (2018) who show that reducing the power outages in SSA firms to the level of South Africa would increase firm sales by 85.1%, which would rise to 117% for firms without a generator.

Table 2. Impact of Power Outages on Firm Performance

Panel A: OLS Estimates				
	(1)	(2)	(3)	(4)
	Log Sales	Log Labor productivity	Exporter	Direct Exports
Power Outages	-0.003*** (0.001)	-0.002** (0.001)	-0.001*** (0.000)	-0.045*** (0.014)
Observations	5,655	5,655	5,786	5,786
Adjusted R ²	0.59	0.23	0.22	0.23
Panel B: IV Estimates				
	(1)	(2)	(3)	(4)
	Log Sales	Log Labor productivity	Exporter	Direct Exports
Power Outages	-0.020*** (0.005)	-0.025*** (0.005)	-0.002** (0.001)	-0.060 (0.064)
Observations	5,621	5,621	5,751	5,751
F-statistic from first-stage regression	150.33	150.33	151.09	151.09

Notes: Robust standard errors in parentheses. *poweroutages* are instrumented by the regional-industry average, leaving out the *i*th firm from the calculation. Firm controls include firm age, indicated size, number of workers, percentage of private ownership, industry and region fixed effects. * $p < .10$, ** $p < .05$, *** $p < .01$. First stage regression results are reported in section 5.1. Kleibergen-Paap Wald rk F statistic reported in the table. F statistic varies between outcomes due to minor differences in sample size.

IV estimates for the probability of exporting (Panel B, Column 3) of table 2 show that the marginal effect of an increase in average monthly power outages by 1, is a 0.2% decline in the probability of exporting. The IV coefficient estimate for direct exports (Panel B, Column 4) is statistically insignificant implying that there is no evidence that for the firms that do exports, a decrease in the number of average monthly power outages increases these exports as a proportion of their annual sales. This can imply that while unreliable electricity supply might be a critical obstacle to conducting business activity, alleviating this crucial concern is a necessary but not a sufficient condition to improve the magnitude of exports. These results contrast with studies such as Gupta and Singh, (2021) which show that power outages in fact do affect firms' export performance.

HETEROGENEITY ANALYSIS

The main specification controls for firm size as well as regional and industry heterogeneity. In this section, I explore how the impact of power outages on firms' outcomes differs across regions. Analysis by firm size and type of industry is not included here but is available upon request.

BIMARU States

The administrative divisions within India are called states and union territories. The nation is comprised of 28 states and 8 union territories. There is tremendous variation across these states in terms of economic earnings measured by per capita GDP. I look at a particular subset of these states collectively known by the acronym BIMARU. These states are Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh along with Chhattisgarh, Jharkhand and Uttarakhand which were part of the BIMARU states when the term was coined. The acronym is close to the Hindi word "Bimar" which means "sick". As Sharma (2015) explains, "the term was coined by demographer Ashish Bose in the early 1980s while commenting on India's demographic diversity". According to Sharma (2015), back then, these states collectively housed 40% of India's population and lagged behind other states in terms of all major development indicators such as birth rate, death rate, infant mortality rate, female literacy rate and so on.

I look at the impact of power outages on firms within this group of states after controlling for firm age, size, legal status and industry by creating an indicator variable BIMARU that equals 1 if the firm is located in any of these seven states and 0 otherwise and interact this variable with power outages. However, since power outages are endogenous to business activity, I instrument this interaction by its proxy which is simply the instrument for power outages interacted with the indicator variable BIMARU. Results are reported in Table 3.

Table 3. Impact of Power Outages on Firms in BIMARU States

	IV Estimates			
	(1) Log Sales	(2) Log Labor productivity	(3) Exporter	(4) Direct exports
Power Outages	0.002 (0.001)	0.002* (0.001)	0.000 (0.000)	0.070*** (0.018)
BIMARU x <i>poweroutages</i>	-0.034*** (0.003)	-0.030*** (0.003)	-0.003*** (0.001)	-0.163*** (0.034)
BIMARU States	0.680*** (0.084)	0.639*** (0.076)	0.083*** (0.021)	6.026*** (1.116)
Observations	5,621	5,621	5,751	5,751
F-statistic from first-stage regression	254.29	254.29	254.95	254.95

Notes: Robust standard errors in parentheses. *poweroutages* are instrumented by the regional-industry average, leaving out the i^{th} firm from the calculation. Firm controls include firm age, indicated size, number of workers, percentage of private ownership and industry fixed effects. * $p < .10$, ** $p < .05$, *** $p < .01$. Kleibergen-Paap Wald rk F statistic reported in the table. F statistic varies between outcomes due to minor differences in sample size.

The coefficients on the interaction variable BIMARU x *poweroutages* indicates that firms that are located in any one of these BIMARU states and experience power outages, have 3.4% fewer sales (Table 3, Column 1) and 3% less labor productivity (Table 3, Column 2) for every additional instance of power in the month as compared to firms located outside the BIMARU states.

This implies that electricity is a much more severe infrastructural constraint for firms within these states than those outside. For firms that experience power outages and are located within these states, the probability of exporting declines by 0.3% (Table 3, Column 3) as compared to firms located outside these states. This coefficient is statistically significant at the 1% level of significance and exports as a percentage of sales for firms in these states are 16.3 percentage points lower (Table 3, Column 4) than that of firms located elsewhere. This implies that facing power interruptions reduces export potential and magnitude of firms in these states as compared to firms located elsewhere in the country. Given that the BIMARU states still lag behind the national average for most demographic indicators (Sharma, 2015), focusing on this infrastructural hurdle might be even more critical to achieving economic growth in these states.

CONCLUSION

This paper looks at the impact of power outages on several firm outcomes such as sales, labor productivity, export potential and export magnitude using an instrument variable estimation technique.

Since power outages are endogenous to business activity, I instrument for the number of average monthly power outages indicated by a firm using the regional-industry average of power outages for all other firms in the group. This leave-one-out method ensures that while the instrument is strongly correlated to firm *i*'s power outages and satisfies the test for a strong instrument, it is exogenous to specification.

Main estimates show that power outages adversely impact firms' sales, labor productivity and export potential. When looking at firms that do export directly or indirectly to the international markets, there is no evidence to conclude that power outages affect export magnitude. These results are in line with the existing literature on the impact of power outages in developing countries and indicate that power supply interruptions are a serious concern to the smooth functioning of a business. For a lower middle-income country like India, where the average number of power outages in a month for all firms stands at 26, driving down this number to 0 as it is in developed countries would have a tremendous impact on firms' performance. However, the estimates also tell a more cautionary tale about export performance. While reducing power outages might marginally increase a firm's probability of exporting, they have no impact on a firm's magnitude of exports. This implies that while tackling the problem of power outages might be a necessary condition for increasing sales and productivity, it is not a sufficient condition for improving firms' export performance. Next, I compare firm outcomes for firms experiencing power outages within the BIMARU states that lag behind the national average for all critical demographic indicators to firms located elsewhere in the country. My estimates show that the effect of power outages on firms' revenues, labor productivity and probability of exporting is in fact adverse for the firms located within these states as compared to firms located outside.

The analysis confirms power outages as a critical channel through which electricity proves to be an obstacle to firms' business activity. This evidence should alert the policymakers and other stakeholders to the need to address this issue. This begets a crucial follow-up question which is, what causes these power outages? The reasons could range from insufficient power generation and supply to the lack of a well-functioning or poorly maintained power distribution grid. While all of these are beyond the scope of the WBES and hence this paper, they are equally important to investigate further and hence the paper concludes by bringing them to the readers' attention.

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ENDNOTES

1. <https://sciencing.com/how-did-electric-power-impact-industry-13655650.html>
2. https://www.enterprisesurveys.org/content/dam/enterprisesurveys/documents/methodology/Sampling_Note-Consolidated-2-16-22.pdf
3. Observations where calculated firm age is less than 0 due to incorrect establishment year reporting, extreme values for total number of workers using the user written STATA command `extremes` (Cox, 2017) (in this case, less than 5 and greater than 6000) are excluded.
4. Organization for Economic Co-operation and Development, Consumer Price Index: All Items for India [INDCPIALLAINMEI], retrieved from FRED, Federal Reserve Bank of St.Louis; <https://fred.stlouisfed.org/series/INDCPIALLAINMEI>, March 31, 2022. Base year is 2015=100.

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APPENDIX**Table A1.** Variable Definitions

Outcome Variables	
Log Sales	Natural log of sales measured in USD
Labor Productivity	Annual Sales (USD)/Total workers
Log Labor Productivity	Natural log of labor productivity
Export dummy	Takes the value 1 if direct exports as % of sales > 0; 0 otherwise
Direct Exports	
	Direct exports expressed as a % of sales
Independent Variables	
Power Outages	# Average monthly power outages experienced by firm i in industry j
Firm Age	Age of the firm counting from year of establishment to survey year
# Workers	Total workers measured as temporary + permanent
Firm Size	Micro <5 employees, Small >=5 and <=19 employees, Medium >=20 and <=99 employees, Large >=100 employees
Legal Status	Shareholding company with shares trade, Shareholding company with non-traded shares, Sole proprietorship, Partnership, Limited partnership, Other
Private Ownership (%)	% of the firm owned by Private domestic individuals, companies or organizations
Female Ownership (%)	% of firm owned by females
Land (%)	% land owned by the firm
Management Time	% of Senior management's time
BIMARU	Equals 1 if the firm is located in either of the states of Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh, Chhattisgarh, Jharkhand and Uttarakhand; 0 otherwise

The Optimal Schedule in Expanding a Franchise Business

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ABSTRACT

This project aims to provide a framework for a franchise to establish multiple locations while maintaining employee satisfaction and quality service. An essential element to succeeding in business is strategic financial resource allocation based on business performance and inflation rates. In this paper, we set up a deterministic dynamic optimization model that maximizes overall utility used to plan optimized growth-oriented operations. We also use numerical methods and tools including data analysis, estimation, and simulations to determine the monthly savings towards capital expenditures. We also created an optimized time schedule for establishing new franchise locations.

INTRODUCTION

Due to new developments in technology and the expansion of franchising, businesses are growing more rapidly than ever. Franchising aims to expand and make higher profits while maintaining worker satisfaction. Franchise businesses help assist the franchisee, encourage brand recognition, and decrease the failure rate. "In general, franchises see higher profits than independently established businesses"(Lauckner, 2010). Unemployment is a big problem in our today's economy where the price of living increases daily and in response, people need extra jobs or more paying jobs. Although these franchises help decrease these problems, there comes sacrifices in operating them. The initial cost of opening up at new locations might be difficult for some small business owners. For businesses to keep opening up new locations, they have to maintain a certain amount of money from their profit to pay off wages, expenses, and initially have saved up enough to open a new location.

Expanding a business by creating multiple locations is one of, if not the most, effective way to increase capital created. Having more stores would create more sales as each store could sell products simultaneously. However, despite being an obvious choice for increasing the revenue of a business, there are a lot of intricacies that go into knowing how and where to expand. To start with, as shown by Frazer et al Expansion Through Multiple Unit Franchising, one of the multiple factors that influence where or how to expand a franchise includes not creating a store located too close to another store. Studies and interviews with store owners have shown that having stores too close together can harm overall sales since it would be

reaching such a small number of potential customers. However, having stores too far apart could make deliveries difficult and much too expensive. It is critical to evaluate the local market dynamics, level of competition, and customer demand before opening a new store. The profitability and potential success of a new store will be determined in part by understanding the target audience and their preferences. One important factor is the availability and cost of real estate. It might be difficult to find good locations that are close to clients, have enough parking, and fit with the brand's style. Additionally, the cost of renting or buying property can differ greatly by region, which can affect the expansion's overall financial health. A thorough business plan is also necessary to direct the expansion process (Lauckner and Beaupre, 2010; Weaven and Frazer, 2017).

Another factor that is believed that must be taken under consideration is the types of employees that are being hired by each new store. This dilemma is shown through the following: New inexperienced employees are willing to do work at a lower rate but for lower pay, however, if you were looking for a store manager, you would want someone with experience, even though they may end up asking for higher pay. Finding the ideal mix between experience and cost is essential when employing staff. While initially saving money by recruiting less experienced workers, this practice might result in inefficiencies and higher training expenses in the long-run. On the other hand, seasoned workers might demand greater pay but bring significant leadership and expertise to the new site. Franchise expansion's financial effects must be efficiently analyzed by taking into account several factors, including the initial investment needed for each new location, estimated monthly income, and ongoing costs for things such as salaries, overhead, and supplies. As shown, franchising is a beneficial first step to increase revenue, however, in doing so, other criterias need to be taken into consideration.

All chain restaurants and fast food establishments have undergone this same process as previously mentioned. One example of a store that has been flourishing recently and booming across the nation is Jersey Mike's, a place known for its heroes. Jersey Mike's began in Point Pleasant, New Jersey, in 1956. They began with that single location located in the center of the Tri-State area. After making a good enough surplus of cash because of their location, the business began to expand their success to other places in the Tri-State area. After those stores also began thriving in their respective areas, the business began expanding across the rest of the country, eventually reaching the West Coast. This expansion, still ongoing, is what made Jersey Mike's the household name we all know today, all due to the power of franchise expansion done correctly.

Franchise companies are a growingly popular way for business owners to grow their operations while utilizing well-established brand recognition. However, expanding a franchise business requires careful planning and execution to achieve long-term success and profit. One vital step in this process is choosing the best timetable for expanding franchise units. The expansion of a franchise business demands strategic decision-making that takes into account a variety of factors such as market conditions, financial resources and customer demand. Franchise owners may improve their growth efforts, reduce risks, and increase returns on investment by using an effective expansion schedule. Consequently, franchise owners and other stakeholders must understand the key elements and factors to take into account while creating an ideal expansion schedule.

In this project, we plan on looking at a hypothetical company that is beginning its first store with 2 million dollars set aside, and looking to increase the revenue to begin opening more stores under the same franchise title. To do so, we would rather need to set a time frame to expand the franchise or the number of stores to expand to. With any of those data points given, we would then be calculating how much it would cost to open up a new franchise location, how much we would be averaging every month from income, and how much we would be spending on wages, overhead, supplies, and other expenses. Once we calculate and create an equation we would have a value for every income or outcome that affects our store productivity and potential expansion, we would then perform sensitivity analysis to determine the accuracy of our numbers and change them as necessary, giving us a final, accurate equation.

MODEL FORMULATION

Let $x(t)$ be the state of the capital of the business in millions of dollars and $f(x(t))$ be the production function. Suppose the business spends $m(x(t))$ of the production to cover maintenance costs. Let $E(t)$ be the control function that determines the growth rate of the capital, an amount of money deposited to the cash part of the capital that will be invested in expanding the business by opening more franchise units. Then,

$$c(t) = f(x(t)) - m(x(t)) - E(t)$$

is the balance left to take care of payroll. We assume that the level of employee and hence customer satisfaction at time t is measured by $\ln(c(t))$. The objective of the financial planner is to determine an optimal expansion plan, $E^*(t)$, such that,

$$J(E^*) = \max_{E,x} \int_0^{t_f} [\ln(f(x(t)) - m(x(t)) - E(t))] e^{-rt} dt \quad (1)$$

or subject to

$$\frac{dx}{dt} = E(t), \quad x(0) = x_0, \quad x(t_f) = x_f, \quad t_f \text{ is free.}$$

The Hamiltonian corresponding to the problem is

$$H(x,E,\lambda,t) = \ln(f(x) - m(x) - E)e^{-rt} + \lambda E, \quad (2)$$

where λ is the shadow value. The necessary condition for the optimal solutions, $E^*(t)$ and $x^*(t)$, is to satisfy the Maximum Principle

1. $\frac{\partial H}{\partial E} = 0$,
2. $\frac{d\lambda}{dt} = -\frac{\partial H}{\partial x}$, $H(t_f) = 0$, and
3. $\frac{dx}{dt} = E(t)$, $x(0) = x_0$, and $x(t_f) = x_f$ fixed, t_f free.

That is,

$$-e^{-rt} + \lambda(t)[f(x(t)) - m(x(t)) - E(t)] = 0 \quad (3)$$

$$\frac{d\lambda}{dt} = - \left[\frac{f_x(x(t)) - m_x(x(t))}{f(x(t)) - m(x(t)) - E(t)} \right] e^{-rt}, \quad H(t_f) = 0 \quad (4)$$

$$\frac{dx}{dt} = E(t), \quad x(0) = x_0, \quad \text{and } x(t_f) = x_f \text{ fixed.} \quad (5)$$

FUNCTIONAL FORMS AND NUMERICAL RESULTS

Suppose the production function is given by $f(x) = \alpha x$, where α is the margin of profit, and the maintenance cost is $m(x) = \rho x$. Solving for $E(t)$ from Equation 3 and substituting this and $f(x) = \alpha x$ and $m(x) = \rho x$ in Equations 4 and 5, we get,

$$\frac{d\lambda}{dt} = -\frac{(\alpha - \rho) \cdot e^{-rt}}{\alpha \cdot x(t) - \rho \cdot x(t) - \frac{-e^{-rt} + ((\alpha - \rho) \cdot x(t)) \cdot \lambda(t)}{\lambda(t)}}, H(t_f) = 0, \text{ for free final time, } t_f \quad (6)$$

$$\frac{dx}{dt} = \frac{-e^{-rt} + ((\alpha - \rho) \cdot x(t)) \cdot \lambda(t)}{\lambda(t)}, x(0) = x_0 \text{ and } x(t_f) \text{ is fixed} \quad (7)$$

The above system of equations can be solved to find the optimal analytic solutions in terms of the parameters. Instead, we solve the system numerically which enables us to adjust them quarterly utilizing a dynamic programming approach.

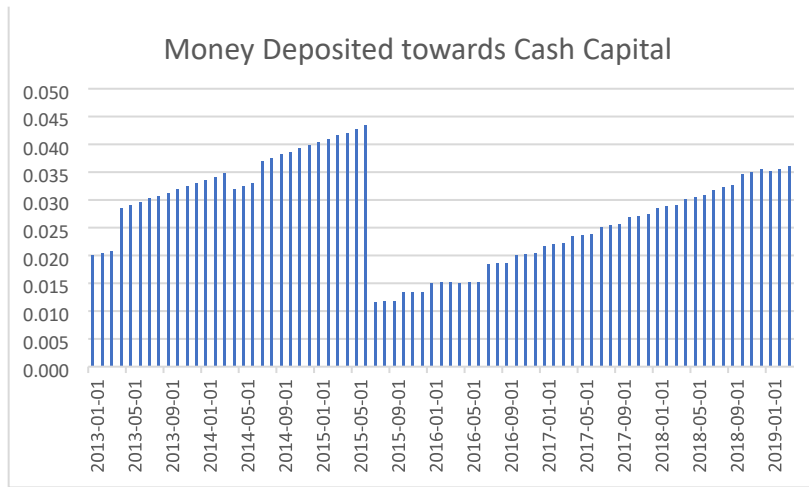


Figure 1: The deposit towards the cash capital

The amount of money we save towards the cash capital must take into consideration the expected marginal profit and inflation rate. Moreover, the motivation and how much to sacrifice determines the rate of saving and hence the optimized amount of time required to open the next store. We include these parameters in our model and adjust the trajectory of our contribution to the savings account. We also evaluated the cash available for payroll which includes a payment for the owner of the business, assumed to be a net profit (see Figure 2).

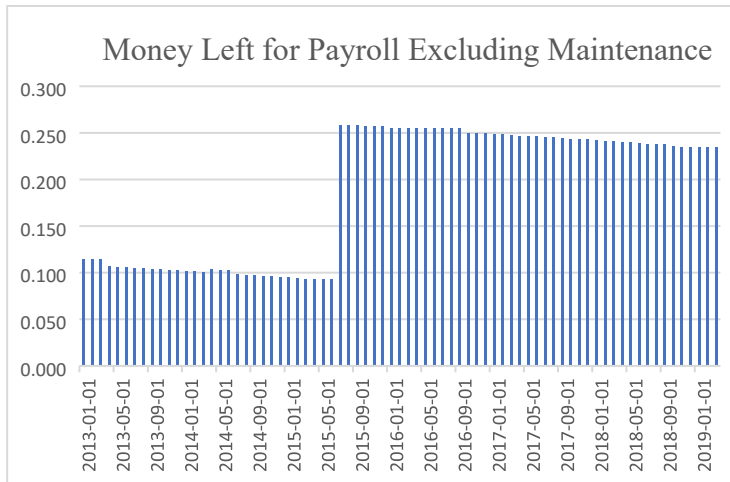


Figure 2: The net cash available for payroll after maintenance and capital growth saving when the owner owns one, then two stores

DISCUSSION

The numerical simulation results show that we kick off the saving towards the cash capital with the initial value based on the motivation and desire to have a second store. Then continuing to save at almost the same level and gradually increasing the rate is an effective method to achieve the goal. We realize with this method it takes 11 quarters (33 months) to reach our goal of opening a second store. After opening the second store, we reduced the rate of saving significantly to give a break to the owner. We realize that opening up the third store takes 14 more quarters (about 41 months after the second store). We realize that it takes the owner about 11 months longer to open up this third store than the second one. We concluded that this was the best decision to keep growing the business and not push the owner of the store into a demanding or exhausting situation.

After opening up the second store, even though the aggression level towards capital expansion decreased; the owner received brand recognition, a lower risk of failure, and most importantly, increased profit. The owner would have to consider other costs as well, such as maintenance costs and employee salaries while expanding their business. As seen in Figure 2, the money left for payroll excluding maintenance increases almost double the amount after the second store is opened due to double the income. We believe that as income increases with each new store, the potential for increased profitability and operational capacity also rises.

Based on the data, the approach we have detailed focuses on gradual, sustainable growth while maintaining a realistic timeline and taking various costs into account. The strategy not only maximizes prospective profit but also prioritizes the well-being of the business owner and the overall success of the business. This comprehensive approach to expansion is likely to lead to long-term success and stability.

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Enterprise Valuation Multiples and Employment: Evidence from Three (3) NYC-Based Financial Services Firms

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ABSTRACT

Using public data and official statistics, this paper explores the correlation between enterprise valuation (using standard measures such as EV/EBITDA, P/E ratios) and employment in the three (3) largest publicly-traded financial services firms headquartered in New York City (NYC) (measured by revenues, market capitalization, and share of total employment). We focus on the period between 2013 and 2022 to explore the relationship between enterprise valuation multiples and employment for the selected NYC-based financial services firms during this period.

INTRODUCTION

The financial sector is an important contributor to New York City's economy, particularly in terms of its contributions to employment, wages, and gross domestic product (New York State Department of Labor, 2021). According to official statistics, 9 out of 10 financial sector jobs in New York State are located in New York City (New York State Department of Labor, 2021). The financial sector generates positive externalities to the City's economy through its relatively high employment multiplier effect (Office of the New York State Comptroller, 2021). It is estimated that for every permanent full-time job in New York City's financial sector, between 2 and 4 non-financial jobs are created (Office of the New York State Comptroller, 2021). The securities industry, a major subsector within the City's financial services industry, contributes to 7% of New York City's tax revenue and 23.3% of its income tax collections (Gonzalez-Corzo & Gargalas, 2019).

Despite its economic contributions and spillover effects, employment in New York City's financial is characterized by relatively high levels volatility (Office of the New York State Comptroller, 2021). This is primarily due to the cyclical nature of the principal sources of revenue for financial sector firms, such as credit intermediation, lending, trading commissions, advisory services, and asset management fees.

Given the cyclical nature of employment in the financial sector, and the role of relative valuation measures as indicators of investors' expectations about future revenues and profits, we apply a multiple linear regression model to examine the relationship between employment (a proxy for labor demand) and three (3) of the most commonly-used relative valuation measures on Wall Street: (1) the Price-Earnings

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(P/E) ratio, (2) Enterprise Value (EV), and (3) the EV/EBITDA multiple (Hooke, 2010). Our study focuses on the three (3) largest financial services firms headquartered in New York City (measured by revenues, market capitalization, and share of total employment).

The paper is organized as follows. Section 1 contains this introduction. Section 2 describes the materials and methods used in our study. Section 3 discusses the results. Section 4 presents the conclusions.

DATA SOURCES AND COLLECTION

Financial and employment data for the top-three (3) publicly-traded financial services firms headquartered in New York City (NYC) used in this study was directly obtained from the 10-K Form filed with the Securities and Exchange Commission (SEC) to collect. Employment data for NYC's Financial Activities Sector was obtained from the NY State Department of Labor's Current Employment Survey (CES). This data is not seasonally-adjusted.

COMPANY SELECTION PROCESS

The NYC-based, publicly-traded, financial services firms included in our study were selected based on the following metrics (or indicators):

- (a) Sales (or Revenues)
- (b) Market Capitalization (or Market Value of Equity – MVE).
- (c) Number of Employers

In addition to being headquartered in NYC, these three (3) financial services firms included in our study were selected because unlike many of their competitors, they can be classified as both: (a) depository institutions and (b) non-depository institutions. Depository institutions include commercial banks, credit unions, savings banks, and savings and loans associations (S&Ls) (Fabozzi, Modigliani, & Jones, 2010). They are financial intermediaries that accept deposits, and their income is primarily derived from loan origination, purchases of financial assets (or securities), and fees or charges for intermediation or brokerage services (Fabozzi, Modigliani, & Jones, 2010). Non-depository (financial) institutions generate the majority of their income from risk-bearing activities, securities underwriting, and multiple forms of fee income and investment income (Fabozzi, Modigliani, & Jones, 2010).

Based on this criterion, the three (3) financial services companies selected for our study were:

- (1) JP Morgan Chase (JPM)
- (2) Citigroup, Inc. (C)
- (3) Bank of New York Mellon, Inc. (BNY)

Table 1 presents the companies' financial highlights and selected employment statistics for fiscal year (FY) 2022:

Table 1. Company Profiles, Dec. 31, 2022

	JPM Chase	Citigroup	Bank of NY Mellon
<u>FINANCIAL HIGHLIGHTS</u>			
Market Capitalization (Billions)	393.30	87.60	36.79
Revenue (Billions)	128.69	75.30	16.03
Net Income (Billions)	35.87	13.70	2.36
Earnings per Share (EPS) (Basic)	\$12.10	\$7.04	\$4.17
<u>Selected Profitability Ratios</u>			
Operating Profit Margin (OPM)	45.06%	26.13%	17.50%
Net Profit Margin (NPM)	35.98%	18.87%	17.50%
Return on Assets (ROA)	1.34%	0.58%	0.67%
Return on Equity (ROE)	16.34%	6.71%	7.23%
<u>EMPLOYMENT</u>			
Total Employees	293,723	240,000	51,700
NYC-Based Employees	37,000	n.a.	5,000
NYC-Based Employees as % of Total	12.6%	n.a.	9.7%
NYC-Based Empl. As % of NYC Financial Activities Sector Empl.(499,000 in 2022)	7.4%	n.a.	1.0%

Source: JP Morgan Chase, 2023; Citigroup, Inc., 2023; Bank of New York Mellon, Inc., 2023 and authors' calculations.

As Table 1 illustrates, in fiscal year (FY) 2022, JPM reported a market capitalization of \$393.3 billion, followed by Citigroup (\$87.7 billion), and BNY (\$36.8 billion). JPM also ranked in first place in terms of profitability, measured by net income and (basic) earnings per share. For FY 2022, JPM reported net income of \$35.9 billion, compared to \$13.7 billion for Citigroup, and \$2.4 billion for BNY. Basic earnings per share in FY 2022 were \$12.10 for JPM, \$7.04 for Citigroup, and \$4.17 for BNY. JPM also surpassed Citigroup and BNY in terms of key profitability and investment return ratios, such as operating profit margin (OPM), net profit margin (NPM), return on assets (ROA), and return on equity (ROE) in FY 2022 (Table 1.)

In FY 2022, JPM had a total of 293,723 employees worldwide; 37,000 were based in NYC, representing 12.6% of the firm's workforce, and accounting for 7.4% of NYC's Financial Activities Sector workers. Citigroup had a total of 240,000 employees globally in FY 2022. However, since Citigroup did not report the number of employees located in NYC on its annual report (or 10-K Form), we were unable to estimate the percentage of its total employees working in the City and their share of NYC's Financial Activities Sector workers. Finally, BNY had 51,700 employees in FY 2022, out which 5,000 or 9.7%

worked in NYC. The company's NYC-based employees represented 1% of the City's Financial Activities Sector workers in FY 2022.

Table 2 shows total employment for the three (3) NYC-based financial services firms included in our study during the 2013-2022 period.

Table 2. Employment

Year	JP Morgan Chase	Citigroup	BNY- Mellon
2013	251,196	251,000	51,100
2014	241,359	241,000	50,300
2015	234,598	231,000	51,200
2016	234,355	219,000	52,000
2017	252,539	209,000	52,500
2018	256,105	204,000	51,300
2019	256,981	200,000	48,400
2020	255,351	210,000	48,500
2021	271,025	223,400	49,100
2023	293,723	240,000	51,700
Chg.	42,527	-11,000	600
% Chg.	16.9%	-4.4%	1.2%

Sources: JP Morgan Chase, 2023; Citigroup, Inc., 2023; Bank of New York Mellon, Inc., 2023; and authors' calculations.

As Table 2 indicates, the total number of employees at JPM increased from 251,196 in 2013 to 293,723 in 2022, representing a growth rate of 16.9% during this period. By contrast, the number of workers at Citigroup fell 4.4%, from 251,000 in 2013 to 240,000 in 2022. Finally, at BNY, total employment increased 1.2%, from 51,100 in 2013 to 51,700 in 2022.

COMPARABLE COMPANIES ANALYSIS

We use the Comparable ("Comps") Companies Analysis valuation method to compare the three (3) NYC-based, publicly-traded, financial sector firms included in this study. The "Comps Table" (Table 3) includes three (3) of the most commonly-used relative valuation methods on Wall Street: (1) the Price-Earnings (P/E) ratio, (2) Enterprise Value (EV), and (3) EV/EBITDA multiple.

- (1) Price-Earnings (P/E) Ratio: Measures the price (per share) that investors are willing to pay for each \$1 of Earnings per Share (EPS) (Brigham & Ehrhardt, 2017). The "trailing" P/E ratio is calculated by dividing the firm's current price per share by its historical (or "trailing") EPS, while the "forward" P/E ratio uses the firm's expected (or future) EPS (Bodie, Kane, & Marcus, 2008). For *relative valuation* purposes, companies with relatively high P/E ratios are considered "growth" stocks, while companies with relatively low P/E ratios are considered "value" stocks (Corporate Finance Institute, 2023b).

- (2) Enterprise Value (EV): Measures the value of a firm's total underlying business, unencumbered by debt, and separate from its cash and marketable securities. Enterprise value (EV) is calculated by estimating the firm's market value of equity (MVE) or market capitalization (i.e., price per share multiplied by the number of shares outstanding) adding its total debt and subtracting its cash and cash equivalents (Corporate Finance Institute, 2023a).
- (3) EV/EBITDA Multiple: This ratio is used to compare the value of the entire firm (i.e. Enterprise Value (EV) with its EBITDA (or Earnings before Interest, Taxes, Depreciation, and Amortization)); it shows how the multiple of EV to EBITDA that investors have to pay to acquire the entire firm (or enterprise) (Corporate Finance Institute, 2023). EBITDA measures a firm's financial performance independent of its capital structure (Brigham & Ehrhardt, 2017).

Table 3. Comps Table

	JP Morgan Chase, Inc.									
	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013
Revenue	128,695	121,649	119,951	115,720	108,783	100,705	96,569	93,543	95,112	97,367
EBITDA	51,433	65,663	42,708	51,445	46,790	40,205	38,115	33,851	33,790	30,652
EBIT	77,262	55,986	77,243	64,275	61,993	60,500	58,454	59,692	61,322	66,715
Net Income	35,892	46,503	27,410	34,642	30,709	22,567	22,834	22,651	20,077	16,557
Market Capitalization	393,343	467,966	387,335	437,226	324,627	371,052	308,768	243,065	233,936	219,837
P/E Ratio	10.96	10.06	14.13	12.62	10.57	16.44	13.52	10.73	11.65	13.28
Enterprise Value (EV)	368,614	276,071	401,828	689,688	579,461	434,546	414,487	360,556	286,674	398,909
EV/EBITDA Multiple	7.17	4.2	9.41	13.41	12.38	10.81	10.87	10.65	8.48	13.01
	Citigroup, Inc.									
	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013
Revenue	75,338	71,884	75,501	75,067	72,854	72,444	70,797	76,354	77,219	76,724
EBITDA	22,749	31,367	17,509	27,736	27,156	26,249	25,076	28,188	18,096	23,148
EBIT	52,589	40,517	57,992	47,331	45,698	46,195	45,721	48,166	59,123	53,576
Net Income	14,845	21,952	11,047	19,401	18,045	-6,798	14,912	17,242	7,310	13,659
Market Capitalization	87,604	119,830	128,374	174,415	127,138	196,740	169,359	154,163	163,926	158,050
P/E Ratio	5.9	5.46	11.62	8.99	7.05	-28.94	11.36	8.94	22.43	11.57
Enterprise Value (EV)	266,725	331,429	319,484	440,644	381,146	453,662	387,565	389,916	458,582	442,732
EV/EBITDA Multiple	11.72	10.57	18.25	15.89	14.04	17.28	15.46	13.83	25.34	19.13
	The Bank of New York Mellon, Inc.									
	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013
Revenue	16,377	15,931	15,808	16,462	16,392	15,543	15,237	15,194	15,692	14,900
EBITDA	4,977	6,503	6,089	6,876	6,543	6,060	6,226	5,628	4,771	5,085
EBIT	11,400	9,428	9,719	9,586	9,849	9,483	9,011	9,566	10,921	9,815
Net Income	2,573	3,759	3,617	4,441	4,266	4,090	3,547	3,158	2,567	2,104
Market Capitalization	36,793	47,964	37,608	46,414	46,542	55,154	50,097	45,052	45,670	40,129
P/E Ratio	15.58	13.5	10.99	10.87	11.36	14.09	14.63	14.76	18.31	19.67
Enterprise Value (EV)	-33,871	-38,948	-90,080	-24,809	7,114	-4,472	7,354	-52,762	-44,958	-75,719
EV/EBITDA Multiple	-0.64	-0.96	-1.55	-0.52	0.16	-0.10	0.16	-1.10	-0.76	-1.41

Sources: JP Morgan Chase, 2023; Citigroup, Inc., 2023; Bank of New York Mellon, Inc., 2023; and authors' calculations.

LINEAR MULTIPLE REGRESSION MODEL

We use a linear multiple regression model to examine the relationship between total employment (a proxy for labor demand) (i.e., the dependent variable) and the following three (3) commonly used *relative valuation* measures (i.e. the independent or explanatory variables): (1) the Price-Earnings (P/E) ratio, (2) Enterprise Value (EV), and (3) the EV/EBITDA multiple.

This model is shown in Equation (1):

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \quad (1)$$

Where:

Y represents the dependent (or predicted variable, i.e., total employment.

β_0 represents the vertical intercept (i.e., the value of Y when all the X values are zero).

β_1 measures the change in Y resulting from a change in X_1 , holding all other variables constant.

X_1 represents the Price-Earnings (P/E) ratio.

β_2 measures the change in Y resulting from a change in X_2 , holding all other variables constant.

X_2 represents Enterprise Value (EV).

β_3 measures the change in Y resulting from a change in X_{23} , holding all other variables constant.

X_3 represents the EV/EBITDA multiple.

RESULTS

Table 4 summarizes the principal results of the multiple linear regression model used in our study.

Table 4. Regression Results

	JPM	Citigroup	BNY Mellon
Multiple R	0.697	0.425	0.796
R Square	0.485	0.180	0.634
Adjusted R Square	0.228	-0.229	0.451
Standard Error	15523.77	19316.05	1089.49
Observations	10	10	10
<i>Significance F</i>	0.23	0.73	0.09
<u><i>P-value</i></u>			
Intercept	0.00	0.00	0.00
P/E Ratio	0.97	0.54	0.06
Ent. Value	0.14	0.73	0.79
EV/EBITDA Multiple	0.07	0.60	0.40

Sources: Authors' calculations.

The *correlation coefficient* (or *Pearson correlation coefficient*) measures the strength of the relationship between two variables; its value can range from – 1.00 (indicating a perfect *negative* correlation) and 1.00 (indicating a perfect *positive* correlation) (Lind, Marchal, & Wathen, 2021). Among the three (3) NYC-based financial services companies included in our study, BNY-Mellon had the highest *correlation coefficient* (0.796), followed by JPM (0.697), and Citigroup (0.425), respectively.

The *coefficient of determination* (R^2) represents the proportion of the total variation in the dependent variable, Y, explained by variations in the independent (or explanatory) variables ($X_1, X_2, X_3 \dots X_n$) and is used to determine the “goodness of fit” of a statistical regression model (Lind, Marchal, & Wathen, 2021). Values closer to 100% indicate a better fit for the model (Corporate Finance Institute, 2023). As Table 4 shows, in the case of JPM 48.5% of the variations in employment (i.e. the dependent variable) were explained by variations in the P/E ratio, Enterprise Value, and EV/EBITDA multiple (i.e. the independent or explanatory variables), compared to 18% for Citigroup, and 63.4% for BNY-Mellon.

To test the *statistical significance* of our multiple linear regression model, we use the *F-Test* (or *F statistic*), which is used to accept or reject the null hypothesis ($H_0: \beta=0$) and to analyze the explanatory power of one or more independent (or explanatory) variables with respect to variations in the values of the dependent variable (Lind, Marchal, & Wathen, 2021). The null hypothesis ($H_0: \beta=0$) is rejected when the critical value of *F* is less than 0.05 (or 5%) (Lind, Marchal, & Wathen, 2021). Since the critical values of *F* for all of the three (3) NYC-based financial services companies included in our study are greater than 0.05 (or 5%), we *fail* to reject the null hypothesis ($H_0: \beta=0$) (Table 4), suggesting that a linear relationship between the dependent variable (i.e., employment) and the independent (or explanatory) variables (i.e., the P/E ratio, Enterprise Value, and the EV/EBITDA multiple) does *not* exist.

We also use the *p-value* to test the *statistical significance* of our multiple linear regression model. The *p-value* represents the probability of observing an *F-value* equal to or greater than F-test statistic, assuming that the null hypothesis ($H_0: \beta=0$) is true (Lind, Marchal, & Wathen, 2021). If the *p-value* is less than the level of statistical significance (in this case 0.05 or 5%), the null hypothesis ($H_0: \beta=0$) is rejected (Lind, Marchal, & Wathen, 2021). All the *p-values* shown in Table 4 are greater than 0.05 or 5%, and, therefore, as was the case with the *F-Test*, we fail to reject the null hypothesis ($H_0: \beta=0$), indicating that there is no linear relationship between employment (the dependent variable) and the P/E ratio, Enterprise Value, and the EV/EBITDA multiple (the independent or explanatory variables) for all of the three (3) NYC-based financial services companies included in our study.

CONCLUSIONS

The financial services industry is one of the principal sources of private sector employment New York City. It is also one of its most volatile sectors. This is primarily due to the cyclical nature of the industry’s revenues and profits, its highly levered capital structure, its dependency on interest rates and monetary policy, the ongoing globalization of finance, the effects of rapid (and often disruptive) changes in technology.

A large number of studies on predictors of employment (or labor demand) in the financial sector have primarily focused on revenues and profits. This study contributes to the existing literature by examining the relationship between employment and three (3) commonly-used relative valuation measures: (1) the P/E ratio, (2) Enterprise Value (EV), and (3) the EV/EBITDA multiple.

For the three (3) NYC-based financial services companies included in our study, we found that variations in the P/E ratio, Enterprise Value (EV), and the EV/EBITDA multiple predict a relatively-small percentage of the variations in employment (or labor demand), as evidenced by their relatively-low *coefficients of determination* (R^2). While it may seem counterintuitive, the results of the *linear multiple regression* model used in our study also revealed that the relationship between employment and the aforementioned *relative valuation* measures is *not* statically-significant. These findings are supported by a cursory review of the data presented in Tables 2 and 3, which demonstrate that between 2013 and 2013 employment increased for all of the three (3) NYC-based financial services firms included in this study, while their corresponding *relative valuation* measures decreased during this period.

In a separate regression model (not included in this study), we also found that the relationship between employment, revenues (sales), and profits (for the same NYC-based financial services companies) was also *not* statistically-significant. However, in this case we found that variations in revenues (sales) and profits were strong predictors of employment (or labor demand), with relatively-high *coefficients of determination* (R^2).

Based on the (preliminary) findings of our research, we conclude that for the three (3) NYC-based financial services companies included in this study a (statistically-significant) linear relationship between employment (or labor demand) and the P/E ratio, Enterprise Value (EV), and the EV/EBITDA multiple does not exist. In addition, as mentioned before, variations in these variables only explain a relatively small percentage of the variations in employment (or labor demand) for the NYC-based financial services companies included in our study.

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The Impact of Fractional Trading on Order Book Dynamics⁴

JANHAVI SHANKAR TRIPATHI⁵ AND ERICK W. RENGIFO⁶

Abstract: We study the impact of fractional trading (FT) on the price levels and order book dynamics observed in stock markets. Using Nasdaq data feed at a minute frequency, we show that there has been a significant increase in the slope of the price-volume structure and average tick size. In some cases, there has been an increase in the number of steps required to place a limit order post-FT. We find that post-introduction of FT, there has been a significant increase in price levels, price volatility, and average tick sizes. The results suggest that buying the same number of shares post-FT costs significantly more. This new price-volume structure raises concerns about the fundamental value signal and market liquidity, which are important factors for market efficiency and stability. Investors are now faced with limit order books that are steeper (high price impact) and riskier (more volatile). Both of these contribute to market uncertainty that could affect professional and non-professional investors alike.

Keywords: fintech, fractional trading, order book dynamics, investor behavior, risk aversion.

JEL classifications: C0, G0, G1, G4, G5

Introduction

Fractional trading (FT) has been recently introduced on multiple trading platforms in equities markets, a feature that already existed in cryptocurrency markets.¹ With FT, individuals can now buy a fraction of a share of stock or ETF. FT, along with direct and easier access to the markets through commission-less trading apps, can potentially modify the risk appetite of non-professional investors² and create opportunities for portfolio creation and diversification (Tripathi and Rengifo 2023). It can also impact non-professional investors' investment behavior, price levels, and market volatility.

With FT and commission-less trading apps³, the demand for investing in the stock market has increased (Tripathi and Rengifo 2023, Da et al. 2021, Gempesaw et al. 2022), increasing the volatility of the mid-quote prices. Investors are now faced with limit order books that are steeper (high price impact) and riskier (more volatile). Both contribute to market uncertainty that could affect professional and non-professional investors alike.⁴

FT could have multiple implications for non-professional investors' risk behavior and the financial markets in general. Firstly, with the option to buy a fraction of stocks or ETFs, the risk appetite of non-professional individuals might increase given the much lower required investment and money-risk exposure, which can increase market participation and stock demand. Secondly, it has the potential to modify the behavior of prices and volumes in limit order books⁵, making them steeper by either keeping the same volume as before and increasing the prices or by keeping the same prices and reducing the offered volume (in either or both the buy and sell sides). These situations create abnormal price movements due to the rise in demand that faces the same or even lower supply of shares available for trade. This increase in demand could potentially have a domino effect in the dynamics of price formation by influencing regular professional investors by either making them reluctant to go to the market (and thus reducing their activity as liquidity providers or takers) or making them behave more like "gamblers" than professional investors. These situations create abnormal price behavior that could translate into price volatility increases (as

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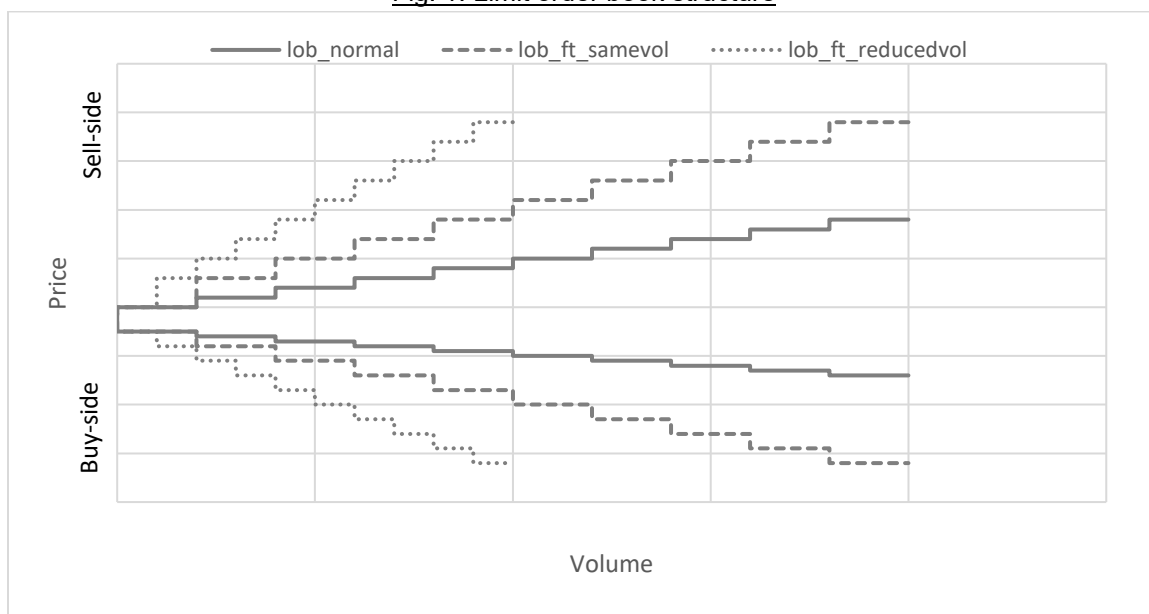
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recently observed in the market) and, at the same time, that could influence professional investors' behavior by making them reluctant to go to the market, contributing in this way to the supply reduction. Fig. 1 illustrates these changes.

To better understand these aspects and the impact of FT on limit order book price-volume structure, we analyze Nasdaq data at the minute level to test hypotheses that are a feature of efficient markets and relevant to aspects such as market liquidity and financial stability. The main testable hypothesis of the paper is that FT does not have any impact on the market liquidity, i.e., FT has no impact on the price levels and the order book dynamics. According to this hypothesis, the limit order book should be similar during pre- and post-FT, i.e., to buy/ sell a certain volume of shares, the change in the price levels should be similar as pre- and post-FT (controlling for time of the day, day of the month and month of the year, to try to have clear comparison observations).

Fig. 1: Limit order book structure



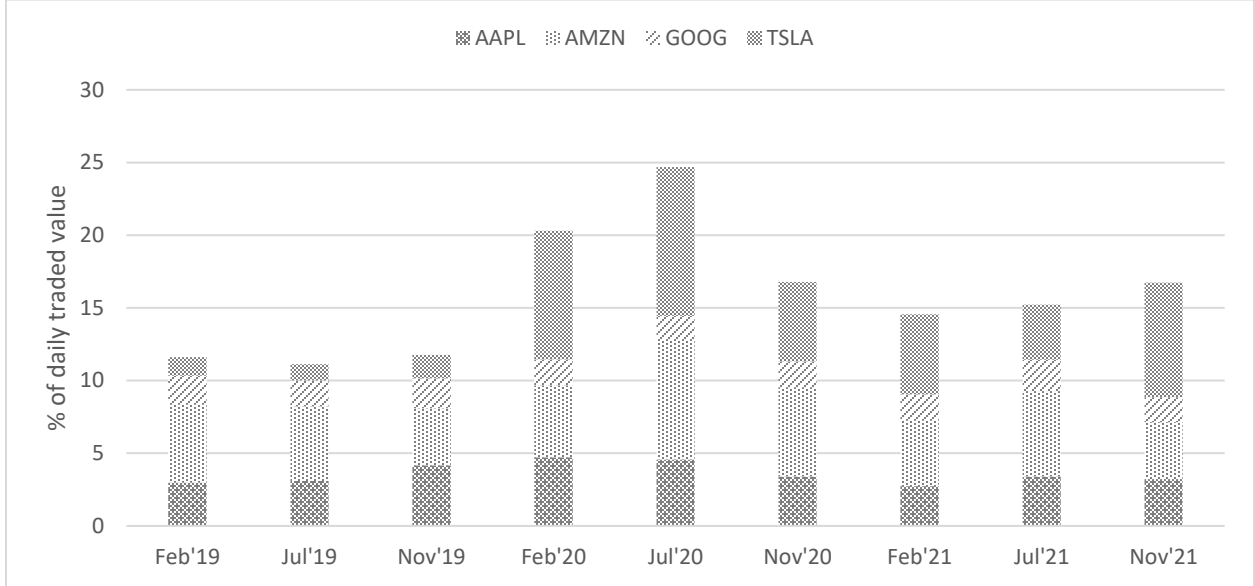
This figure illustrates a hypothetical limit order book structure. The 'lob_normal' line presents the structure under a normal scenario without FT. With FT, as the market demand increases and the supply remains the same, it has the potential to modify the limit order book structure, making it steeper to keep the same volume ('lob_ft_samevol') or to modify the limit order book to become even steeper with a reduced volume ('lob_ft_reducedvol').

Data

We use Historical Total View-ITCH data from Nasdaq, historical tick-by-tick order data.⁶ We use the data during the trading hours (09:30 – 16:00) for February, July and November 2019; February, July and November 2020; and February, July and November 2021. The stocks chosen for this study are Apple (AAPL), Amazon (AMZN), Google (GOOG), and Tesla (TSLA), as these are the stocks with the most trades during the day. These stocks cover, on average, 15 – 20 % of the daily traded value (see Fig. 2).⁷

We perform the analysis for both the buy and sell sides. To test the hypothesis, the analysis is done for November 2019 (pre-FT) vs. February 2020 (post-FT). Further, we also performed the analysis for February 2019 vs. February 2020, November 2019 vs. November 2020, February 2019 vs. February 2021, and November 2019 vs. November 2021 to deal with any calendar effect that could be present in the study. As there was a stock split for Apple and Tesla in August 2020, we performed the month-wise comparison analysis using July 2019 vs. July 2020 (instead of November 2019 vs. November 2020) for these stocks. Also, we leave out the 2021 comparison to avoid any ambiguity in results due to the stock split for these stocks.

Fig. 2: Percentage of average daily traded value



This figure presents a stacked bar chart with the average percentage of traded value for Apple, Amazon, Google, and Tesla during the trading day for the months under study. We see that post-FT; these four stocks account for 15-25% of the average daily traded value.

Analysis by top 5 and top 10 best quotes

In this first part of the analysis, we fetch the best 5 and 10 quotes at each minute for the stocks under study. Then, we calculate the cumulative volume of shares of the stock till the best 5 (10) quotes are reached. We get the change in price, defined as $\Delta p_5 = p_5 - p_1$; $\Delta p_{10} = p_{10} - p_1$. Similarly, we calculate the change in the cumulative volume of the shares of the stock traded as $\Delta q_5 = q_5 - q_1$; $\Delta q_{10} = q_{10} - q_1$. Further, we calculate the slope of the price-volume structure (i.e., price impact factor), $PIF_5 = \frac{\Delta p_5}{\Delta q_5}$; $PIF_{10} = \frac{\Delta p_{10}}{\Delta q_{10}}$. Using these price impact factors, we test the changes observed in the price-volume structure post-introduction of FT.

Empirical Tests and Results – Buy and Sell Side

We compute the price impact factor at each minute level for all the trading dates during the months under study and perform the test for equality of means and variances. In Table 1, we present the results of the test based on the analysis of the best 5 quotes at each minute.⁸ On the buy-side, we see that the averages of the slopes are statistically different pre- and post-FT. The results suggest that the price impact factors (PIFs) increased in February 2020 (post-FT) vs. November 2019 (pre-FT) by 1.47, 2.26, 1.96, and 2.69 times for Apple, Amazon, Google, and Tesla, respectively. This suggests that placing a buy order for these stocks costs significantly higher post-FT. Comparing the PIFs for other months in 2019 with 2020, and 2021, we find similar results. The PIFs are statistically different and significantly higher post-FT. Further, we also analyze variances in the slope of the limit order book. We find that the variances of PIFs are significantly different and have increased in February 2020 vs. November 2019 by 3.36, 18.14, 19.81, 9.89 times for Apple, Amazon, Google, and Tesla, respectively.⁹ Similarly, on the sell-side we find that the averages of the slopes (sell-side) are statistically different and significantly higher post- FT.¹⁰

Table 1. Price Impact Factor (buy and sell sides) using the best 5 quotes at each minute level

PIF5																
	AAPL				AMZN				GOOG				TSLA			
	Buy-side		Sell-side		Buy-side		Sell-side		Buy-side		Sell-side		Buy-side		Sell-side	
Dates	Nov' 19	Feb'20	Nov' 19	Feb' 20	Nov' 19	Feb'20	Nov' 19	Feb' 20	Nov' 19	Feb'20	Nov' 19	Feb' 20	Nov'19	Feb'20	Nov' 19	Feb' 20
Mean	-0.0009	-0.0014*	0.001	0.0013*	-0.0025	-0.0056*	0.0028	0.0048*	-0.0015	-0.0030*	0.0014	0.0026*	-0.0017	-0.0046*	0.0024	0.0062*
Ratio of Means	1	1.47	1	1.36	1	2.26	1	1.74	1	1.96	1	1.82	1	2.69	1	2.59
Variance	3E-08	9E-08*	1E-08	5E-08*	2E-07	3E-06*	4E-07	2E-06*	1E-08	2E-07*	3E-08	5E-07*	7E-08	7E-07*	2E-07	1E-06*
Ratio of Variances	1	3.36	1	3.63	1	18.14	1	4.88	1	19.81	1	16.11	1	9.89	1	4.84
Dates	Feb' 19	Feb'20	Feb' 19	Feb' 20	Feb' 19	Feb'20	Feb' 19	Feb' 20	Feb' 19	Feb'20	Feb' 19	Feb' 20	Feb'19	Feb'20	Feb'19	Feb' 20
Mean	-0.0008	-0.0014*	0.0008	0.0013*	-0.0029	-0.0056*	0.0021	0.0048*	-0.0013	-0.0030*	0.0011	0.0026*	-0.0018	-0.0046*	0.0017	0.0062*
Ratio of Means	1	1.74	1	1.63	1	1.89	1	2.28	1	2.27	1	2.43	1	2.56	1	3.64
Variance	2E-08	9E-08*	2E-08	5E-08*	7E-06	3E-06	8E-08	2E-06*	1E-08	2E-07*	4E-09	5E-07*	1E-07	7E-07*	1E-07	1E-06*
Ratio of Variances	1	3.83	1	2.41	1	0.42	1	26.79	1	20.22	1	110.46	1	5.27	1	10.1
Dates	Jul'19	Jul'20	Jul' 19	Jul'20	Nov' 19	Nov' 20	Nov' 19	Nov' 20	Nov' 19	Nov' 20	Nov' 19	Nov' 20	Jul'19	Jul'20	Jul'19	Jul'20
Mean	-0.001	-0.0015*	0.0007	0.0019*	-0.0025	-0.0056*	0.0028	0.0103*	-0.0015	-0.0021*	0.0014	0.0029*	-0.0019	-0.0082*	0.0022	0.0043*
Ratio of Means	1	1.46	1	2.43	1	2.26	1	3.69	1	1.4	1	2.03	1	4.25	1	1.91
Variance	7E-08	3E-09*	7E-09	9E-08*	2E-07	7E-07*	4E-07	4E-06*	1E-08	5E-07*	3E-08	6E-08*	7E-08	2E-06*	5E-07	2E-07
Ratio of Variances	1	1.56	1	12.62	1	4.09	1	10	1	45.08	1	1.97	1	35.93	1	0.51
Dates					Feb' 19	Feb'21	Feb' 19	Feb' 21	Feb' 19	Feb'21	Feb' 19	Feb' 21				
Mean					-0.0029	-0.0071*	0.0021	0.0111*	-0.0013	-0.0025*	0.001	0.0042*				
Ratio of Means					1	2.38	1	5.17	1	1.93	1	3.89				
Variance					7E-06	3E-06	8E-08	2E-06*	1E-08	2E-07*	4E-09	1E-07*				
Ratio of Variances					1	0.36	1	26.72	1	19.4	1	32.29				
Dates					Nov' 19	Nov' 21	Nov' 19	Nov' 21	Nov' 19	Nov' 21	Nov' 19	Nov' 21				
Mean					-0.0025	-0.0143*	0.0028	0.0127*	-0.0015	-0.0056*	0.0014	0.0073*				
Ratio of Means					1	5.74	1	4.54	1	3.62	1	5.00				
Variance					3E-07	4E-06*	4E-07	8E-06*	1E-08	2E-06*	3E-08	3E-06*				
Ratio of Variances					1	22.96	1	18.18	1	148.09	1	104.78				

This table presents the results of the tests for equality of means and equality of variances of the averages of the slopes of the order books (i.e., price impact factors) using the best 5 quotes on the buy and sell sides at each minute level. The results suggest that the averages of slopes are statistically different pre- and post-FT. The price impact factor has increased post-introduction of FT significantly. Note: The number of observations for the analysis is 391 for the monthly comparison tests, and * suggests that mean/ variance is statistically different in post-FT compared to pre-FT.

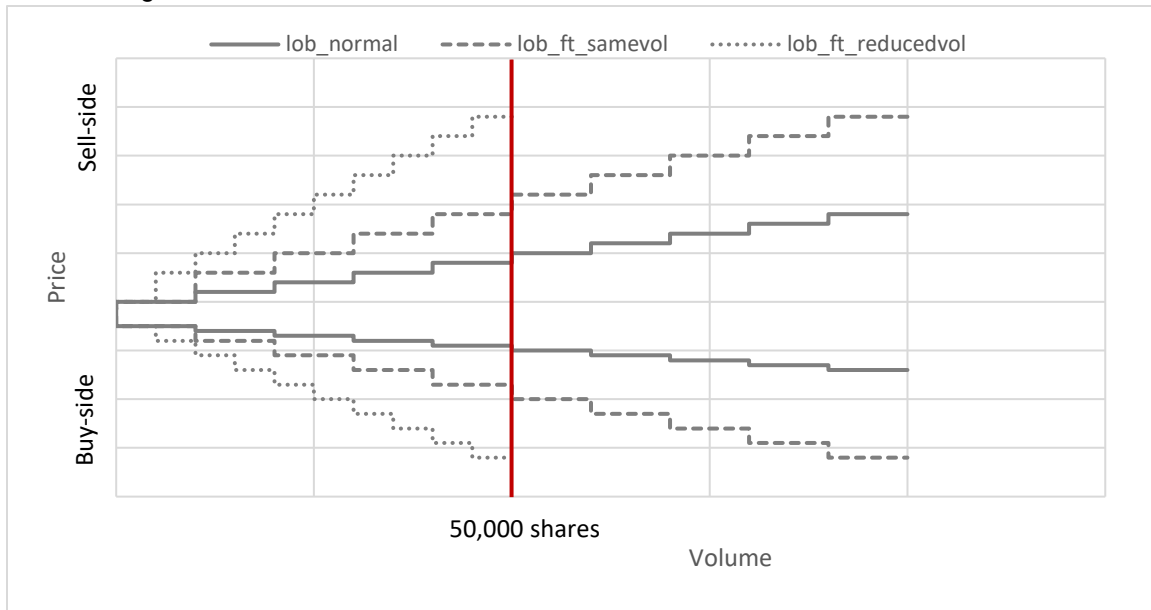
Analysis by fixed cumulative volume

As a robustness check, we set the cumulative volume at 50,000 shares and collect the corresponding price for each stock at each minute. Then, we compute the change in price to place a buy/ sell limit order of 50,000 shares of the stock under study, $\Delta p_{50,000}$. Further, we calculate the price impact factor (PIF),

$slope_{50,000} = \frac{\Delta p}{50,000}$. Using this PIF, we test the changes observed in the price-volume structure post-introduction of FT.

Finally, we also calculate the number of steps required to place a limit order to buy/sell 50,000 shares at each minute level, $steps_{50,000}$. Using the steps, we calculate the average tick size (defined as the minimum price movement of the stock) at each minute level. We define average tick size as $average\ tick\ size = \frac{\Delta p_{50,000}}{steps_{50,000}}$.

Fig 3. Limit order book structure with fixed cumulative volume at 50,000 shares



This figure illustrates a hypothetical limit order book structure with a fixed cumulative volume of 50,000 shares.

We use these variables to perform equality of means and equality of variances analysis for the buy and sell sides. On the buy-side, we find that the PIF when we fix cumulative volume at 50,000 shares are statistically different pre- and post-FT, i.e., placing a buy order for these stocks post-FT costs significantly higher (see Table 2).¹¹

Next, we analyze the average number of steps and find that there has not been a significant increase in the average number of steps (see Table 3.).¹² Finally, we test for the tick size and find that the average tick size when we fix cumulative volume at 50,000 shares is statistically different pre- and post-FT (see Table 4).¹³ Similarly, on the sell-side we find that the average tick size is statistically different pre- and post-FT (Table 4).

Table 2. Price impact factor of the price-volume structure (buy and sell sides) while placing an order for 50,000 shares

PIF50k																
	AAPL				AMZN				GOOG				TSLA			
	Buy-side		Sell-side		Buy-side		Sell-side		Buy-side		Sell-side		Buy-side		Sell-side	
Dates	Nov' 19	Feb'20	Nov' 19	Feb' 20	Nov' 19	Feb'20	Nov' 19	Feb' 20	Nov' 19	Feb'20	Nov' 19	Feb' 20	Nov' 19	Feb'20	Nov' 19	Feb' 20
Mean	-0.0009	-0.0013*	0.0017	0.0036*	-0.0023	0.0064*	0.0096	0.0190*	-0.0018	0.0022*	0.0033	0.0051*	-0.0002	0.0062*	0.0042	0.0181*
Ratio of Means	1	1.47	1	2.14	1	2.77	1	1.97	1	1.2	1	1.55	1	3.04	1	4.29
Variance	1E-08	6E-08*	5E-09	9E-08*	1E-07	2E-06*	1E-06	5E-06*	2E-08	4E-08*	9E-08	1E-07*	1E-07	5E-07*	2E-07	1E-06*
Ratio of Variances	1	4.87	1	16.79	1	12.68	1	4.38	1	2.01	1	1.58	1	5.05	1	5.16
Dates	Feb' 19	Feb'20	Feb' 19	Feb' 20	Feb' 19	Feb'20	Feb' 19	Feb' 20	Feb' 19	Feb'20	Feb' 19	Feb' 20	Feb' 19	Feb'20	Feb' 19	Feb' 20
Mean	-0.0007	-0.0013*	0.0013	0.0036*	-0.0042	0.0064*	0.0124	0.0190*	-0.0016	0.0022*	0.0003	0.0051*	-0.0019	0.0062*	0.0055	0.0181*
Ratio of Means	1	1.69	1	2.65	1	1.53	1	1.53	1	1.34	1	1.67	1	3.23	1	3.28
Variance	2E-08	6E-08*	3E-08	9E-08*	7E-07	2E-06*	2E-06	5E-06*	2E-08	4E-08*	2E-08	1E-07*	7E-08	5E-07*	2E-07	1E-06*
Ratio of Variances	1	3.37	1	3.12	1	2.56	1	2.85	1	2.15	1	5.77	1	7.82	1	4.41
Dates	Jul'19	Jul'20	Jul'19	Jul'20	Nov' 19	Nov' 20	Nov' 19	Nov' 20	Nov' 19	Nov' 20	Nov' 19	Nov' 20	Jul'19	Jul'20	Jul'19	Jul'20
Mean	-0.0009	-0.0015*	0.0012	0.0029*	-0.0023	0.0070*	0.0096	0.0202*	-0.0018	0.0026*	0.0033	0.0051*	-0.0016	0.0066*	0.0038	0.0225*
Ratio of Means	1	1.64	1	2.82	1	3.01	1	2.09	1	1.41	1	1.56	1	3.94	1	5.89
Variance	2E-08	8E-08*	3E-08	7E-08*	1E-07	4E-06*	1E-06	2E-06*	2E-08	8E-08*	9E-08	4E-07*	5E-08	5E-07*	4E-07	6E-06*
Ratio of Variances	1	3.66	1	2.01	1	27.4	1	1.52	1	4.59	1	5.04	1	9.56	1	14.9
Dates					Feb' 19	Feb'21	Feb' 19	Feb' 21	Feb' 19	Feb'21	Feb' 19	Feb' 21				
Mean					-0.0042	0.0103*	0.0124	0.0183*	-0.0016	0.0032*	0.0003	0.0081*				
Ratio of Means					1	2.44	1	1.48	1	1.95	1	2.66				
Variance					7E-07	3E-06*	2E-06	2E-06	2E-08	7E-08*	2E-08	3E-07*				
Ratio of Variances					1	3.87	1	0.98	1	4.12	1	12.1				
Dates					Nov' 19	Nov' 21	Nov' 19	Nov' 21	Nov' 19	Nov' 21	Nov' 19	Nov' 21				
Mean					-0.0023	0.0154*	0.0096	0.0279*	-0.0018	0.0095*	0.0033	0.0147*				
Ratio of Means					1	6.6	1	2.89	1	5.08	1	4.47				
Variance					1E-07	2E-06*	1E-06	1E-05*	2E-08	3E-06*	9E-08	2E-06*				
Ratio of Variances					1	11.37	1	7.95	1	184.88	1	27.34				

This table presents the equality of means and variances for the averages of the price impact factor based on the first 50,000 shares on the buy and sell sides at each minute level. The results suggest that the averages of price impacts are statistically different pre- and post-FT. The slopes have increased post-introduction of FT. Note: The number of observations for the analysis is 391 for the monthly comparison tests, and * suggests that mean/ variance is statistically different in post-FT compared to pre-FT.

Table 3. Number of steps needed to place an order of 50,000 shares pre-and post-FT (buy and sell sides)

steps50k																
	AAPL				AMZN				GOOG				TSLA			
	Buy-side		Sell-side		Buy-side		Sell-side		Buy-side		Sell-side		Buy-side		Sell-side	
Dates	Nov' 19	Feb' 20	Nov' 19	Feb' 20	Nov' 19	Feb' 20	Nov' 19	Feb' 20	Nov' 19	Feb' 20	Nov' 19	Feb' 20	Nov' 19	Feb' 20	Nov' 19	Feb' 20
Mean	38.95	39.90*	40.94	40.94	50.93	54.70*	53.23	54.85*	51.18	52.18*	54.9	53.84*	51.76	51.82	52.46	49.46*
Ratio of Means	1	1.02	1	1	1	1.07	1	1.03	1	1.02	1	0.98	1	1	1	0.94
Variance	2E+00	1E+00	9E-01	1.81*	2E+01	1E+01	2E+01	1E+01	4E+00	3E+00	4E+00	3E+00	4E+00	16.43*	5E+00	14.13*
Ratio of Variances	1	0.64	1	2.13	1	0.66	1	0.55	1	0.81	1	0.67	1	4.1	1	2.65
Dates	Feb' 19	Feb' 20	Feb' 19	Feb' 20	Feb' 19	Feb' 20	Feb' 19	Feb' 20	Feb' 19	Feb' 20	Feb' 19	Feb' 20	Feb' 19	Feb' 20	Feb' 19	Feb' 20
Mean	35.17	39.90*	37.05	35.94*	48.37	54.70*	49.57	54.85*	47.58	52.18*	47.84	53.84*	49.02	51.82*	50.09	49.46*
Ratio of Means	1	1.13	1	0.97	1	1.13	1	1.11	1	1.09	1	1.13	1	1.06	1	0.99
Variance	3E+00	1E+00	6E-01	1.81*	4E+01	1E+01	3E+01	1E+01	2E+00	3.08*	2E+00	2.90*	8E+00	16.43*	1E+01	1E+01
Ratio of Variances	1	0.45	1	2.92	1	0.29	1	0.38	1	2.03	1	1.74	1	2.09	1	1.01
Dates	Jul'19	Jul'20	Jul'19	Jul'20	Nov' 19	Nov' 20	Nov' 19	Nov' 20	Nov' 19	Nov' 20	Nov' 19	Nov' 20	Jul'19	Jul'20	Jul'19	Jul'20
Mean	37.52	43.14*	36.9	42.37*	50.93	59.83*	53.23	56.94*	51.18	59.38*	54.9	57.78*	50.76	50.79	50.33	49.64*
Ratio of Means	1	1.15	1	1.15	1	1.17	1	1.07	1	1.16	1	1.05	1	1	1	0.99
Variance	1E+00	1E+00	7E-01	1E+00	2E+01	30.19*	2E+01	30.94*	4E+00	4E+00	4E+00	4E+00	2E+00	17.08*	4E+00	21.00*
Ratio of Variances	1	0.92	1	1.66	1	1.77	1	1.49	1	1.17	1	0.96	1	11.16	1	4.82
Dates					Feb' 19	Feb' 21	Feb' 19	Feb' 21	Feb' 19	Feb' 21	Feb' 19	Feb' 21				
Mean					48.37	62.14*	49.56	57.82*	47.58	57.46*	47.84	58.23*				
Ratio of Means					1	1.28	1	1.17	1	1.21	1	1.22				
Variance					4E+01	43.59*	3E+01	48.91*	2E+00	4.68*	2E+00	3.49*				
Ratio of Variances					1	1.14	1	1.60	1	3.09	1	2.09				
Dates					Nov' 19	Nov' 21	Nov' 19	Nov' 21	Nov' 19	Nov' 21	Nov' 19	Nov' 21				
Mean					50.93	62.82*	53.23	61.56*	51.18	65.97*	54.89	63.86*				
Ratio of Means					1	1.23	1	1.16	1	1.29	1	1.16				
Variance					2E+01	61.19*	2E+01	1E+01	4E+00	14.76*	4E+00	12.66*				
Ratio of Variances					1	3.59	1	0.66	1	3.9	1	2.94				

This table presents the test results for equality of means and variances for the average number of steps needed to order 50,000 shares on the buy and sell sides at each minute level. Note: The number of observations for the analysis is 391 for the monthly comparison tests, and * suggests that mean/ variance is statistically different in post-FT compared to pre-FT.

Table 4. Average Tick Size to place an order of 50,000 shares pre-and post-FT (buy and sell sides)

Average Tick Size																
	AAPL				AMZN				GOOG				TSLA			
	Buy-side		Sell-side		Buy-side		Sell-side		Buy-side		Sell-side		Buy-side		Sell-side	
Dates	Nov' 19	Feb' 20	Nov' 19	Feb' 20	Nov' 19	Feb' 20	Nov' 19	Feb' 20	Nov' 19	Feb' 20	Nov' 19	Feb' 20	Nov' 19	Feb' 20	Nov' 19	Feb' 20
Mean	0.0117	0.0169*	0.0209	0.0405*	0.0231	0.0632*	0.0899	0.1843*	0.0183	0.0212*	0.0301	0.0503*	0.02	0.0638*	0.0414	0.1927*
Ratio of Means	1	1.44	1	2.15	1	2.73	1	2.05	1	1.16	1	1.67	1	3.18	1	4.65
Variance	1E-06	1E-05*	1E-06	1E-05*	5E-06	3E-04*	1E-04	4E-04*	1E-06	3E-06*	8E-06	1E-05*	1E-05	9E-05*	3E-05	2E-04*
Ratio of Variances	1	10.61	1	14.69	1	52.43	1	3.45	1	2.42	1	1.66	1	6.89	1	7.54
Dates	Feb' 19	Feb' 20	Feb' 19	Feb' 20	Feb' 19	Feb' 20	Feb' 19	Feb' 20	Feb' 19	Feb' 20	Feb' 19	Feb' 20	Feb' 19	Feb' 20	Feb' 19	Feb' 20
Mean	0.0113	0.0169*	0.0184	0.0450*	0.0454	0.0632*	0.1321	0.1843*	0.0175	0.0212*	0.0333	0.0503*	0.0199	0.0638*	0.0566	0.1927*
Ratio of Means	1	1.49	1	2.44	1	1.39	1	1.39	1	1.21	1	1.51	1	3.19	1	3.4
Variance	2E-06	1E-05*	5E-06	1E-05*	8E-05	3E-04*	3E-04	4E-04*	1E-06	3E-06*	2E-06	1E-05*	1E-05	9E-05*	5E-05	2E-04*
Ratio of Variances	1	6.79	1	2.88	1	3.03	1	1.4	1	1.8	1	5.76	1	9.17	1	3.98
Dates	Jul'19	Jul'20	Jul'19	Jul'20	Nov' 19	Nov' 20	Nov' 19	Nov' 20	Nov' 19	Nov' 20	Nov' 19	Nov' 20	Jul'19	Jul'20	Jul'19	Jul'20
Mean	0.0129	0.0184*	0.0173	0.0345*	0.0231	0.0585*	0.0899	0.1882*	0.0183	0.0223*	0.0301	0.0454*	0.0168	0.0712*	0.0383	0.2314*
Ratio of Means	1	1.43	1	1.99	1	2.53	1	2.09	1	1.22	1	1.51	1	4.22	1	6.04
Variance	3E-06	1E-05*	6E-06	7E-06*	5E-06	1E-04*	1E-04	2E-04*	1E-06	6E-06*	8E-06	4E-05*	5E-06	8E-05*	4E-05	8E-04*
Ratio of Variances	1	3.88	1	1.23	1	19.71	1	2.04	1	5.74	1	4.85	1	16.82	1	18.95
Dates					Feb' 19	Feb' 21	Feb' 19	Feb' 21	Feb' 19	Feb' 21	Feb' 19	Feb' 21				
Mean					0.0454	0.0808*	0.1321	0.1709*	0.0175	0.0286*	0.0333	0.0712*				
Ratio of Means					1	1.78	1	1.29	1	1.63	1	2.13				
Variance					8E-05	5E-05	3E-04	2E-04	1E-06	4E-06*	2E-06	3E-05*				
Ratio of Variances					1	0.64	1	0.74	1	2.78	1	10.89				
Dates					Nov' 19	Nov' 21	Nov' 19	Nov' 21	Nov' 19	Nov' 21	Nov' 19	Nov' 21				
Mean					0.0231	0.1317*	0.0898	0.2545*	0.0183	0.0682*	0.0301	0.1117*				
Ratio of Means					1	5.69	1	2.83	1	3.73	1	3.71				
Variance					5E-06	1E-04*	1E-04	7E-04*	1E-06	1E-04*	8E-06	1E-04*				
Ratio of Variances					1	20.86	1	6.24	1	135.03	1	15.26				

This table presents the test results for equality of means and equality of variances of the averages of average tick size to place an order of 50,000 shares on the buy and sell sides at each minute level. The results suggest that the average tick size is statistically different pre- and post-FT. The average tick sizes have increased post-introduction of FT. Note: The number of observations for the analysis is 391 for the monthly comparison tests, and * suggests that mean/ variance is statistically different in post-FT compared to pre-FT.

Conclusion

In this paper, we perform three types of analysis, showing that the market dynamics have significantly changed post the introduction of fractional trading (FT), along with direct and easier access to the markets through commission-less trading apps. These two recent developments can potentially modify the risk appetite of non-professional investors (who are generally myopic and risk-averse) and create opportunities for portfolio creation and diversification, hence increasing the demand for stocks.

We find that post-introduction of FT, there has been a significant increase in price levels, price volatility, and average tick sizes. The results suggest that buying the same number of shares post-FT costs significantly more. This modifies the price-volume structure and raises concerns about the fundamental value signal and market liquidity, which are important factors for market efficiency and stability. Investors are now faced with limit order books that are steeper (high price impact) and riskier (more volatile). Both of these contribute to market uncertainty that could affect professional and non-professional investors alike.

¹ In December 2019, Robinhood was one of the early trading apps to launch FT on their platform. Other trading apps that currently provide FT option include Charles Schwab, Fidelity Investments, Interactive Brokers, M1 Finance, TD Ameritrade, E-Trade, among others. These platforms vary in terms of minimum purchase, the stocks available in the program and order types.

² Non-professional investors are individuals for whom their main occupations do not concern financial investments and/or who lack the necessary knowledge, expertise, time, or any combination of them for making more sophisticated investment decisions and that often rely on the help of professional portfolio managers in devising an optimal mix of risky assets. These individuals are generally myopic and risk averse (Rengifo and Trifan, 2010).

³ The fintech-based trading applications provide commission-free trading opportunities to non-professional investors. When an individual buys or sells stocks, ETFs, or options with a fintech-trading app, they send the orders to market makers that typically would offer better prices than the public exchanges. These market-makers in turn pay a small fee to these fintech-based applications for sending these trades to process through their platform. The market makers are competing with the exchanges, so, they also offer rebates to the brokerages like fintech-trading apps. This is one of the ways for platforms like Robinhood to remain competitive and provide different financial products and services at low costs. The objective of these fintech-trading apps is fulfilling these orders in stocks and ETFs at the fastest rate possible. To ensure this fast and seamless order execution in case few market makers are unable to execute orders, some of these orders in stocks and ETFs posted by retail investors using these apps are routed to exchanges, depending on the quality of exchanges' past executions. The fintech-trading platform will pay the exchange when they take liquidity and are paid when they provide liquidity. These commission-less trading platforms like Robinhood also allow investors to place limit orders in their platforms. They also maintain inventory to execute regular market orders in regular exchanges. Increases in demand for stock trading with fractional trading on these platforms can potentially increase the demand for limit orders in regular markets. (<https://robinhood.com/us/en/support/articles/stock-order-routing/>)

⁴ Further, (Bartlett et al. 2022a, 2022b) discuss that fractional trading has been a recent introduction and currently does not fit into the current national market system of trade reporting. The recent "rounding up" rule of trade reporting by FINRA can potentially distort market efficiency. The Rounding up rule says: "When reporting a trade for a fractional number of shares, firms should delete the fraction and report the whole number, except if the whole number would be zero. If the whole number would be zero, firms should round up to 1. Where a trade is executed for less than one share, firms should round up and report a share quantity of 1." (Source: FINRA Filing and Reporting – Trade Reporting FAQs).

⁵ A limit order is an order to buy or sell a security at a specific price or better. Buy limit orders can only be executed at the limit price or lower and sell limit orders can only be executed at the limit price or higher.

⁶ Order books are the primary source of market data. They provide real-time updates throughout the day, reflecting all trading activities. The order books reveal the market depth throughout the day by listing the number of shares being bid on or offered at each price point. Market depth is the key indicator of liquidity and the potential price impact of sizable market orders. It allows to track individual orders for equity instruments from placement to execution or cancellation. The data comprise the time-sequenced messages describing the history of trade and book activity. Each message is time-stamped to the nanosecond and hence provides a detailed picture of the trading process and the state of the Nasdaq book.

⁷ Further, the processing of these daily tick-by-tick Nasdaq data files is a highly time intensive and requires large storage spaces for data processing and analysis. This also becomes a constraint in terms of how many stocks and days/ months we can analyze. We have ensured that our data is a good representative sample using daily trade value to select the stocks for analysis. We also select months before and after fractional trading to gauge the effect of fractional trading on order book dynamics. Further, to cancel any calendar effect, we analyze and compare numbers for same months in different years for the representative stocks.

⁸ We perform the analysis using top 10 best quotes as well and get similar results.

⁹ Except for Amazon (February 2020 vs February 2019 and February 2021 vs. February 2019), the variances of price impact factors are statistically different and significantly higher post- FT.

¹⁰ Except for Tesla (July 2020 vs. July 2019), the variances of price impact factors are statistically different and significantly higher post- FT.

¹¹ PIFs have increased in February 2020 vs. November 2019 by 1.47, 2.77, 1.2, and 3.04 times for Apple, Amazon, Google, and Tesla, respectively.

¹² We see the average number of steps when we fix cumulative volume at 50,000 shares are similar for Apple, Amazon, Google, and Tesla pre- and post-FT (Table 3.). In some cases, there has been an increase in number of steps to place an order for 50,000 shares post- FT but the result is not conclusive. We find similar results for the test of equality of variances.

¹³ The results suggest that the average tick size increased in February 2020 vs. November 2019 by 1.44, 2.73, 1.16, and 3.18 times for Apple, Amazon, Google, and Tesla, respectively. The tick sizes are statistically different and significantly higher post-FT. We also analyzed variances in the slope of the limit order book and find them to be statistically different and significantly higher post-FT.

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