Acknowledgements

The editorial team of *Snider Undergraduate Research Journal* is very grateful for support of the SURE Faculty Review board and mentors: Dr. Hossein Abbasi, Dr. Serguey Braguinsky, Dr. Gilad Chen, Dr. Qingbin Cui, Dr. Christina Elson, Dr. Gordon Gao, Dr. Virginia Haufler, Dr. Sandra Loughlin, Doctoral candidate Audra Meade, Dr. Jim Purtilo, Dr. Steve Sonka, Dr. Mircea Raianu, and Ike Richman.

During the year, we also call on faculty to provide workshops and we are grateful to Dr. Joe Bailey for the scoping workshop, Dr. Purtilo and Dr. Raianu for the research methods workshop and students Jordan Steiner and Steph Baylounay for the poster presentation workshops.

Lastly, we would like to thank Dr. Rajshree Agarwal and Dr. Christina Elson of the Ed Snider Center for providing the creative freedom, funding and continuous support.

Thank you,
Editorial Team
A Note from the SURE Faculty Director

Dear Readers:

Ideas that take shape, grow, and produce great things for many people often begin from small, well-thought-out experiments. In 2015, less than a year after the launch of the Ed Snider Center, Amanda (Mandy) Yard became one of the Center’s first interns. With the center in full experimentation mode, Rajshree Agarwal, the Director of the Ed Snider Center, charged Mandy with designing her own intern experience. Mandy, a graduating Smith School senior and QUEST alum, gladly took up the charge. She decided to focus on the one thing she wished she had been able to experience at Maryland--designing and executing a truly independent research project. Mandy knew that other students also desired an opportunity to experience research, not as a team or analyzing a small part of a faculty project; rather, these students were looking for a challenging and messy experience forcing them to dive deep into a well-scoped out question and come up with an answer grounded in data.

Since that well-thought-out experiment by Mandy, SURE has been shepherded by faculty and students. Dr. Rajshree Agarwal, Dr. Joe Bailey and Dr. Kylie King have all contributed substantial time and energy to supporting the program’s growth and development. But SURE is a program run by students for students and its growth from five to sixteen fellows in two short years reflects the extraordinary energy and dedication of the student directors who followed Mandy: Lalitha Cheruvu (2016) and Sade Ayinde and Adam Hostetter (2017).

Thanks to Sade and Adam our 2017 SURE cohort came from disciplines across campus and attracted interdisciplinary faculty mentors including Dr. Hossein Abbasi and Dr. Gordon Gao. I am deeply appreciative to Dr. Abbasi, Dr. Gao and all our mentors. They sincerely enjoy guiding students through the challenges and rewards of good research. As the faculty director for SURE, it gives me real pleasure to support SURE’s continued growth and success.

Dr. Christina Elson
Faculty Director, Snider Undergraduate Research Experience
A Note From the Student Leadership

Dear Readers:

In academic research, the prevailing notion is to “stand on the shoulders of giants.” To stand on the shoulder of giants is to build on the work of others, to initiate new ideas, and to further drive the collective conversation in that field. As undergraduates, it is intuitive to learn inside the classroom but seldom does that learning cross into the realm of application. It takes a rare, curious mind to want to dig deeper into the rabbit hole and a desire to contribute to the open-forum of research. The students who partook in Snider Undergraduate Research identify with this rarity.

This unique group of individuals took the initiative to join tough conversations and tackle rigorous problems. These students are not only passionate but fresh with young perspectives and novel thinking spanning the fields of solar energy development, corporate messaging, innovation, public health and more. Bubbling with a curiosity and eagerness towards learning, they are truly superlative among their peers. Hence, with great pleasure, we welcome you to dive deep into the findings of this compiled work for the Snider Undergraduate Research Journal (2018 edition).

Sade Ayinde

Adam R. Hostetter

Student Directors, Snider Undergraduate Research Program
Staff and Administrative Support

Dr. Rajshree Agarwal
Director, The Ed Snider Center For Enterprise And Markets

Christina Elson
Managing Director, The Ed Snider Center For Enterprise And Markets
SURE Faculty Director

Sade Ayinde
Student Director, Snider Undergraduate Research Program

Adam Hostetter
Student Director, Snider Undergraduate Research Program

Ada McNally
Administrative Assistant, The Ed Snider Center For Enterprise And Markets

Joyce Koo
Coordinator, The Ed Snider Center For Enterprise And Markets
Contents

The Complete Framework of Disruptive Innovations
By Mohammed Alghaffari, Finance and Information Systems 9

Behavioral and Social Factors That Influence HIV/AIDS Product Market Opportunities for Adolescents and Young Women in South Africa
By Adwoa Boateng, Economics 29

Government Policies and Solar Power Adoption in Maryland
By Modibo Abbo, Economics 44

A Roadmap for c-Si Solar Panel End-of-Life Treatment
By Sydney Edwards, Electrical and Computer Engineering 59

European Economic Recovery: The Impact of Cross-border M&A on a Sustainable Economic Growth
By Hannah Koh, Economics 71

Corporate Messaging: The Role of Diversity and Inclusion on Company Communication
By Mario Menendez, Marketing and Information Systems 90

The Effect of Market Size on Franchise and Player Values in Today’s NBA
By Alden Newman, Marketing 113

The Use of Blockchain in Waste Accountability
By Shiv Patel, Computer Science 130

The Effect of State-Level Corruption on the Likelihood and Success of Corporate Investment in Four Indian States
By Ashwin Suryavanshi, Government & Politics 147

An Analysis of the Relation Between Class Rank on Financial Literacy Levels in an Undergraduate Business School
By Jonathan Taylor, Accounting and Finance 159

What Makes a Successful Mobile Money Technology Vendor?
By Gareth Weakly, Economics & Mathematics 178

Corporate Compliance in a World of Self-Regulation: A Look at Conflict Minerals
By Ethan Liu and Jeffrey Yin, Finance/Information Systems; Accounting 195
printing enables the routine manufacture of devices which even a decade ago could not have even been imagined because of their complexity. Materials science offers new composites that dramatically expand the array of building blocks available to designers. 'Big data' let us tease out the key properties of systems like never before, predicting market demands for inventors savvy enough to recognize them.

The explosive growth of mechanisms of innovation make for a dizzying space of market opportunities, limited only by one's imagination. The market does not reward all innovation equally, of course, which poses a tough prediction problem to investors: what properties of some technology or invention best foretell its disruptive potential - that is, its potential to rapidly supplant an existing market rather than compete for share in an existing market?

Mohammed Alghaffari comes to this question as a young technologist and entrepreneur, and by literature review identifies four existing (but differing) models of disruptive change. After some analysis, he goes on to assert a grand composite model to resolve their differences and make sharper the predictions of what properties foretell an innovation's disruptive potential.

Mohammed Alghaffari is a SURE Fellow in the R.H Smith School of Business at the University of Maryland, College Park, MD. His email address is malghaff@terpmail.umd.edu.
Abstract

Currently, emerging innovations constitute a large portion of the market for goods and services. Investors have increasing options for investing in technologies that improve people’s lives, and thus need better tools for predicting the possible return on those investments. A common factor among emerging innovations is that they're disruptive. Therefore, an effective forecast model needs to consider the disruption potential of emerging innovations. This research seeks to contribute to the overall understanding of disruptive innovations: recognizing which factors play a role in impacting the disruption potential of innovations, and building a complete framework of disruption that could be used as a potential evaluation tool. This study is conducted through a meta-analysis of multiple models of disruption. The research also includes an introduction to network effects as an evaluation factor that has not received enough credit by various disruption models.

Keywords: Disruptive innovations, diffusion, Christensen theory, decision tree, ecosystem, network effects

Introduction

The concept of disruptive innovation is becoming more relevant in our lives with emerging and new firms that alter our daily interactions; either in our social lives or our businesses. One hears the term being used by a variety of mediums including books, articles and daily breaking news. When people hear of a new emerging disruptive innovation, they might think of a new software or a new machine that will alter their lives somehow. Some of them might get excited by the idea that their life will become “easier,” while others might fear the automation potential of this new idea that could cause a loss of employment. Nevertheless, this overuse of the term has caused its original definition to become irrelevant.

Disruptive innovation is a term used to describe the emergence of a new idea or technology that alters the market of an established product or service or at some point creates a whole new market. The term was coined by an American scholar, Clayton Christensen, back in 1997 when he published his book, The Innovator’s Dilemma. Christensen originated this term in order to describe his observations and analysis of the new emerging firms during the dot-com bubble. He established a framework to evaluate innovations and to categorize them as disruptive or not. The importance of Christensen’s model is that it offers a clear method to follow and results in a judgement on whether or not an innovation is disruptive. This method helps business people and investors, who are attempting to invest in an emerging innovation, decide whether such innovation has potential to grow.
Nevertheless, as mentioned earlier, when the term started to become overused, people ignored its original intent and started to utilize it as an adjective to attract news readers. This research will be based on the definition of the term as stated earlier for the purpose of benefiting from the term as an evaluation tool rather than a glamorous adjective for headlines.

Investors are always on the hunt for new evaluation tools and frameworks that could help them make decisions. This research is dedicated to establishing a complete framework that evaluates the disruptive potential of emerging innovations. In order to create a complete framework, an analysis of the different factors that influence the emergence process needs to be considered. The starting point of this research as highlighted before is based on the term disruptive innovation as described by Christensen. Nevertheless, the discussion is not limited to the Christensen model, it involves various other theories and key ideas: The Ecosystem model by Ron Adner and Rahul Kapoor, the D-Day, V-Day, and Bleak Days model by Chen, Zhang, and Jun of the European Journal of Operational Research, and the key idea of network effects. Each of the stated models and ideas will be introduced and discussed further as the paper progresses. This research hopes to achieve the following two objectives:

1. Evaluating the major models of disruptive innovations and showing their limitations.
2. Distilling the essential factors from each model; also, introducing a new factor, and showing how they represent a powerful evaluation tool if used collectively.

One might question both the relevance of such a framework and the actual benefit to investors who might utilize the model. Well, one possible dream for all investors is having a superpower of predicting the future or at least the financial future of the firms they’re investing in. Imagine buying a stock of Google at its IPO, and selling it in 2018. Moreover, imagine having the knowledge that Facebook will disrupt Myspace or that Netflix will win in the battle against Blockbuster. In today’s data-driven world, we are building powerful tools that are helping us evaluate and analyze what’s about to happen. This is what this research is trying to accomplish through building a predictive framework that investors may utilize.

**Literature Review**

The term disruptive innovation was coined by the Harvard Business professor Clayton Christensen. His model defines clear rules for evaluating an innovation as being “disruptive” or not. Later, other frameworks emerged to develop a better understanding of the idea, and each of them presents great insights, while never fully clear of limitations. The following review presents
a variety of sources and discussions regarding the disruption potential of innovations to set the stage for a later evaluation between different models.

To understand the different disruption models, we first need to examine the early research that was done on the topic. The Diffusion of Innovations Theory by Everett Rogers is one of the earliest theories that helps set the foundation for later disruption models. Rogers designed a model to describe the stages at which a new idea would get spread and adopted (Rogers).

Based on Rogers work, Clayton Christensen started his research and developed the Disruption of Innovations model, in which he defined the term; he stated that an emerging product or service that is introduced to the market will eventually spread to the point where it will displace existing firms (The Innovator’s Dilemma). Moreover, to help create a complete model of disruption, we need to present the lenses from which we’ll examine the idea. And here we list four of them: demand, external factors, supply, and internal factors.

**Demand**

Perhaps the best model to make sense of how the disruption potential of an innovation is related to consumer demand would be the Christiansen model. The model incorporates the performance demanded by consumers of the old and new product or service to help draw the trajectory of the two competitors (Christensen). The research will also discuss the different types of disruption as recognized by the Disruption of Innovations Theory ("Disruptive Innovation"). Moreover, the research will highlight the limitation of considering the demand factor by itself through discussing a recent controversy of the Christensen model ("What Is Disruptive Innovation?").

**External Factors**

The external factors evaluation is reflected in the Ecosystem model. The Ecosystem model is presented by Ron Adner and Rahul Kapoor based on the research they conducted on the Semiconductor industry. In their article “Right Tech, Wrong Time,” the researchers argue that “the strength and maturity of the elements that make up the ecosystem play a key role in the success of new technologies—and the continued relevance of old ones” (Adner and Kapoor). The defining question of their model considers what exactly constitutes the timing of an innovation emergence. Their paper answers the question through the examination of the pace at which an entrant to the market will substitute an incumbent.

While the model of Adner and Kapoor does a good job at setting up the ecosystem model, it does not go in-depth and explain the dimensions of an ecosystem that needs to be considered when utilizing the model.
Nevertheless, an article published in 2016 by the research company Gartner, provides us with eight dimensions of business ecosystems that will help to complete the model (Panetta).

**Supply**

A quantitative model by Chen, Zhang, and Jun of the European Journal of Operational Research presents a method that incorporates supply and demand to offer an analytical tool to predict the timing of technology disruption (Chen et al.). Their model builds on a lot of early research by Rogers and Christensen in addition to some work done by Frank Bass. Bass’s model of diffusion brings great quantifiable insights to help shape the supply side of the equation (“The Bass Model”).

**Internal Factors**

For this final section, the research tries to introduce the idea of network effects; the idea is an essential factor of disruption that is ignored by many previous disruption models. Network effects is a term that describes strategic resources that come from the basic assumption that the value of a product or service increases as its customer base grows. The research will show the impact of network effects on a firm’s survival and emergence (Gallaugher).

The topic of disruptive innovation is a vast one, and research is still being conducted on different fronts. Moreover, inventing a model to evaluate the disruption potential of a new idea is a prevalent one nowadays giving the rise of new firms with limited lifespans. Investors need such models to evaluate the firms that they’ll bet on. The preceding models provide tools and insights of evaluation; nevertheless, each of them cannot stand on its own. Each of them needs the others to offer a complete framework that investors may use for making decisions. It is very much like evaluating a company’s stock; an investor would have to consider fundamental and technical analysis before purchase. This is what this study is aimed to achieve; a meta-analysis highlighting the limitations of individual models and the strength of them combined.

**Methodology**

This research makes use of the following theories and frameworks on disruptive innovations in order to formulate an evaluation tool:

- The Christensen Theory of Disruptive Innovation
- The Ecosystem Framework for analyzing the pace of technological substitution
• The D-Day, V-Day, and Bleak Days Framework of Disruptive Technology

The research also includes a final discussion of the key idea of network effects as another essential component of the evaluation framework.

The first set of sources, that is based on the three models, represents the secondary data of the research. It involves evaluating the strengths and limitations of the models. Moreover, as mentioned earlier, the aim of this research is to extract the set of factors that impact the emergence of innovations based on the ideas from the different models. The factors include demand, external factors, supply, and internal factors. The first three factors are reflected by the three models, as for the fourth, it is described in a final discussion of the key idea of network effects.

Discussion

Before we start our evaluation of the main disruption models, we need to consider the question: How does a new product or service emerge and establish itself within a market? The question is a generic one in order to include any innovation regardless of its disruption potential. As for the answer, it’s a simple one, a new innovation emerges as its customer base grows and more people adopt it. Thinking about the previous question and answer helps guide the research toward considering the process to which an innovation emerges. Moreover, there’s no better theory than the “The Diffusion of Innovations Theory” to help describe the spread and adoption of an innovation.

The Diffusion of Innovations Theory was developed in 1962 by the Sociologist Everett Rogers. The theory describes the spread of a new innovation over time within a specific region or culture. The theory models the diffusion through dividing the population into five adopter categories (Rogers):

1. **Innovators**: first people to adopt the innovation; tend to be risk takers and have an entrepreneurial mindset
2. **Early Adopters**: Leaders who are trying to be the earliest investors
3. **Early Majority**: Non-leaders who base their judgment on prior successes achieved by the early adopters
4. **Late Majority**: People who are initially resistant to change but eventually come around
5. **Laggards**: Very conservative segment that has been bounded to change
The figure represents where each adopter category lies based on the spectrum of adoption and resistance. Rogers also assigned specific percentages to each segment as shown in the figure.

The purpose of discussing Roger’s theory is to establish a starting point and a lens through which we can view the overall idea of the emergence of disruptive innovations. Next, we’ll start our evaluation process of the different disruption models. The Christensen model would be the first one since it makes use of the diffusion theory and builds on it.

**The Christensen Model (Demand)**

Clayton Christensen was the pioneer who started the exploration of disruptive patterns and coined the term disruptive innovation. In his book *The Innovator’s Dilemma*, Christensen sets two main characteristics to describe disruptive innovations (The Innovator’s Dilemma):

1. They emerge at the low end of the market; start off as inferior products or services.
2. They progress and develop to the point where they meet consumer expectations and start competing with incumbents.

Christensen indicates that it’s a must for a new innovation to have these characteristics in order to be considered disruptive. The first characteristic indicates that the innovation will start off as an unnecessary product or service with a very low customer base. Customers will already have an alternative, good or service, with good performance to which they are familiar with and willing to keep using. The second characteristic indicates that the innovation will surpass the challenge of being inferior and
emerge through advancements and better performance to the point where it meets the performance demanded by customers (mainstream demand). Moreover, since the new innovation will provide customers with the performance they demand at lower cost, it will start shaking the market to its favor and disrupt existing firms (incumbents) who’re not able to coup with the emerging power. Furthermore, Christensen recognized that there are two forms of disruption. The first takes place when the entrant emerges and starts disrupting an incumbent. The second is when an entrant opens up the door for a completely new market and works its way toward building a new customer base (The Innovator’s Dilemma). The following model will summarize the previous points.

![Fig. 2. Two Type of Disruptive Innovations, Christensen, Clayton M. “Disruptive Innovation.” The Interaction Design Foundation, (1997).](image)

The figure highlights the previous characteristics and utilizes linear curves to show the demand side at the low end, mainstream, and high end of the market (three parallel dotted arrows in red). It draws the contrast between the entrant and the current competition. The red part “sustaining strategy” models the first type of disruption and the green part, labeled “New-market disruption” models the second type as described earlier.

What makes the Christensen model special and a good a starting point in researching disruptive innovations is that it is simple to use. Christensen provides us with a clear and precise guideline to evaluate a new innovation as disruptive based on three sets of questions:

- Deciding whether the new entrant has a potential to become a market disruptor based on incumbent performance
  - Were the incumbent limitations what inspired the new research and emergence of the new innovation?
Do people have any inconveniences using the product or service?

- Deciding whether the disruption started at the low end of the market
  - Are there enough people at the law end level of the market who are willing to try the new product or service?
  - Will the entrant be able to establish some capital from profits to achieve performance development?
- Deciding whether the entrant will be able to surpass the challenge of starting off as an inferior and compete with incumbents
  - Is the innovation disruptor to all incumbents or could some firms, with established infrastructure, imitate its model and gain an advantage?

If the innovation was able to pass all three sets of questions, then it could be described as a “disruptor with great potential” according to the Christensen model (“Disruptive Innovation”).

What makes the Christensen model simple is that it only considers the demand side of the market. And while this is an advantage to offering some clear and on point description, it’s not good enough of a tool to evaluate the disruption potential of new innovations that investors may utilize. We will see how such minimal view, that only considers demand, created an issue while trying to classify Uber as a disruptor.

A huge controversy occurred recently when Clayton Christensen announced that evaluators were misusing his model and that Uber is not a disruptor (“What Is Disruptive Innovation?”). According to the model, Uber is not a disruptor simple because it did not start at the low end of the market. Christensen explains that Uber did not disrupt Taxi since Uber was never an inferior service and that it emerged at the high end of the market. Such controversy highlights the limitation of the model since it only utilizes the demand factor, which perhaps worked for a long time under the one-sided market where producers and consumers were separated. Nevertheless, today’s modern firms like Uber are shifting to a two-sided structure where the supplier and the consumer are intertwined and therefore, we cannot depend on the demand factor alone.

The Ecosystem Model (External Factors)

Ron Adner and Rahul Kapoor were the pioneers who inspired the incorporation of external factors in evaluating disruptive innovations. Their study was based on the semiconductor industry. Based on their observations of that industry, they formulated the Ecosystem model to describe the pace of disruptive substitution. Through their article, “Right Tech, Wrong Time” they try to answer the question of why do some innovations emerge and
The Ecosystem model in basic terms tries to build on the original Christensen model of disruption by not only considering the demand factor but rather focus on the external elements and business environment that controls an entrant’s potential to emerge as a disruptor. Adner and Kapoor recognized similar observation to Christensen, which is that there are two types of substitution as it relates to the ecosystem. The first is when the entrant does not need any “complement” or support from the existing ecosystem which will result in a rapid substitution pace. The second, is when the entrant does need some support and further development that the existing ecosystem has not yet reached which will result in a slower rate of substitution. Such observation highlights the simple introductory part of the theory that’s based on the resources available. The second part of the theory is more about the relationship between the entrant and the incumbent.

The relationship between entrants and incumbents is defined by the model on the basis that each is trying to survive; the entrant is trying to emerge through overcoming challenges while the incumbent is trying to maintain its existence. According to this relationship, the model highlights four different outcomes of substitution based on the entrant and incumbent performance (Adner and Kapoor). The following figure of a probability table summarizes this relationship and provides examples of past disruptions.

A. **Quadrant 1** → Creative Destruction: the fastest form of substitution that highlights an innovation with the greatest potential. The entrant suffers from no ecosystem challenges “bottlenecks” and the incumbent has little room for improvement.

B. **Quadrant 2** → Robust Coexistence: A slower form of substitution that occurs when the entrant has good potential to face challenges and emerge while the incumbent also has a large potential for improvement.

C. **Quadrant 3** → Illusion of Resilience: Another slow form of substitution that occurs when the entrant has little potential to facing challenges and emerging while the incumbent also has little room to improve.

D. **Quadrant 4** → Robust Resilience: The slowest form of substitution that occurs when the advantage is in favor of the incumbent; the
entrant has little potential to improve while the incumbent has a large potential to excel.

These points are represented on the following model in their respective order A, B, C, and D:


The model intersection points, between the new technology and the old one, represent the four forms of substitution. It also shows the emergence of S-curves rather than the linear ones used by Christensen. The S-curves accommodate the external factors in accordance with Rogers theory of diffusion. In his book, Diffusion of Innovations, Roger explains that most innovations follow an S-curve during their substitution stage. He further explains that such curves emerge because the rate of substitution is no constant among all innovations. Nevertheless, Roger did not go in depth to explain the ecosystem idea but rather offers a generic idea of a “social system”, which simply talks about a set of factors and correlations within an environment that would affect the rate of substitution but are hard to detect (Rogers).

What makes the Ecosystem model beneficial is that it’s able to reshape the Christensen model into a more accurate and realistic model. Nevertheless, Adner and Kapoor do not offer us specific measurements of the ecosystem challenges or describe any components of the social system idea that Rogers introduced. In 2017, the research company; Gartner,
published an article outlining multiple dimensions of ecosystems, which will be discussed next in order to give a complete picture of the Ecosystem model.

According to the article by Gartner, Kasey Panetta highlights eight dimensions of business ecosystems. Panetta explains that in the digital world that we live in, organizations must start evaluating their models based on the eight dimensions whenever they are in the process of making decisions or coping with a changing environment. Below is a list of the dimensions and a brief explanation of each (Panetta):

1. **Ecosystem Strategy**: Differentiating between organic ecosystems and deliberate ecosystems
   a. Organic ecosystems are ones that emerge at a slow rate given step by step improvements in the industry, government policies, or market trends
   b. Deliberate ecosystems are ones that emerge based on a plan that causes a revolution/disruption

2. **Degree of Openness**: Deciding whether the ecosystem is public, private, or hybrid. Such information will define the relationship between entrants and incumbents

3. **Engagement of Diverse Participants**: Defining the people, businesses and industries involved

4. **Types of Relationships**: Defining how people are connected through the channels of the digital world

5. **Form of Value Exchange**: Highlighting the leverage of “information, reputation, services, and other non-monetary forms”

6. **Diversity of “Industries”**: Drawing the directions for influence over multiple industries

7. **Complexity of Multiple Ecosystems**: Identifying how “ecosystems interact, identify potential fractures and overlaps, and acknowledge constraints and implications”

8. **Technologies**: figuring ways to integrate existing technologies, businesses processes, and information systems

Identifying the dimensions of the Ecosystem model helps complete the tool for evaluating the external factors that influence the potential of disruptive innovations. Nevertheless, the framework is not yet complete. The two models; the Christensen model and the Ecosystem model, offered two major factors for evaluating the disruption potential of innovations: Demand and External Factors, yet neither one has emphasized the supply side of the market. This is the area of limitation for both models. Therefore, the research will explore a third model that incorporates the supply side of the equation; the D-Day, V-Day, and Bleak Days Framework of Disruptive Technology.

The D-Day, V-Day, and Bleak Days Framework of Disruptive Technology (Supply)

21
This third model is based on a disruption framework that was published by the European Journal of Operational Research. The framework as mentioned before incorporates the supply factor in addition to the demand factor to establish an inclusive model of disruption. The study utilizes qualitative sources to cover the demand side, and quantitative sources to cover the supply side. In the end, both sides are joined together to establish a tool for predicting the timing of disruption.

Before starting to explore the framework, some terminology must be defined:

- **D-Day**: the time when a disruptive innovation reaches an emerging market (new market)
- **V-Day**: the time when a disruptive innovation reaches the mainstream of a market (existing market)
- **Bleak Days**: a period of time when a disruptive innovation may suffer from temporary setbacks in its performance that slows down the substitution rate

The first section of the model is about evaluating the demand factor. The model basically relates to earlier work by Christensen based on his theory of disruptive innovations that was explained in a previous section. The model utilizes the same combination of qualitative data that was used earlier in this paper and emphasizes how consumer preference plays a huge role in the diffusion process of an innovation. Moreover, the model acknowledges the assumption that the disruptive innovation follows the S-curve throughout its emergence stages, but sets one rule for that that will be discussed later. It also divides the stages into two levels to fit the different types of disruption, the first of which is the D-Day where the disruption first starts and customers in the new market are indifferent about the various products and services. The second level is the V-Day, the time at which customer in an existing market becomes indifferent to both the entrant and the incumbent. Since the rest of the demand side has already been explained by previous models, the paper will skip to the quantitative side of this framework that focuses on supply.

For the supply factor, the model makes the assumption that continued performance improvements are the main determinant of the timing of disruptive substitution. In order to predict the likelihood of a performance improvement, the study relates to the work of Frank Bass. Bass was the person who quantified Roger's work on the diffusion of innovations. The next section will take the turn to explain the Bass model to help set the stage for the D-Day, V-Day, and Bleak Days model.

Early in this paper, the work of Everett Rogers and his book; Diffusion of Innovations, was introduced to explain the process of market adoption that a new product or service has to go through. After the publication of Rogers' work, Frank Bass designed a quantifiable model based on differential equations to model Rogers' diffusion idea. The section of Bass's model...
needed for the purpose of this research could be summed up in one formula that tries to predict the portion of people that will adopt an innovation at time (“The Bass Model”)

\[
\frac{f(t)}{1 - F(t)} = p + \frac{q}{M} [A(t)]
\]

- \(f(t)\) → the portion of \(M\) that adopts at time \(t\).
- \(F(t)\) → the portion of \(M\) that have adopted by time \(t\),
- \(a(t)\) → adopters (or adoptions) at \(t\) and
- \(A(t)\) → cumulative adopters (or adoptions) at \(t\).
- \(M\) → the potential market (the ultimate number of adopters),
- \(p\) → coefficient of innovation and
- \(q\) → coefficient of imitation.

This paper will not go in depth toward explaining the different variables since the D-Day, V-Day, and Bleak Days model will redefine some of the variables to fit the disruption idea. Nevertheless, the basic idea of the formula is providing an estimate of the diffusion rate of a new product of service in order to help an investment center of a firm decide whether to commit to a new innovation.

The D-Day, V-Day, and Bleak Days model represents the supply side using a functional formula that is based on the preceding Bass model:

\[
F'(t) = [p + q \cdot \frac{F(t)}{M}] [M - F(t)]
\]

\(F(t)\) could be calculated using a second formula that traces the innovation S-curve:

\[
F(t) = M \cdot \frac{1 - e^{-(p+q)t}}{1 + \left(\frac{q}{p}\right)e^{-(p+q)t}}
\]

The functional formula calculates the likelihood of a performance improvement of a disruptive innovation. This likelihood is bounded by two main components: \(p\) and \(q\). \(p\) is called the “ease component” and represents the external influence and challenges of the environment. If available technology supports the process of performance improvement then performance improvements will take less time to achieve; a favorable outcome for the entrant. \(q\), on the other hand, is called the “network component” and represent the internal influence within the product or service itself. If the product had the qualification that allows it to improve substantially, the time spent on performance improvement will be shortened; another favorable outcome for the entrant. \(M\) represents the limit of an innovation S-curve (limit to improving performance). As for \(F(t)\), it represents the total level of performance improvements at a specific time \(t\). Moreover, for the \(F(t)\) formula to trace an S-curve, the ease component must be less than or equal to the network component (\(p \leq q\)) (Chen et al.).
The key takeaway from these formulas is that performance improvement could be measured via two components: p and q. Nevertheless, the value of p and q diminishes as the innovation level of performance improvement keeps approaching M. As for the part about coming up with the values for p and q, the study indicates that such values could be attained by two possible methods:

1. Estimations based on analogous technologies
2. Regression analyses based on historical data

The study concludes by combining the demand and supply factors to create a decision tree that is the essence of the evaluation tool for forecasting the timing of innovation disruption. Nevertheless, before introducing the tree, a new term needs to be defined and explained; planning horizon for technology disruption (PHTD). The concept is defined as, “the future time for which an organization plans to exert time-based efforts, supported by sufficient financial and human resources, in improving technology performance in the process of new product planning and innovation.” The concept simply describes the length of time at which an organization is willing to keep investing in the process of performance improvement of an innovation (Chen et al.). Now that the final concept of the model is explained, the decision tree will be introduced.

![Decision Tree](image)

*Fig. 5. A Decision Tree for Technology Evaluation and Forecasting, Chen, Chialin, et al. "The D-Day, V-Day, and Bleak Days of a Disruptive Technology: A New Model for Ex-Ante Evaluation of the Timing of Technology*
The tree model aggregates and sums up the concepts discussed so far by the D-Day, V-Day, and Bleak Days framework. The model highlights four outcomes according to the time estimates that the functional equation provides. The first outcome represents step by step performance improvements that do not involve any leap or major advancement and therefore indicates a sustaining technology rather than a disruptive one. The second outcome represents a situation in which the D-Day is longer than the planning horizon meaning that the performance improvement likelihood is low and therefore the innovation could be characterized as disruptive but with no strategic significance. The third outcome will take place when the planning horizon is between the D-Day and the V-Day. At that point, the entrant is able to create a new market qualifying it to be described as disruptive with strategic significance. The fourth and final outcome may occur when the planning horizon is longer than the V-Day. The entrant will be able to create a new market and establish itself within the mainstream of an existing market, and by that, achieving the highest level of disruption (Chen et al.).

Up to this point, the D-Day, V-Day, and Bleak Days model was able to incorporate all the factors discussed so far (demand, external factors, and supply); nevertheless, one more factor remains missing and will be discussed next; network effects.

**Network Effects (Internal Factors)**

Network effects is a concept that describes strategies for creating value that is based on the assumption that, “the value of a product or service increases as the number of users grows.” It is also called Metcalfe’s Law. Bob Metcalfe was the inventor of the Ethernet. His law simply states that “the value of a network equals its number of users squared.”

So far, the research has explored areas of evaluating the potential of disruptive innovations based on their capability to emerge; nevertheless, what if the innovation was capable of emerging but failed in the later stages? The Ecosystem model tried to entertain the idea but did not go in depth to the point where it shows the value of network effects and its relation to performance. The D-Day, V-Day, and Bleak Days model, on the other hand, came the closest out of the three models to incorporating network effects and performance through the p and q components. Nevertheless, the network components in that model were more concerned with the technology that
enhances performance rather than the strategies that create sustainable value according to the network effects discussed in this section. This section will be dedicated toward discussing network effects and how they could represent an evaluation tool of the disruption potential of an innovation.

Ever since the launch of Windows and Office, Microsoft has acted almost like a monopoly with competition barely affecting the firm. Facebook’s rise was able to disrupt MySpace and to this day Facebook is still the market leader in social media. Probably tens of search engines have been designed ever since the internet was founded but only a handful are still being utilized, on top of all is Google. The list goes on, but what is the common factor among all of these disruptors? All of these firms utilized network effects to create an impenetrable model of sustainable value. The value created by network effects come from three main sources (Gallaugher):

1. **Exchange**: Describes the interactions among customers that inspire more people to use the product or service and in turn increase the value. A good example is Facebook. Facebook with only one customer or even a hundred who do not know each other, is worth essentially nothing

2. **Staying Power**: the pull force that influences a customer base to stick to the product or service and not switch to another. There are two forms of this force: switching costs and data. Each of which takes on a variety of forms besides the financial burden. These forms include:
   a. Learning costs
   b. Information and data
   c. Financial commitment
   d. Contractual commitments
   e. Search costs
   f. Loyalty programs

3. **Complementary Benefits**: The side products or service that are tied to the original innovation and that the customers are already using. A good example of this is Microsoft’s Office Suite product. An entrant’s potential will be judged based on its ability to utilize network effects and create value from the previously stated sources. Nevertheless, if the entrant is trying to enter a market with incumbents who already have established network effects then the evaluation will shift to the entrant’s ability to leapfrog. Technological leapfrogging is a very popular term which the tech industry that describes a disruptor’s ability to come up with an innovation of better performance and quality that challenges incumbents established network effects.

**Conclusion**
Each of the preceding models in this research focuses on a specific area, yet to accomplish a complete evaluation, one needs to consider all of them combined. Favoring one model over the other might cause an oversight of a key component that could cost an investor a lot.

During the process of constructing a framework for evaluating the disruption potential of innovations, the research evaluated the strengths and limitations of the Christensen model, the Ecosystem model, and the D-Day, V-Day, and Bleak Days model. It also introduced the key idea of network effects as an additional evaluation tool. Moreover, the research distilled the key factors of disruption: Demand, External Factors, Supply, and Internal Factors. These factors are what constitutes this complete framework of disruptive innovations. Further research will be needed on network effects since it is the common factor that many modern disruptors share. With the continued rise of technological disruption, network effects will be more relevant.

Acknowledgments

I would like to thank Dr. James Purtilo, Dr. Gorkem Ozer, and the Ed Snider Center faculty for supporting this research project.
References


Behavioral and Social Factors That Influence HIV/AIDS Product Market Opportunities for Adolescents and Young Women in South Africa

Adwoa Boateng

Foreword by Research Mentor, Dr. Guodong (Gordon) Gao

I would like to thank the Snider Center's SURE program for this great opportunity of working with Ms. Adwoa Boateng. I am impressed with Adwoa's passion for doing good for society, especially in the healthcare domain. Her research project is based on a collaboration between Smith School's Center for Health Information and Decision Systems (CHIDS) and the National Institutes of Health (NIH)'s Division of AIDS. One major challenge faced by South Africa women is the lack of action to protection themselves from HIV infections, even if the medical products are available to them. Therefore, we conducted a detailed ethnographic study in South Africa to understand better how we can motivate them.

In this process, Adwoa has been working diligently to digest and synergize the lengthy interview records and to come up with new insights on reach-out strategies. She also created typologies based on the HIV risk levels and provided recommendations. Adwoa's work is already making an impact -- she was invited to an all-day workshop hosted by NIH and CHIDS on the subject and made valuable contributions to the discussion. Her insights in this report will be shared with the NIH team and will help design more effective HIV prevention plans. Needless to say, I regard this as high-quality work from the SURE program and feel privileged to have this opportunity working with her.

• Adwoa Boateng is a SURE Fellow in Economics and Government & Politics at the University of Maryland, College Park, MD. Their email address is adwoaobooteng@gmail.com.
Abstract

There are over 7.1 million people living with HIV (Human Immunodeficiency Virus) in South Africa. Social and cultural factors increase the risk and vulnerability of contracting HIV for young black women and adolescents. Historically, uptake and adherence to products for HIV infection prevention in South Africa have been low. This study analyzes the social factors that influence sexual health practices among adolescents and young women. Using Kantar TNS data from an ethnographic study, market segments are developed to understanding the markets’ beliefs and lifestyles towards sexual health. A holistic understanding of the lifestyles, beliefs, product choices and influencers of this target group can help unlock product marketing opportunities that will drive adherence of STI preventative products in the future.

Keywords: HIV/AIDS, South Africa, HIV risk, product marketing, community interventions, public health, sexual education, sexual behavior, young women, condom use, pre-exposure prophylaxis, adolescents

Introduction

In South Africa, over 7.1 million people live with HIV and one in four new HIV infections occur in women and girls. The Joint United Nations Program on HIV/AIDS (UNAIDS) reported 1.8 million people in Eastern and Southern Africa were infected with HIV in 2016, accounting for 43% new HIV infections worldwide\(^1\). Women accounted for over half of the newly diagnosed infections. This epidemic has prompted extensive research on the development of HIV prevention products specifically for women.

The National Institute of Health (NIH) conducted several clinical trials to evaluate the safety and effectiveness of a range of Pre-Exposure Prophylaxis (PrEP) products. PrEP products, when used consistently, reduce the risk of HIV infection in people who are at substantial risk of HIV contraction\(^2\). The studies enrolled over 5,000 sexually active women from 18 to 45 years to use PrEP. Final results from these experiments indicate that the intervention products are safe, but not effective in reducing the risk of

---


HIV contraction. Analysis of blood specimens from participants revealed most of the women were not adhering to the directions of the products. Understanding the barriers to PrEP take up is crucial to reducing the risk of HIV infection in the region and ultimately reduce the prevalence of HIV globally.

This paper contributes to the work on HIV prevention by analyzing the barriers and social factors that influence young black women and adolescents in South Africa. Additionally, it examines their sexual health knowledge and creates market segments based on young women’s sexual experiences and vulnerability of contracting HIV. Using market segments, this study categorizes HIV risk levels young women face to highlight need for various channels to increase PrEP usage. The study sought to answer the following questions to improve the design and marketing of current and future PrEP and reduce HIV risk for young black women and adolescents:

1. Who and what are the main influencers in the lives of young women and adolescents in South Africa?
2. What is their social media presence?
3. Do young women and adolescents have access to clinics and accurate information on women and reproductive health?
4. How can the social factors that influence young women and adolescents in South Africa improve the design and promotion of HIV prevention products?

Definitions

*Acquired Immunodeficiency Syndrome (AIDS):*
The most advanced stage of HIV infection, where a person with HIV has a t-cell count less than 200 cells/mm$^3$. People with AIDS become more vulnerable to opportunistic infections$^3$.

*Human Immunodeficiency Virus (HIV):*
A virus that spreads through certain body fluids that attacks the body’s immune system, specifically T-cells, which help the immune system fight off infections. This damage to the immune system makes it challenging for the body to fight off infections$^4$.

*Pre-exposure prophylaxis (PrEP):*


$^4$ Ibid.
Anti-HIV medications to keep HIV negative people from becoming infected. The U.S. Food and Drug Administration approved PrEP. It is highly effective for preventing HIV if used as prescribed, but it is much less effective when not taken consistently.  

**Literature Review**

Sexually Transmitted Infections (STIs), including HIV, are a major public health challenge in Sub-Saharan Africa. STIs and HIV/AIDS disproportionately affect women, people from low socio-economic backgrounds, and rural communities. Campaigns to educate the public about sexual health and improve access to health facilities target vulnerable groups to reduce their risk of contracting HIV. Cultural traditions and personal beliefs influence consumers’ likelihood of understanding their risk and using PrEP products. The literature review summarizes the effectiveness of previous public health initiatives, perceptions about sexual health and HIV/AIDS, and motivates this research topic.

Ramjee, Abbai, and Naidoo (2015) researched the epidemiology, management of common STIs affecting African women, and the health complications associated with these infections. They conclude that in general, comprehensive STI screenings are lacking. In addition to limited screening opportunities, reports from surveys conducted in South Africa indicate that women use condoms less frequently than men. Religious beliefs, cultural views, and women’s limits in persuading sexual partner(s) to wear condoms contribute to the gap between men and women’s use of condoms. With their analysis, Ramjee et al advocate for the development of less costly screenings at health facilities in resource-limited areas. One limitation of the study is that the authors do not discuss strategies to increase education programs that could change behavior to improve condom.

To determine the prevalence of HIV infection and exposure to national HIV prevention programs, Pettifor et al (2005) conducted a national survey of HIV prevalence and sexual behavior among 15–24 year olds. Their results suggest that national HIV prevention programs reduce the risk of HIV infection. Though interviewees were familiar with national programs like loveLife, only 15% of women and 7% of men reported knowing their HIV status. Additionally, they found young women were significantly more likely to be infected than young men, across all ethnic groups. The interviews were translated into local languages to account for any language barriers and

---

enhance interviewees’ trust in the interviewer.

Hoosen & Collins (2004) examined the social influences that shape women’s sexual behavior, focusing on gender and HIV/AIDS awareness. The authors conducted discussions with seven focus groups with black women living in Durban, South Africa. The study found out that women in KwaZulu-Natal were not always in a position to make rational choices about using condoms, since such decisions were often reserved for men. The women share that men are often socially constructed as figures of authority in their relationship, so they make decisions in their relationship. Additionally, young women felt they were expected to be “subordinate, submissive, and passive subjects who are encouraged to comply with men’s demands for sex. In their discussion on sexual health and AIDS awareness programs, many of the women noted they choose not to participate because AIDS education programs excessively use fear tactics. This reinforces dangerous sexual practices and explains why young women in South Africa expose themselves to a higher risk of getting HIV.

Myers, Kline, Browne, Carney, Parry, Johnson, and Wechsberg (2013) describe ethnic differences in alcohol and drug related sexual risks for HIV among vulnerable women from Cape Town, South Africa. The authors examined if there is variation in alcohol and drug related sexual risk behavior using a cross-sectional dataset on 720 alcohol and drug-using women from poor townships in Cape Town. Results indicate that there are differences in drug use among black women and mixed race women; however, both groups are at high risk of contracting STIs compared to whites and Asians in South Africa. A third of women reported they were drug or alcohol impaired and had unprotected sex during their last sexual encounter. Myers and coauthors contribute to the literature on HIV risk by analyzing the role of race in the exposed risk for black and mixed race women. With quantitative data analysis, they effectively argue there is a strong link between alcohol and drug use and the chance of engaging in unprotected sex. While the risk of HIV is effectively analyzed, Myers and coauthors do not discuss how they account for self-report bias. Social desirability could influence participants’ responses to questions about sexual history.

Similar to Myers et al (2013), Kon and Lackan (2011) investigate ethnic disparities in obtaining medical care for the four major ethnic groups (Blacks, Whites, mixed race, and Asians) in post-apartheid South Africa with data from the 2002 Afrobarometer Survey of South Africa. They find disparities in health, education, income, and basic public health infrastructure between black and mixed race South Africans and Whites and Asians. Specifically, nearly half of black South Africans went without medical care when they needed it in the past year. These disparities in access to health care contribute to the health and financial vulnerability that black and mixed race
South Africans experience. Additionally, the authors discuss public perceptions of the government and health care system. While some black and mixed race individuals are disappointment in the government’s provision of health care, the overwhelming majority recognize an increase in public health campaigns in townships. One of the strengths of this report is connecting the history of apartheid in explaining the differences in perceptions between black and mixed race respondents and white and Asian respondents.

Condoms are physical barriers that reduce the risk of a sexual exposure to infections, including HIV. The Government of South Africa ran a condom program to educate the public and increase condom use. Bebsinska and coauthors (2013) analyzed service related issues of condom distribution programs. Contraceptive use is high in South Africa, at 64% among sexually active women, but unplanned and teen pregnancies remain high. Condom use is also lower in rural areas compared to urban settings. They identify knowledge of the protective effect of condoms as a significant barrier, as accurate knowledge about prevention of HIV transmission declined from 60% to between 40 and 50% from 2005 and 2008.

Though condom use is limited, studies have demonstrated that youth in South Africa are aware of HIV/AIDS. However, awareness of the illness has not deterred people from engaging in unprotected sex. Mulwo, Tomaselli, and Dalrymple (2010) investigate the behavioral factors influencing sexual practices and perceptions among university students in KwaZulu, South Africa. Mulwo and co-authors conducted ethnographic surveys that focused on the student’s knowledge, attitudes and practices with regard to HIV/AIDS, their access to HIV-prevention campaigns, and their attitudes towards HIV-prevention messages. They report that condoms provided by the governments and non-profit organizations are perceived as ineffective, smelly, and infected with the HIV virus. Additionally, free condoms are seen as products for those of a lower socioeconomic status compared to the commercial condom brands. This influences students’ decision to engage unprotected sex rather than using free condoms. Empirical evidence from this study low cost or free goods will not always incentivize a higher demand, if the target group perceives the subsidized item as an inferior good.

Chimbindi, McGrath, Herbst, Tint, and Newell (2010) investigate patterns and socio-demographic determinants of condom use and consistency of use among young adults aged 15-24 years in rural South Africa. Using the South African Demographic Health Survey, they found knowledge about condoms and HIV prevention are high among young adults but general perception of risk to infection and vulnerability is low despite high HIV rates. Over 30% of the women surveyed used injectable hormonal contraception to prevent pregnancies but were not actively protecting themselves from contracting infections. Surveying three age groups, 15-17; 18-20 and 21-24
year age groups; captures the wider range of young people who engage in risky sexual behavior and/or have inaccurate sexual health information. The authors give recommendations to increase condom use; however, they do not research what factors influence young adults not to use condoms.

Although contraceptive use in South Africa is increasing, the risk of HIV is prevalent. Quaife et al (2018) examine the cost-effectiveness of multi-purpose HIV and pregnancy prevention technologies that address HIV risk and the sexual and reproductive health needs of women in South Africa. Using a discrete choice experiment, the authors provide five different products that tailor to the preferences of sexually active women. Their results suggest that co-formulation of contraceptive and HIV prevention products will be cost-effective among younger women and female sex workers, but not among older women. Notably, they predict a 10-percentage point increase in uptake if provided with multipurpose prevention technologies. Their main conclusion, incorporating contraceptive characteristics into HIV prevention products would result in a meaningful increase in product use, fails to address the social barriers that would prevent younger women from accessing these products.

The findings from the literary review support the research questions of this study, and highlight the gap in understanding the social factors that can influence young women and adolescents to proactively use PrEP, especially products that are free or subsidized.

Theoretical Framework and Research Methodology

This study uses an ethnographic framework to examine the social factors that influence young women and adolescents’ product preferences and perceived risk of contracting sexually transmitted infections. As the literary review highlights, there are strong behavioral practices influencing women’s vulnerability and risk. The proposed framework examines the behavior of participants to understand their culture and the major influencers of young women’s behaviors. Studying the sexual behaviors and product preferences of young women and adolescents in South Africa can be leveraged to develop HIV prevention products that reduce vulnerability and improve access to accurate sexual health information. The methodology of this study included analyzing interviews from Kantar TNS, a marketing company in South Africa, in the following settings:

- In context interviews and immersions with 32 young women for 3 days
Focus groups of friendship quads with 12 participants from individual interviews

11 interviews with key influencers of the women who engaged in individual interviews

**Demographics of South Africa**

Participants in the study were predominately from the Zulu or Xhosa tribe living in townships located outside major urban areas. Though they come from families with different socioeconomic backgrounds, many of the women depend on government subsidies and social programs to support their livelihoods. Because of limited employment opportunities in the townships, many of the interviewers travel to major urban areas for job opportunities. The distance between townships and major urban spaces has contributed to the development and expansion of informal economies within townships. Often, shops in townships provide similar goods and services sold in city shops.

**Data Analysis**

*Who and what are the main influencers in the lives of young women and adolescents in South Africa?*

Social media, beauty and fashion trends, relationships, female role models, religion and culture, and education are the main channels of influence for the participants. Below, I provide an in-depth analysis of the effect of each channel on a young woman’s sexual practices and perceptions.

**Beauty and Fashion Trends**

Along with using social media, beauty and fashion trends heavily influence young women and adolescents’ product preferences. Personal care products, including deodorant and sanitary products, are a signal of femininity and/or success for the target group. In the interviews, they often mention the importance of maintaining a “clean” image. It is a signal of beauty and self-awareness. They recognize societal expectations of grooming, and support it. Young women and adolescents purchase products based on trends, price, and recommendations from their social network. Actively managing their personal care gives them control over their appearance and confidence. For the young adults who are unemployed or underemployed, they sometimes switch to generic brand products or save their beauty products for special occasions. This has significant implications for the branding of HIV prevention products. Products should contribute to young women’s’ confidence and femininity, rather than a product for medicinal purposes alone. Because they shop for items that they deem quality and trustworthy, quality reassurance of HIV prevention products is
important. Many low income women question the quality of products that are offered for free, which supports the findings of Mulwo and co-authors (2010). Young South Africans view public sector condoms as products for low income/low class people.

**Female Role Models**

Female role models play a significant role in shaping young women in urban and rural South Africa. High divorce and separation rates in South Africa has contributed to the prevalence of single parent, female-headed households. All the young women and adolescents in the sample identified a woman, or more than one, as her main role model. Older women are seen as knowledgeable and caretakers. Many of their mothers, the head of the household, work long hours, leaving children and adolescents in care of grandmothers or without care. The lack of male input and guidance contributes to young women’s perceptions of men, sex, and relationships.

Within the community, older women foster sisterhood for young girls to guide them through their path to womanhood. Mothers and grandmothers, who often consider themselves as the “disempowered generation” strive to provide education for the younger generation. Education is seen as an access to upward financial mobility. They try to foster a sense of self-worth and acceptance, and advice against relationships with older men.

**Relationships**

Most of the young women interviewed were in relationships and/or maintained contact with the father of their child. Some of the adolescents were in relationships, but often hid it from their mothers. Most are sexually active with one partner and use contraceptives to prevent pregnancies. However, they do not take any measures to protect themselves from contracting STIs. Some young women engage in risky behavior, washing their vaginas with dish soap or taking local pills/herbs, to please their sexual partner(s). This indicates men have great influence over women’s sexual and health choices. Additionally, young girls are faced with early sexual induction and a lack of agency in negotiating safe sex.

Women, especially low income women, face some level of risk and vulnerability because of their sexual/romantic interactions with men. They note that men often do not want to use condoms, and they cannot change their partner’s decision. In the interviews, young women and girls fear their sexual activity will bring her shame in the community, but men/boys have the freedom of having multiple sexual partners.

For many women in South Africa, pursuing her own financial independence is ideal but unlikely. In her journey to financial freedom, some young women date only men with ‘promising’ jobs. Most do not necessarily default to finding a Blesser, but they prefer a temporary relationship with a
man who can help cover luxury expenses - weave, brand clothing/ spa treatments, spending money, her own apartment or car. Young girls and women often exploit their sexual power and compromise their sexual health in order to attain a Blesser. Increasing HIV/AIDS risks stem from non-monogamous relationships, relationships with abusive partners, compromising protection, and health choices.

Religion and Culture

Participants describe a tension between cultural expectations and modernity. There is a push towards modernity, but a pull back to traditional obligations, and expectations. They often feel limited and disempowered by the social and cultural requirement to do it all. Some women are breaking free from cultural molds and prescribed social roles. They perceive cultural practices are historical and outdated. Rite of passage is often cultural and entrenched in traditional notions of womanhood. For example, old Zulu ceremonies determine whether a girl has the right to be seen as a woman in her community. Some women are taught that ‘women must endure’, some believe that overcoming struggles is part of ‘being female’.

Most of the women in the sample identify as Christian, and many are heavily involved in local churches. Those who practice Christianity make decisions about sex based on their religion and their observations of other women in their church. Virginity is often social capital: allows social acceptance in larger community. Remaining a virgin is critical for acceptance by ‘institutions’ of community: church, elders, ancestors etc.

The cultural and religious expectations of young women often hinder their search for sexual health information or squash their sexual curiosity. When they do seek out information and free products at local clinics, women and adolescents often encounter social backlash and labeled as a ‘bad girl’. Nurses are critical touch-points to empower young women, but their personal biases dissuades young girls from returning to the clinic. Additionally, often nurses misinterpret medication/ procedure/ treatment information, leaving young women misinformed and exposed to risk.

These channels of influence have major implications for future HIV prevention products- cost, access, partner integration, and communication and messaging inclusive of young women and the community.

What is their social media presence?

Participants are active on major social media platforms, specifically Facebook, WhatsApp, and Instagram for various reasons. Usage varies across different social media platforms, for both age groups. For some women and adolescents, the costs of internet limit their Instagram and Facebook usage. However, everyone uses WhatsApp to communicate with immediate friends and, occasionally, meet new people through large group chats. Apart from communicating with their friends on social media, women
and adolescents learn about western and African pop culture on social media. Interviewees follow celebrities, from the entertainment industry, and beauty bloggers on social media, especially Instagram, to learn about new fashion trends and popular products. Additionally, some interviewees use social media as their primary source of information and news. Given their active social media presence, HIV prevention products that are marketed in social media can increase awareness about risk and increase demand for products.

Do young women and adolescents have access to clinics and accurate information on women and reproductive health?

Generally, a young woman’s sexual autonomy and health are interlinked with her educational opportunities, earning power and access to accurate sexual advice. Most of the participants in the study rely on their social network for sexual health information and product reviews. For the younger participants, their mothers play a significant role in their knowledge about sexual health and the personal care products they purchase. When they do seek out sexual health information from professionals, young women often receive partially accurate information. Nurses are young women’s primary source of accurate sexual health information and treatment; however, nurses often misinterpret treatment and medication information, leaving young women uninformed.

Risk and Vulnerability Typologies

The typology approach divides the market into groups based on their shared interests, lifestyles, beliefs and sexual practices. These typologies were created by analyzing the intersection of gender, race, class, and culture from the qualitative data. Typologies categorize HIV risk levels young women face to highlight the need for various channels to increase PrEP usage.

Type 1: Young adults with information

Though they are not the majority, a few women in this group practice abstinence for religious and personal reasons. The average woman in this group takes contraceptives, most commonly the 3-month injection from a local clinic. She is sexually active, usually with one partner, in a committed relationship. Along with using birth control to prevent having more children, she knows about the benefits of condoms and understand the risks of engaging in sexual activities without condoms. Women in this group often seek out services at a local clinic. A few mention the importance of women’s health, but admit to never seeking out those services.

Within this group, those who are most careful and are exposed to minimal risk have attended prenatal care in the past. They mention that the nurses in the prenatal classes gave lessons about preventing STIs, and have continued using these products postpartum. Apart from the young mothers, young women who have reached at least tertiary education level also seek
out these services. To encourage women in this group to use HIV prevention products, resources and services should be offered regularly at health facilities on campuses and in local towns.

*Type 2: Young adults with minimal information*

Women in this group are usually sexually active; however, they lack full information about protecting themselves. They are relatively relaxed when it comes to sexual health and do not retrain from having casual sex or having multiple partners. They are more likely to use home remedies to solve gynecological issues, like drinking special concoctions to prevent STIs. Often, they consider contraceptives and/or antibiotics as the best form of protection against HIV, which shows that they may be misinformed about what contraceptives do. They know how to prevent pregnancies, but product misinformation contributes to a high risk of contracting an infection. Their sexual activity and lack of intent to prevent HIV infection makes them particularly vulnerable.

*Type 3: Teenagers with information*

Most of the girls in this group learn about sexual health from older sisters, mothers/grandmothers who are willing to talk about sexual health, and/or Life Orientation in school. Some are sexually active, usually with one partner in a committed relationship. They use Facebook and Google to find answers to their questions about sex and contraceptives. Through their discussions with friends, they hear about products and services offered at clinics. However, societal pressure is a nonfinancial barrier to sexual healthcare access, which puts them at a relatively low risk.

*Type 4: Teenagers with minimal information*

Within this group, there is some variation in sexual curiosity and risk/vulnerability. Some girls in this group come from very conservative households, which is why they rarely talk about boys and sex. They do not perceive peer pressure as a challenge in their lives. Culture and religion are important, and they often look forward to traditional rituals celebrating their virginity and journey to womanhood, like the Umemulo ceremony. The little information they know come from watching TV or hearing other girls talk, who they think are bad children, in the community. They don’t actively seek out the information and sometimes have never heard about the word contraceptives. Social and family pressure outweighs peer pressure, so they choose abstinence. Because they adhere to social norms, they have the lowest risk of HIV.

On the other hand, some teenagers in this group have little information but are still curious about sexual health. The biggest barrier to receiving information in this group is adults unwilling to provide sexual
education for various reasons. Their mother, teachers, and other role models’ expectations and beliefs are a barrier to learning about HIV prevention products. Respect for their role models influence some teenagers to hide their relationships and sexual activity, exacerbating their risk of HIV contraction. Their social networks become their main channel of information so they are more likely to try home remedies and use products for various purposes. They are most concerned with looking attractive and “mature” for potential partners, often increasing their vulnerability and risk of HIV infection in the process.

**Recommendations**

To leverage social factors to design prevention products that appeal to market segments, future HIV prevention programs should disseminate sexual health information through informal channels:

- Advertisement campaigns on Facebook and Instagram, including paid partnerships with well-known beauty bloggers who influence fashion. Using hashtags that are common in South Africa, like #girlboss, will increase publicity for PrEP and spark conversations about HIV risk.
- Create partnerships with local businesses in the townships, so young women can purchase PrEP conveniently in their neighborhoods. Additionally, business owners should receive training on where users can seek professional guidance on HIV risk and protection.
- Investigate in skills based after-school programs where trained sexual health professionals have a platform to distribute accurate information and answer questions. Mothers, the main role model for teenagers, may support programs that train their daughters and provide safe after-school activities.
- Improved sexual health training for health care workers. There is a critical gap in the health care system that contributes to misinformation. Nurses should receive training on new PrEP’s function, benefits, and directions for applying the treatment.

**Conclusion**

The ethnographic study supports the hypothesis that social factors strongly influence the behavioral and perception of young women and adolescents in South Africa. Many of these young women have a false perception of their own vulnerability and risk of contracting HIV. This
presents challenges in encouraging young black women to use condoms, PrEP, and seek medical, especially since they are generally not in a position to negotiate safe sex. HIV prevention products are crucial to reducing the risk young women and adolescents are exposed to. Appropriate branding and access to accurate information is critical to increasing awareness and influencing change to reduce the prevalence of HIV/AIDS and other STIs in South Africa. Future research should investigate if there is a difference between the social factors in South Africa’s cultures and other cultures that should be accounted for when promoting PrEP in other countries.
References


Government Policies and Solar Power Adoption in Maryland

Modibo Abbo

Foreword by Research Mentor, Dr. Steve Sonka

In recent decades, the world has been seeing a push away from fossil fuels and toward renewable forms of energy, which reduce pollution of the environment or contributions to the greenhouse effect. Although solar photovoltaic (PV) energy is still relatively small compared to the likes of wind and hydroelectric, it is one of the most rapidly rising forms of renewable energy in the United States. Because government policy can significantly affect the level of solar PV adopted, it is important to ascertain which sorts of policies are most effective, and how effective they are.

Modibo Abbo, an economist with interests in public policy and its effects on clean energy availability undertakes an extensive literature review to explore the relevant policies in place within the state of Maryland. The study draws upon solar PV installation data, dating back to 1998. His research findings emphasize that cash incentives tend to be more effective than tax incentives, commercial incentives tend to be more effective than residential incentives, and Renewable Portfolio Standards tend to be very effective as regulatory policies.

- Modibo Abbo is a SURE Fellow in Economics at the University of Maryland, College Park, MD. His email address is mabbo@terpmail.umd.edu.
Abstract

This study uses past research as a reference to identify potential effects that government policies in effect within Maryland may have had on solar adoption trends. It also aims to identify if the trends in Maryland significantly deviate from what would be expected based on established research. A literature review outlines the relevant established research on the relationship between government policies and solar PV usage. The study then takes an in-depth look at the government policies in place in Maryland, and examines solar photovoltaic installation data, dating back to 1998. It is found that the perceived relationship between government policies and solar adoption trends in Maryland does not contradict what is suggested by the literature.

Introduction

In recent decades, the world has been seeing a push away from fossil fuels and toward renewable forms energy, which do not pollute the environment or contribute to the greenhouse effect. These include nuclear, hydroelectric, geothermal, wind, biomass, and solar energy. Although solar photovoltaic (PV) energy is still relatively small compared to the likes of wind and hydroelectric, it is one of the most rapidly rising forms of renewable energy in the United States. Because government policy can conceivably have a significant effect on the level of solar PV adopted, it is important to ascertain which sorts of policies are most effective, and how effective they are. In the U.S., both federal and state governments have undertaken policies to incentivize the adoption of solar PV. This study takes an in-depth look at the policies in place within the state of Maryland. The study draws from solar PV installation data, dating back to 1998. The goal is to use past research as a reference to identify potential effects that government policies have had on solar adoption trends. The study also aims to identify if the trends in Maryland significantly deviate from what would be expected based on established research.

There are a wide variety of policy options available to a government aiming to incentivize solar PV adoption. These include grants, rebates, loans, regulatory mandates, and tax incentives. Tax incentives can be further categorized into property tax credits, income tax credits, sales tax credits, and tax exemptions. These can be broken down even further, as they are typically targeted toward either individuals or businesses. Moreover, in the United States, both the federal and state governments have the authority to implement these policies as they see fit. Maryland, being one of the states with the most solar incentive programs, implements all these policies in some
form. The research exhibited in this literature review touches on many of these incentives. Thus the five major policies listed above will be defined.

Grants are a lump-sum of money awarded by the government with the condition that they are used toward installing solar PV systems. Typically, these are given to commercial enterprises. In Maryland, they can range from $20,000 to $200,000 (DSIRE). Rebates are partial refunds from the government, which are meant to cover some of the cost of purchasing a solar power system (DSIRE). Loans are also money awards from the government, with the condition that they are used toward installing a solar system and that they are paid back with interest. Typically, the interest rates are reduced. Although there is no statewide loan program in Maryland, a federal loan is available. There is not much research that has examined the effect of loans on solar adoption, so this incentive will not be represented in this literature review. Regulatory mandates typically come in the form of renewable energy portfolios, which mandate that utilities derive a certain amount of their electricity from renewable energy. With tax credits, individuals or businesses receive a reduction in their taxes paid, typically as a percentage of the cost of the solar PV system that was installed. As mentioned before, these include property, sales, and income tax credits.

Another type of incentive which has shown itself to be effective and is used around the world, is the Feed-In-Tariff (FiT). A FiT is a payment for all electricity a consumer produces (with solar power), even if they use it themselves. In addition to this, they are given bonus payments for electricity they export into the grid. Although Maryland does not implement this specific policy, its rebate program is relatively similar.

**Literature Review**

The first study that will be used is “Public policy influence on renewable energy investments—A panel data study across OECD countries” (Polzen, Migendt, Taube, & Flotow, 2015). This study evaluates the impact of public policy measures on renewable energy investment in general. The data used for this study was drawn from a sample of OECD countries, including the U.S. Many renewable sources were considered, but emphasis will be placed on the results as they pertain to solar PV. The researchers conducted a panel regression examining the period from 2000 to 2011. In this model, the dependent variable was the aggregated newly installed capacity (in megawatts) for each year in a certain country. The results of the study indicated that, for less mature technologies, fiscal incentives such as Feed-In-Tariff should be implemented. For more mature technologies, market-based incentives such as Greenhouse Gas emissions trading systems should be implemented. Solar power, being one of the least used forms of renewable energy and only becoming more prevalent within the last two
decades, would be considered a less mature technology. This implies that more direct cash incentives like FiTs would be the optimal type of policy for the mobilization of solar PV adoption.

In “The impact of state financial incentives on market deployment of solar technology” (Sarzynski, Larrieu & Shrimali, 2012), the researchers determined a quantitative impact that state-level financial incentives could have on solar power adoption. The study examined the total annual solar PV capacity for each U.S. state, over the period of 1997-2009. The data also contained information about each state’s active financial incentives over the period of the study. To measure the effect of these incentives, the study employed two time-series cross-sectional fixed effects models. For both models, the dependent variable was the annual amount of solar PV technology installed, in kilowatts. The independent variables for the first model were dummy variables that indicated the presence of four different types of policies: income tax incentives, sales tax incentives, property tax incentives, and cash incentives. Specifically, “cash incentives” refers to policies such as rebate and grant programs. The independent variables in the second model were the years since each of the four types of policies listed above were enacted. The purpose of this was to test the hypothesis that, as more time passed, the impact of financial incentives would grow. Both models controlled for factors such as electricity prices, per capita GDP, and population. The results showed that states offering cash incentives (such as rebates and grants) experienced significantly stronger deployment of solar PV technology than states which did not offer cash incentives. States with cash incentives were associated with a 248% higher amount of PV installed. They also installed an additional 23% more PV per year, as compared to states without a cash incentive. Conversely, it was shown that states which offered tax incentives (income, property, and sales taxes) did not experience any stronger deployment of solar PV than states which did not offer tax incentives. Overall, it was suggested that because cash incentives tend to be simpler to administer and are larger in value, they yielded a much more significant effect on solar PV adoption than tax incentives.

In “Efficient scale for photovoltaic systems and Florida's solar rebate program” (Burkart & Arguea, 2012), the purpose of the study was to estimate a model that described the cost of a solar PV system as a function of solar panel wattage for both residential and commercial consumers in Florida. The significance of this is that it can provide insight about the cost-efficiency of Florida’s tax credits. Before the study was carried out, it was expected that economies of scale would be observed – as more solar systems were installed, the cost of doing so would decrease. To test this hypothesis, the dependent variable was set as the installation cost. The independent variables included the nominal panel wattage (for each particular system), and a dummy indicator variable. This dummy variable
took on a value of 0 for residential sites and a value of 1 for commercial sites. The study drew its data from a sample of 1,188 solar PV sites throughout Florida. The results showed that there was, in fact, an economies of scale effect for both residential and commercial sites. However, it was also revealed that the level of rebates for either type of site was inefficient. Both residential and commercial consumers tended to purchase solar systems that conformed either exactly to their rebate limits, or very closely to them (5 kW for residential, 25 kW for commercial). However, for the residential users, the rebate limit fell short of the efficient scale (6.9 kW). Meanwhile, for the commercial users, the rebate limit largely exceeded the efficient scale (13.8 kW). Based upon this observation, it was recommended that the state of Florida increase the rebate limit for residential users, and decrease it for commercial users. Two implications can be drawn from this study. One is that, although cash incentive programs such as rebates tend to yield results, there is nuance in how they should be applied, depending on the target consumer. Another is that because there is an economies of scale effect, commercial consumers use more solar PV energy.

Recently a comparative case study of Denmark, Germany, the UK, and Ontario was also published (Curtin, McInerney & Johannsdottir, 2018). Its purpose was to identify what types of financial incentives (for both solar and wind energy) were effective at the feasibility, development, construction, and operation stages of project development. To achieve this, the researchers reviewed statistical data on renewable deployment and investment trends in each of the four countries. If it was not possible to determine the impact of a particular incentive on renewable deployment (as it was in the cases of Denmark and Ontario), the researchers undertook interviews with four experts that had detailed knowledge of the use of financial incentives to promote renewable energy adoption. The study did not speak on solar power incentives in Denmark. However, in Germany, it is noted that a robust grant program, loan program, and Feed-In-Tariff program have greatly contributed to solar PV adoption in the country. The grant program provided up to 70% of the upfront costs of installations. The loan program offered loans to individuals and businesses at a low rate of 2% for solar PV purchases. The Feed-In-Tariff is said to have been a major factor contributing to the success of solar adoption. FiTs also played a role in solar adoption within the UK. However, the benefits from this policy were not allowed to be compounded with grant programs, so the effect was smaller than it was in Germany. Ontario also seemed to exhibit similar results to Germany and the UK, with regard to FiTs. From this study, it is clear that the use of FiTs was a successful policy for mobilizing solar PV usage.

In an evaluative study by researchers Andrew Macintosh and Deb Wilkinson, the effects of the Solar Homes and Communities Program were examined. This was a rebate program initiated by the Australian government
in the early 2000s. Specifically, the researchers examined the extent to which
the residential component of this program increased the use of renewable
energy. They found that between 2000 and 2009, cumulative installed solar
PV capacity in Australia increased from 29 to 184 MW (megawatts). Around
80% of this increase is estimated to be from users who utilized the rebate
program. The study acknowledges that there were surely other factors which
contributed to this rise in PV implementation, such as the introduction of
FiTs and additional subsidies by individual jurisdictions within Australia.
However, it concludes that most households would not have invested in the
solar PV systems if the rebate program had not existed.

Finally, in a study entitled “A review on global solar energy policy,”
(Solangi, Islam, Saidur, Rahim, Fayaz, 2011) the researchers analyzed solar
energy policy instruments around the world. They specifically examined the
levels of success that Renewable Portfolio Standards, production tax credits,
Feed-in-Tariffs, and subsidies were (or were not) obtaining in North
American and Europe. The study found that the most beneficial energy
policies tended to be Feed-In-Tariffs and Renewable Portfolio Standards.

These studies each examine different aspects of solar power
incentivization. However, the common thread seems to be that the optimal
policy for improving solar PV adoption is to offer direct, simple cash
incentives to both residential and commercial entities. Moreover, the
Renewable Portfolio Standard as a regulatory policy also appears to lead to
significant solar adoption. Other incentives, such as sales tax credits,
property tax credits, and income tax credits also seem to have an impact, but
it is not quite as large. In effect, a policy like the income tax credit is not very
different from a cash incentive. However, the fact that it is typically smaller
and more complicated to implement may explain why it is not as effective.

Research Methodology

In order to form conclusions about the potential effect of government
policies on solar PV adoption in Maryland, it is necessary to have a
comprehensive understanding of:
(1) The established literature that speaks to this effect.
(2) The policies that are being implemented in Maryland.
(3) The data on solar PV usage in Maryland.

Thus, the primary research method employed in this paper is descriptive
– both qualitatively and quantitatively. Using document and data review, it
aims to draw inferences about the nature of the relationship between our
dependent variable (solar PV adoption in Maryland) and our independent
variable (Maryland government policies). The dependent variable is
measured in kilowatt-Hours, megawatt-Hours, and gigawatt-Hours. The
independent variable is examined through a qualitative lens – our interest lies in the variation among the different types of financial incentives.

The qualitative aspect of the research is reflected in two parts. The first is the literature review, which compiles, summarizes, and draws conclusions from already established research on the effects of financial incentives on solar energy adoption. This information is key, because it acts as the standard from which our inferences will be drawn.

The second part of the qualitative aspect of this research is a review of the policies pertaining to renewable energy adoption currently in effect within Maryland. This information is necessary because it affords us a clear understanding of our independent variable. It is obtained primarily from two sources: The Database of State Incentives for Renewables & Efficiency (DSIRE) and the Maryland Energy Administration (MEA) websites. DSIRE was used to search and sort through the policies in effect within Maryland, both at the federal and state level. The MEA was used to obtain more detailed information about these policies.

In similar fashion, the quantitative aspect of the research affords us a clear understanding of our dependent variable; it compiles the data on solar PV use within Maryland between 1996 and 2017. The source for this data is the Electric Power Monthly report from the U.S. Energy Information Administration. In this paper, the data is not represented in its original format. The relevant data points were extracted from tables and were used to show the change in solar PV usage over time.

Data

Renewable Energy Policies in Maryland

In Maryland, there are a total of 49 distinct regulatory policies and financial incentives that potentially contribute to the level of solar PV adoption. However, only the policies with significant lifespans and a sizeable area of influence are represented here. Many of the policies that are not shown do not last longer than a year, are only applicable at the county or city level, or only pertain to very small, specific industries. The policies that were deemed most likely to have a significant impact on solar adoption in Maryland are summarized in this chart, and more detailed descriptions are provided below:

<table>
<thead>
<tr>
<th>Policy</th>
<th>Implementing Sector</th>
<th>Type</th>
<th>Target</th>
<th>Amount</th>
<th>Year Initiated</th>
</tr>
</thead>
<tbody>
<tr>
<td>USDA - Rural Energy for America</td>
<td>Federal</td>
<td>Grant</td>
<td>Farms/Agricultural Businesses</td>
<td>&lt; 25% of cost</td>
<td>2003</td>
</tr>
</tbody>
</table>
Federal

**USDA – Rural Energy for America Program (REAP):** This policy is a grant program for rural small businesses and agricultural producers. This is particularly relevant to Maryland because farmland makes up 2 million acres of Maryland’s total 6 million acres of land (Maryland State Archives). These grants are awarded for the purchase of installation of renewable energy systems, or for making energy efficiency improvements through the use of renewable technology. They cover 25% of a project’s cost.

**Residential Renewable Energy Tax Credit:** This is a tax credit intended for residential users who implement geothermal heat pumps, small wind power systems, or solar PV. With this policy, a homeowner can claim a credit of
30% of their expenditures on solar PV. These expenditures include costs such as labor, site preparation, and assembly/installation. The budget for this program is limitless; there is no cap on the total amount in tax credits that can be awarded.

**Renewable Energy Production Tax Credit:** This credit targets taxpaying electricity-generating facilities. Facilities who sell off any excess electricity they generate with a renewable energy system are eligible for the tax credit. For wind, geothermal, biomass, and solar systems, the credit amounts to $0.023/kWh generated. A user can only take advantage of this credit for the first 10 years of operation.

**State**

**Residential Clean Energy Grant Program:** This grant program is for homeowners who install geothermal heat or solar technology. For solar PV specifically, a flat amount of $1000 is awarded to the user for any installation between 1-20 kW. This grant is subtracted from a user’s adjusted gross income, so that he or she is not required to pay taxes on it.

**Commercial Clean Energy Grant Program:** This is a grant program for geothermal heating systems and mid-size solar PV systems. It is intended for businesses, non-profits, and local government facilities. It covers a capacity range of 1-99.99 kW, and $60/kW of solar PV installed.

**Clean Energy Production Tax Credit (Personal/Corporate):** Any individual or corporation that applies for and receives certification from the Maryland Energy Administration can take advantage of this credit. With this credit, the user is eligible for a credit of $0.0085/kWh. The credit can only be claimed for the first 5 years of operation, and there is a maximum incentive amount of $2.5 million.

**Renewable Energy Portfolio Standard (RPS):** This is a law that requires electricity suppliers to obtain a minimum proportion of electricity sales from eligible forms of renewable energy. Solar PV is one of these eligible forms, and it requires that 2.5% of sales come from solar resources by 2020.

**Solar Renewable Energy Credits (SREC):** This policy mandates electricity suppliers to purchase and retire solar renewable energy credits from net-metered customers and solar PV on-site generators within Maryland. These suppliers must purchase at least enough to comply with the 2.5% indicated by the RPS. If they fail to do so, they must pay a Solar Alternative Compliance Payment (SACP), which is capped at $400/MWh.

**Solar PV Adoption in Maryland**

Below is a trend line showing the amount of solar energy generated between 1998 (when it was first measured) and 2017. It is graphed on a logarithmic scale.
Because our policies of interest range from 2003 to 2015, it is useful to examine this data over a smaller time period:

Solar Energy Generated in Maryland from 1992 - 2017

From this chart, there are three noticeable points in time where we see a significant increase in the amount of solar energy generated: 2011, 2013, and 2015. The following graph provides a clearer idea of change in generated energy in the years surrounding these three points of high growth:

Solar Energy Generated in Maryland from 2007 - 2017
Interpretation

It can be inferred from the data observed that if there was a policy which influenced the sharp increases in solar adoption, it would have gone into effect in the proximal time period surrounding 2011 to 2015. Based on our knowledge of the government policies implemented during that time, the policies most likely to be an influence are the Commercial Clean Energy Grant and Solar Renewable Energy Credits programs.

Based on the literature, it is evident that cash incentives are the most effective ways to incentivize solar energy adoption. The two policies listed above are variations of cash incentives; therefore, at a minimum, it can be stated that our results do not contradict what the established research suggests. At a maximum, this result serves to bolster the established research.

However, these are not the only cash incentives available in Maryland, so it is worth considering why heavy growth was not observed around the other cash incentive policies; specifically the USDA Rural Clean Energy for America (REAP) program (implemented in 2003) and the Residential Clean Energy Grant Program (implemented in 2004).

As mentioned before, the REAP program is a direct subsidy that targets the agricultural sector, a sizeable portion of Maryland’s economy. It would not be unreasonable to expect a sharp take-up of renewable energy use in Maryland’s agricultural sector as a result of this subsidy. However, this is not observed with solar PV. An explanation for this could be that solar PV is considered inefficient in agriculture because of the amount of land it requires. Rather, wind power has long been used on farms to pump water and generate electricity (UCSUSA). Therefore it is possible that wind, rather than solar, saw a large increase in take-up as a result of the REAP program.
In addition, the *Residential Clean Energy Grant* program is also one where we could reasonably expect to see significant growth in solar adoption, especially because it is so similar in concept to its (presumably) more successful counterpart, the *Commercial Clean Energy Grant*. However, it is seen in the research that programs targeting businesses tend to yield better results than programs which target homeowners. This could explain why we observe more substantial growth with the commercial version of this grant program.

The literature also indicates that implementing portfolio standards tends to be correlated with increased solar adoption. This may not seem relevant with our study because Maryland implemented its RPS in 2007, during which there was not much growth observed. However, it is important to note that Maryland’s *SREC* program is directly dependent on the portfolio standards; it exists as a mechanism by which electric suppliers can meet their requirements. Therefore, it is possible that the perceivable success of the *SREC* program is due not only to its nature as a cash incentive, but also because it is conjoined with an RPS policy. As such, this would also serve to bolster the findings of the established research.

**Conclusions & Recommendations**

In conclusion, it is at the very least clear that trends apparent in Maryland do not contradict the trends indicated in the literature. In fact, the results appear to fall very much in line with three takeaways from the literature:

1. Cash incentives tend to be more effective than tax incentives.
2. Commercial incentives tend to be more effective than residential incentives.
3. Renewable Portfolio Standards tend to be very effective as regulatory policies.

However, although our results tend to agree with the literature, it would be presumptuous to definitively conclude that the increases in Maryland solar adoption are a direct consequence of the *Commercial Clean Energy Grant* and *SREC* programs. There are various other variables that could be playing a significant role in the sharp rise we are witnessing.

One such variable could simply be awareness and education. It is possible that awareness of all the available tax credits, grants, rebates, and other policies, has simply started to rise in the last decade. It may be that the increases we observe starting in 2011 are a result of potential solar customers seeing others adopting solar PV and realizing the cost savings potential.

Another such variable could be the change in cost of solar PV over time. Although government policies certainly cut down the costs significantly, it is possible that the market price of solar panels themselves has declined. In fact, between 2009 and 2015, the price of both residential and non-residential...
solar PV declined by $4 per Watt. For comparison, between 1998 and 2009 the price also declined by $4 per Watt. This means that the price of solar PV decreased by the same amount in this 6-year time period (2009-2015) as it did in the previous 11 years (LBNL).

It is difficult to imagine that the falling market price wouldn’t have a significant effect on the recent rise in solar adoption. Thus, this could potentially be an avenue for future research. New research could attempt to determine not only the effect of recent market prices on solar adoption, but also attempt to compare the difference in effect between market prices and government incentives.
References


Commercial Clean Energy Grant Program. (n.d.) In Database of State Incentives for Renewables and Efficiency (DSIRE). Retrieved from http://programs.dsireusa.org/system/program/detail/3753


MEA- Data Center Energy Efficiency Grant Program. (n.d.) In Database of State Incentives for Renewables and Efficiency (DSIRE). Retrieved from http://programs.dsireusa.org/system/program/detail/22041


What Are Feed In Tariffs? (n.d.) In Feed In Tariffs. Retrieved from http://www.fitariffs.co.uk/fits/
A Roadmap for c-Si Solar Panel End-of-Life Treatment

Sydney Edwards
Research Mentor, Dr. Qingbin Cui

Abstract

As the installation of PV systems grows to promote a path for sustainable energy generation, solar panel recycling and end-of-life procedures have become areas of increasing concern. Given the post-2000s boom in PV installation, and the 25-30 year lifetime of a PV plant, the new industry created by this anticipated 20,000 tons of solar panel waste will be worth upwards of 112 million dollars by 2025 [7]. Building upon research that explores the limitations of Solar Panel Recycling (SPR) methodologies and economics, this paper will identify new factors for assessing the potential of this upcoming industry. These factors will support that SPR technology will be increasingly favorable than past research suggests. To begin forming a roadmap that outlines all necessary considerations for SPR infrastructure, a system dynamics approach has been utilized. A closed-loop model was created to demonstrate industry potential based on technological limitations and economics for the U.S. and a small case study for the state of Maryland.

Keywords: Solar Panels, Recycling, Silicon, Photovoltaic, End-of-Life Treatment

• Sydney Edwards is a SURE fellow in the department of Electrical and Computer Engineering at University of Maryland, College Park, MD. Their email address is sydneyedwards72@gmail.com.
Introduction

The rapid expansion of the solar photovoltaic (PV) industry has resulted in solar playing a crucial role for the future of power generation systems. PV technology is considered to be a sustainable power generation process as it generates electricity directly from the sun and avoids fossil fuel consumption and greenhouse gas emission. Over the last decade, the technology has proven the ability to become a major generator for the world, with robust and continuous growth even during times of financial and economic crisis. Significant research and industry spending has gone into creating more efficient solar panel manufacturing, installation, and operations/maintenance procedures. An aspect of the technology that is often left out, however, is the End-of-Life Treatment (EoLT) of these solar power plants. SPR by nature can be used to reduce PV waste, utilize recycled raw materials, and create a closed-loop life cycle specifically for the U.S. solar industry. Up until now, there has not been a way of modelling factors in the SPR industry to draw conclusions on what a roadmap to designing it would require. However, through the SPR infrastructure model discussed in this paper, we are now able to explore how the industry will be affected by the following aspects: Number of installations per year in a given area, Rate of decommissioning for an average panel, Cost efficiency of recycling vs. landfill disposal rates, Previously developed SPR infrastructure, and Importance of SPR Awareness. It should be noted that within the context of this paper, “decommissioned” will refer to solar panels that are now ready to be disposed of per the end of their useful lifetime.

Literary Review

To date, lack of awareness and concern about this issue is a result of very few panels having reached the point of decommissioning. Solar power plants have a technical lifetime of 25-30 years, with installation of these plants occurring exponentially since the 2000s [15]. Currently, most PV modules that have reached their decommissioning date have either been defects during production, damaged during transportation and installation, or malfunctioned during their first year of operation. Based on the timeline established, and further research that will be provided below, the date when entire solar power plants will need to be decommissioned is quickly approaching. In order to insure that these panels are efficiently recycled and not disposed of in landfills, an infrastructure must be created in the U.S. to support a closed loop cycle for the solar industry that keeps the promise of sustainable power generation.

Before a closed loop SPR model can be created, the needs of this new and growing industry must be understood. The PV modules that will be the first to experience EoLT concerns in the next decade are those with
crystalline silicon (c-Si) wafers. This is because c-Si panels were predominantly installed before the commercial validity of 2nd or 3rd generation solar technology, that utilize other chemical elements, was proven. To date, silicon wafer-based PV modules are still the most common type of solar cell manufactured in the world. Among the different technologies, c-Si PV technology still dominates the market, accounting for 85–90% of the technology share [3]. Previous development of the small SPR industry that exists to date in the U.S., however, was designed to meet the needs of an entirely differently market. The push for the creation of these SPR processes originated from concerns about 3rd generation modules. These are solar panel modules that utilize materials such as cadmium, tellurium, lead, and selenium which are regulated and hazardous materials [4]. Concern for the effects of disposing these materials in municipal landfills put pressure on PV installers to have a structured end-of-life procedure determined before implementation, which has led to programs such as First Solar’s CdTe-based recycling program, [5] and initial development of the SPR industry in the U.S. However, 3rd generation modules will not be the majority of solar panels requiring EoLT in the near future. As stated previously, c-Si modules are the bulk of the panels nearing their decommission date in the largest numbers. The outcome for this unmet market is an anticipated 20,000 tons of solar panel waste, worth upwards of 112 million dollars, by 2025 as reported by GM Insights.

Based on past research, development of the SPR industry has already suggested strong economic validity. A study conducted by N.C. McDonald found the estimated total cost of collection and recycling of c-Si panels to be in the range of $0.08-0.11 / W. This is compared to the $23.96-23.99 per panel landfill disposal cost sited in the same study, meaning landfill disposal of a 300-watt solar panel would cost roughly $0.08 to decommission. At these comparable costs, it was determined at the time of the study, in 2010, that SPR was economically comparable with landfill rates. The average price to dispose of a ton of municipal solid waste in a U.S. landfill, however, has reported to be continuously rising. An IBISWorld Procurement Research study shows that from 2013 to 2016, the prices of landfill and solid waste collection services have increased at an estimated average rate of 1.7-2.9% per year. From 2016 to 2019, IBISWorld says it expects the prices of solid waste collection and disposal services to increase at a moderate annualized rate of 2.0%. The reasons behind this increase will not be explored in the scope of this paper, however, a parallel can easily be made to landfill disposal costs overall. These factors suggest SPR may be more economically viable compared to landfill disposal with the passage of time based on cost efficiency.

An additional factor is the increasing cost of silicon and aluminum materials. On January 22, 2018 President Trump issued a 30% year-one tariff
on imported solar cells and modules [9]. Tariffs are set to decline over a four-year period, with the first 2.5 gigawatts of imported cells excluded from the additional tariff in each of those four years, according to the U.S. Trade Representative. Many news outlets have speculated on the impact of this tariff, with a consensus in solar news reports being that the tariff will result in an increase in the cost of solar installations, as well as an increase in domestically-made solar modules [10]. On March 8, 2018, President Trump also imposed a 10% tariff on aluminum imports, with the only exemptions being Canada and Mexico [11]. No connections have yet to be drawn between the aluminum tariff and its effects on the cost of purchasing and building solar panels. Solar panels, however, are 10.30% aluminum, which is the second largest component within the panel besides glass at 74.16% [12]. Being mindful of shifts in the solar panel political climate will likely prove beneficial when reconsidering the costs and significance of the SPR industry in the U.S.

Lastly, the increasing costs of silicon on a global scale will soon show favor of SPR. UMCO is a Japanese silicon wafer manufacturer estimated to provide two-thirds of the world’s supply of silicon wafer. This silicon wafer is one of the raw materials used in semiconductor manufacturing and is utilized in everything from CPUs to GPUs and DRAM. SUMCO has confirmed the price of silicon wafer has jumped 20% this year alone, and it’s set to continue rising substantially for the next few years at least. “We are also planning to increase the price of silicon wafer by 20% in 2018,” said SUMCO CEO Hashimoto Mayuki. “Price of silicon wafer will continue to rise in 2019” [13]. As discussed in Muller et al., during the last decade the PV industry has grown by more than 20% p.a. Today, about 15,000 tons / year of silicon are used by solar wafer manufacturers. The available silicon capacities of both microelectronic and PV industries are limited to 30,000 tons / year for the time being. His research suggests that the shortage of silicon supply could easily limit the growth of the PV industry based on silicon availability and cost in the U.S. This again suggests the increasing validity of the SPR industry within a closed-loop system that utilizes cheaper materials already available on U.S. soil.
Research Methodology

To map how the previously discussed aspects of the solar industry connect to development of a SPR infrastructure, the following model was developed using system dynamics software. The model is structured as follows. The input for the system is the number of installed c-Si solar panels in a region by year. This data was pulled from a report released by the U.S. Department of Energy in July 5th 2017. The report outlines, the kWhr/month of solar power generation in the U.S from 1998-2017. From this data, a function where the input is a time step, called “Time”, starts at zero and models the number of installed panels per year in the U.S. Using the assumption that an average panel is 300 watts, with 5 average sun hours/day of exposure for an average of 30 days per month, one solar panel was determined to be roughly 45,000 kWhr/month. This made it simple to divide the function by this number and determine a function input for the number of panels per year installed from 2008 onwards, titled Installation Rate (2).

\[
\text{Panels/Year} = -0.4303 \times \text{Time}^8 + 26.329 \times \text{Time}^7 - 568.35 \times \text{Time}^6 + 5597.2 \times \text{Time}^5 - 26034 \times \text{Time}^4 + 52239 \times \text{Time} - 21822
\]

The Installation Rate has an error due to the fact it is produced using a function versus specific data points per year. This error has been tracked in figure 3.

Although this error is relatively high initially, which we’ve been able to adjust using an adjustment ratio, a function is necessary instead of actual data values because it allows flexibility of the model for adjustments per region. After calibrating the model, the percentage of error decreases towards zero.
as time progresses, where it will effectively become more accurate for larger stretches of time modelled.

The next rate to consider is the Decommissioned Rate. This rate is based on how many panels need to be disposed of before the 25-30 year plant life concludes, and all the remaining panels are disposed of. It is based on the average number of panels that experience malfunctions or breakage based on what stage in their lifetime this has been shown to happen. Estimating this rate was based on a study done by Fthenakis, V.M. From it, the average delay of when commissioned solar panels need to be disposed of can be extrapolated. For the first year, 10% of the panels will need to be disposed of, whether this be to accidents, technological failures, etc. Then, from the 2nd-10th year 4.5% of panels will need disposal, and for the 10th-29th 0.05% respectively. At the 30th year it was assumed that all panels will be decommissioned based on the U.S. standard. The function created for the Decommissioning Rate reflects all these delays. Lastly, the Recycling Rate, controlled by the Recycling Ratio shown in figure 5, was established by determining the three main factors that effect it, multiplied together:

1. Awareness: The knowledge of SPR in the solar industry, as well as a strong public understanding of the technical and economic aspects of it.
2. Infrastructure: The amount of facilities in a region with the ability to recycling solar panels in a sustainable closed-loop process.
3. Cost Efficiency: How competitive SPR costs are with landfill disposal costs.

Awareness in this model is reflected using a 0 or 1 function. This assumes that awareness of the ability to recycle one’s solar panels is the first step to recycling them. Without this, no panels get recycled, hence an overall Recycling Rate of 0. Per the definition of infrastructure above, infrastructure in the model is calculated based on the number of facilities in an area times the amount of panels that a SPR facility should be able recycle in a year. Each solar recycling facility should be able to handle a rated number of solar panels per year based on its capacity. Therefore this number of solar panels is multiplied by the number of facilities. Then, cost efficiency refers to the cost of solar recycling being competitive with landfill costs. This is also a 0 or 1 function. This will be assessed in terms of solar panel recycling legislation. Currently, there is only a 1-2 cent difference between the costs of solar panel recycling and landfill rates, as discussed more thoroughly above. Therefore, this function is controlled by the user of the model, and based on the arguments made previously, it was set to 1 for our model.
SPR Infrastructure Feedback Loop with Recycling Ratio displayed

The subsequent stocks and flows in the model are determined by calculating how many raw materials can be recycled from a solar panel and how much raw material is needed to remake a new panel. It was determined that $1/0.015$ of a ton of these raw materials can be used to make a new solar panel based on the average weight and recyclable material from a panel. This is also presuming reuse of $90\%$ of the panel as demonstrated by PV Cycle [7]. These values are then used to complete a full lifecycle roadmap. The output of our model is shown in figures 6 and 7. For these graphs, time 0 represents the year 1998 and Time 30 represents the year 2038.

(6) Commissioned Solar Panels

Decommissioned Solar Panels

Based on this model, we now have a way of demonstrating the effects and potential of a full lifecycle SPR industry infrastructure that can be adjusted based on various considerations. This model is important in determining how
fluctuations in SPR economics and legislation effect the capacity of the technology.

**Data Analysis with Maryland Case Study**

To assess if our model could accurately predict the potential of SPR for various regions, as claimed, a case study was conducted for the state of Maryland (MD). Beyond the fact that this was the location of our research and funding, we felt this area would be a good example of why SPR infrastructure needs to be supported in even the smallest states that are not the top producers of solar power in the U.S. To adjust for the MD area, the input *Installation Rate* function needed to be fitted based on MD installations per year. Data from SEIA was taken for known values for 1998 to 2017 and predicted values for 2018 to 2023. The error of this function was calculated to be at most 30% initially, with the same decreasing error trend as time progressed. The overall error for this function was found to be substantially less than our function for the U.S. *Installation Rate*, which suggests that different regions may be either more or less accurate when applied to our model. Using this function, we can get a strong estimate of the solar panel recycling needs of the area up until 2023. The results for estimated decommissioned panels is shown below:

![Decommissioned Solar Panel for MD SPR Infrastructure Model](image)

We can see that the estimated rise of solar panels needing decommissioning is pushed back to a later date then the U.S.. This result makes sense, as MD isn’t a top solar state and has not been at the forefront of solar installation in the U.S., as compared to states such as California or Arizona. However, since the 30 year time mark represents 2028, with over 1 million panels estimated to require decommissioning, we can determine that the need for SPR infrastructure in MD is still a valid concern. Based on the number of solar panel recycling facilities in the area being zero, this graph reflects if no solar panels are recycled. If this remains the case by 2028, an estimated 1.24 million panels will be sent to the landfill. However, with our model we can
also predict how much could be recycled if there was a certain level of awareness, cost efficiency, and infrastructure developed in the area before then.

Conclusions

Based on the research and findings provided above, we are now able to accurately predict the capacity of solar panels in any region and assess the number of decommissioned panels that will be available by a certain date. This information should help to structure the infrastructure needed in the U.S. for SPR. The next step in this roadmap is determining where SPR facilities would best be located. A feasible recycling program for solar panels will require careful attention to the experiences of comparable industries and to the economics of collection and materials. The basic viability of any recycling program often hinges on the geographic concentration of the goods and their proximity to appropriate recycling facilities [4]. PV systems are not concentrated by nature as the industry is dominated by dispersed installations, such as off-grid power and stand-alone residential systems. To carry out the recycling process, a method for collection of the panels must be discussed. Logistically, collecting panels is more economically feasible for large, centralized installations. Pick up from various small kW capacity locations has shown to significantly increase the PV recycling process cost [4]. Ideally, it should be the utility’s responsibility to transport decommissioned modules to recycling plants, however, there is currently no integrated process between utilities and module recycling companies to allow for this to happen. This concept has faced many challenges in the past due to the fallibility of solar companies who have unclear security in the future PV industry. Major solar companies such as SunEdision, BP Solar, and Sungevity have gone bankrupt despite being leaders in the field [16]. Increased producer responsibility for EoLT of solar generation sites will be required to insure the success of the SPR industry in the U.S., as demonstrated by PV Cycle in Europe.

By combining past research with the new considerations mentioned in this paper, we are now able to accurately predict the number of decommissioned panels that will be available by a certain date within any given region. This information will help to provide a roadmap for the SPR infrastructure needed in the U.S. This is essential as end-of-life considerations for solar power plants will become a significant concern in the next decade as more plants reach their decommissioning dates. The capacity of this new industry can now be predicted using a systems dynamics approach. The model itself uses discussed inputs such as installation rate of an area, awareness, infrastructure, and cost efficiency, along with
background research to create a versatile means for prediction. This research and data will help the industry prepare for the oncoming boom of decommissioned solar panels in the next decade
References


European Economic Recovery: The Impact of Cross-border M&A on a Sustainable Economic Growth

Hannah Koh

Foreword by Research Mentor, Dr. Hossein Abbasi

The great recession of 2008 shook the economies on most developed countries. Europe experienced a sharp and long downturn. It took several years for European countries to recover from this cession. Among the policies adopted by European countries to alleviate the effect of recession, merger and acquisition (M&A) attracted relatively less attention of researchers. M&As play a key role in recovery of stressed sectors of economies by providing cash, management, and low-cost input for businesses.

Hannah thoroughly investigated the trends of economic downturns in European economies and examined a variety of channels through which M&A may affect economic performance. After a diligent analysis of the existing theories and literature, she carefully examined the available data and designed an appropriate empirical strategy to determine the extent of the effect M&A on economic recovery. Using a panel of European countries and fixed-effects models, she finds that cross-border M&A significantly improves the growth rates of GDP and households’ disposable income. I am delighted to be involved in such a wonderful opportunity that Snider Center’s SURE program provides for our talented students such as Hannah.

• Hannah Koh is a SURE Fellow in Economics at the University of Maryland, College Park, MD. Their email addresses is hannah.koh1025@gmail.com.
Abstract

Over the last ten years, the European economy has experienced a severe downturn, faced with banking crisis and sovereign debt crisis. In 2017, GDP in the entire Eurozone increased by 2.5% while the U.S. experienced 2.3% GDP expansion. Moreover, EU banks have shown signs of recovery, reaching the average LCR of 139%. However, the European economy still faces challenges in terms of low investment, youth unemployment and credit growth. Therefore, it is essential for the Eurozone to find reliable economic drivers that can lead the signs of recovery to sustainable economic growth. This research investigates the impact of cross-border M&A on a sustainable economic recovery in the European Union.

Acknowledgements

This research of European Economic Growth: The Impact of Cross-border M&A on a Sustainable Economic Growth was prepared under the guidance of Dr. Hossein Abbasi at the Department of Economics at the University of Maryland-College Park and the Ed Snider Center for Enterprise and Markets at the Robert H. Smith School of Business.

Introduction

After suffering from the devastating economic recession caused by various types of debt crises in 2009, the European economy is finally on the comeback trail. Key economic indicators such as real GDP, unemployment rate, and household disposable income are turning for the better and the recovery process has even been accelerating these days. According to CEIC, a Euromoney Institutional Investor Company, the real GDP growth rate has reached 2.7%, which is slightly higher than the European Union’s target real GDP growth rate of 2%, after hitting a record low of -5.4% in March, 2009. Moreover, the unemployment rate in the European union has declined to 7.3% in 2017 from a record high of 10.9 in 2013, while the household disposable income growth rate has increased from -0.69% in 2012 to 2.1% in 2017. All these indicators tell that the European economy has been recovering rapidly but steadily and this recovery trend is expected to continue so long as it doesn’t get hit by other debt crises.

Since the economy of the member states of the European Union was devastated by the banking and sovereign debt crises in 2009, no one expected that their economy could revive this fast, bringing most of the major

---

6 “Real GDP Forecast” OECD Data. Web April 23, 2017
economic indicators back on its track. When the economy is recovering from the long recession, there are usually more than one driver that are interconnected to each other. For example, it could be an increase in the government spending to expand the total output of the economy or the depreciation of their own currency to make themselves more competitive in the international market in order to increase their aggregate demand. In most case, when a country is suffering from a recession caused by debt crisis, they tend to implement monetary policy such as adjusting interest rate in addition to fiscal policy. However, the European Union is a monetary union which has one unified currency and central bank, each member state does not have any power to exercise monetary policy but has to rely on the European Central Bank’s decision. Therefore, unlike the United States where the Federal Reserve played a key role by exercising their monetary policy during the mortgage crisis in 2008, the member state of the European Union must have had other factors that saved them from further recession besides the fiscal and monetary policies.

Considering the limitation in implementing monetary policies, due to the presence of the monetary union, it is plausible to say there must be some other factors that have driven the recent European economic recovery besides traditional monetary policies such as adjusting interest rates and increasing the money supply. This paper is especially focusing on the role of inbound Mergers & Acquisitions in Europe in the recovery to examine whether inbound M&A deals could be a source of the sustainable economic growth in the Eurozone.
Review of Literature

Over the last ten years, the European economy has experienced a severe downturn, faced with various debt crises. Although their economy has recently become more stable compared to the last ten years, showing a sign of a recovery, many sectors of the European economy including their governments, banks, and corporations are still having difficulty dealing with the consequences of the debt crises. During the European recession, the international demand for Euro plummeted and the European governments could not pay back their government bonds to commercial banks or foreign investors. This drove the whole Europe into a devastating economic slump for a long period, preventing any flow of Foreign Direct Investment and other capital into the European economy. However, as the European economy started bouncing back faster than economists predicted, it brought worldwide attention to investigating possible reasons for the recent trend of recovery. In this context, this paper will examine the role of cross-border mergers and acquisitions in the recent recovery in the European economy. Furthermore, it will investigate whether the cross-border M&A is a reliable breakthrough or a threat to European countries.

In his thesis “The Euro’s Three Crises, Jay C. Shambaugh, an economist at Georgetown University, argued that there were three major crises in Europe that put the entire Europe into a serious slump for almost ten years from 2007. To fully understand why European countries encountered the severe debt crises, it is essential to know the European monetary policies and the role of commercial banks in Europe. Paul de Grauwe, a Belgian economist, well explained the unique characteristics of the European monetary institutions and commercial banks in his book “Economics of Monetary Union”. According to his argument, one of the unique facets of the European economy is that most European countries cannot exercise any monetary policies because they do not have a control over their monetary institution. Unlike other countries in the world, most European countries do not have their own central bank which exercises monetary policies such as controlling interest rates and exchange rates. In 1993, they created the European Union, which is a monetary union, and agreed to have a unified currency and one central monetary institution, the European Central Bank (ECB). Grauwe emphasized that the EU was able to facilitate international trade among the European countries and benefit some countries which needed to either revalue or devalue their own currency to become more competitive in the global market. However, he also pointed out that having one, unified central
bank for many countries sometimes made it extremely difficult to practice efficient monetary policies and put them into a huge economic slump.

The other unique aspect of the European economy Grauwe mentioned was their economy highly depended on commercial bank in terms of assembling capital. For instance, in the United States, a number of private companies issue their own corporate bonds to secure their budget as well as borrowing from commercial banks. However, in Europe, private sectors tend to borrow money from commercial banks rather than issuing corporate bonds by themselves. Also, even the public sectors such as local and state governments sell their state bonds mainly to commercial banks to secure budget. Therefore, the size and role of commercial banks in Europe are a lot bigger than any other countries and it sometimes makes the commercial banks more vulnerable to the liquidity and insolvency issues.

Due to these distinctive aspects, the European economy became more vulnerable when the major debt crises occurred in Europe. In “The Euro’s Three Crises” Shambaugh argued that the three Euro crises: banking crisis, sovereign debt crisis, and growth crises drove the whole Europe into an inescapable downturn because the three crises were interlocking due to their unique monetary system. In other words, if a country encounters one of the three crises, it was inevitable to prevent themselves from facing the rest of them.

According to Shambaugh, banking crisis indicates that commercial banks experience a liquidity issue due to a sudden withdrawal of the deposits in the banks and their inability to sell their assets to collect cash immediately. Banking crisis started in 2007 in the United States when house prices had started to decline and consequently, assets that were tied to the U.S. mortgages become questionable in value and it affected the commercial banks in Europe (Shambaugh). Since the mortgages and other asset values decreased, it became increasingly difficult for banks to borrow (it means low deposits or a sudden massive withdrawal of deposits.). Also, in addition to banking crisis, most European governments could not pay back their state bonds to commercial banks when the commercial banks tried to sell them for cash because the government deficit was already huge in Europe at that time. This sovereign debt crisis worsened the economic recession in Europe and distracted foreign investment flows from Europe. However, in recent years, due to ceaseless efforts of the European Central Bank to normalize European economy around 2011, the amount of Foreign Direct Investment started to increase again, followed by the number of cross-border M&A deals in Europe.
In the thesis “Benefits and Threats of Cross-border Mergers and Acquisitions for European Transition Countries by Anita Macek, Macek suggested that economic and financial crisis caused a decline of FDI and Cross-border M&A in 2008 and 2009. In 2008, it decreased by 12% compared to the previous year and in 2009 by 32% compared to 2008. In 2010, the volume of global FDI and M&A started increasing again (Macek). Moreover, Macek also examined whether Cross-border M&A was a breakthrough for European economy or a threat to it by comparing various macroeconomic data such as per capita income and the amount of government deficit in the European countries with M&A industry data. She analyzed that new technology and access to new markets would be great benefits revitalizing the European economy while shrinking of domestic markets and low pricing of sold assets could be major threats to their economy (Macek). However, according to her survey in transition countries, 53% of the respondents said it happened rarely or very rarely, while 15% of the respondents believed that it happened often or very often. Therefore, she concluded that as the benefits had been stressed more than threats, it was safe to say that international capital flows and cross-border M&A were important tools for economic development in European countries.

In the report “Mergers and Acquisitions Involving the EU Banking Industry-Facts and Implications by the European Central Bank, the authors pointed out two major threats to the European economy that could be caused by cross-border M&A deals. One of them was that institutions such as banks and corporations in two different countries were subject to different fiscal and accounting treatment and reporting requirements, which led to serious operational conflicts and economic loss (30). Also, they warned that, in case of large M&A deal, managers may be tempted to pursue an increase in size without paying due attention to the strategic and managerial consequences. Therefore, if they merely try to seize the opportunity to cash in through M&A without paying close attention to the quality of their services in the new markets, it will become a huge corporate loss in the European economy, devaluing their domestic products and making other European assets less competitive.

The Shambaugh’s study proved that Cross-border M&A played an important role in getting the European economy back on track even though there were some disadvantages that might threat their economic stabilization. Therefore, this study will continue to examine the correlation between cross-border M&A deals in Europe and their economic growth and investigate the costs and benefits of the deals.
European Economic Overview

European Debt Crisis

In 2009, an unprecedented recession cascaded through the European economies, destroying banks and destabilizing the entire financial structure of Europe. Financial institutions including commercial banks experienced liquidity shocks, European governments were afflicted with sovereign debts, and the whole European economy was dragged into deep recession.

The financial crisis in Europe was preceded by long period of rapid credit growth, low risk premiums, abundant availability of liquidity, strong leveraging, soaring asset price, which led to the development bubbles in the real estate sector. The real estate bubbles and the seizing up of markets for asset-backed securities in 2007 rendered financial institutions extremely vulnerable to the debt crisis. In the early stage of the crisis, financial institutions in Europe was mainly experiencing severe liquidity shortage due to an sudden increase in the number of investors who realized their securities. The investors started doubting the redeemability of bank assets and consequently the banks experienced ever stiffer market conditions for rolling over their debts and acute liquidity shortage problems.

The financial crisis even intensified as major US investment banks such as Lehman Brothers and Merrill Lynch defaulted in September 2008. As confidence among financial institutions collapsed, investors massively liquidated their positions and stock markets went into a tailspin.

The European debt crisis in the banking sector also led to sovereign debt crisis in Europe. Several European Union member states such as Greece, Spain, Portugal, and Ireland were unable to repay or refinance their government debt or to bail out over-indebted banks under their national supervision without the assistance of their parties like the European Central Bank (ECB) or the International Monetary Fund (IMF). This situation where the governments of the member states cannot pay back their debts and become insolvent is called “sovereign debt crisis”. Once the governments lose their credibility due to insolvency, the investors who have bought their

---

7 Economic Crisis in Europe: Causes, Consequences, and Responses. Economic and Financial Affairs, European Commission, 2009
8 Economic Crisis in Europe: Causes, Consequences, and Responses. Economic and Financial Affairs, European Commission, 2009
9 Ibid.
government bonds try to sell them out. As a result, the government bond price falls the interest rate goes up. Also, other investors who deposit their money in private banks in those countries tend to withdraw their money because they think the sovereign debt crisis also affects the whole economy, and therefore they won’t be able to collect their deposits back. When a number of customers withdraw their deposits from the banks, the banks experience banking crisis where they go illiquid or insolvent. The detailed causes of the debt crisis varied. In several countries, private debts arising from a property bubble were transferred to sovereign debt as a result of banking system bailouts and government responses to slowing economies post-bubble. The structure of the Eurozone as a currency union without fiscal union (political union such as tax and public pension rules) contributed to the crisis and limited the ability of European leaders to response. As a result, European banks own a significant amount of sovereign debt, such that concerns regarding the solvency of banking systems or sovereigns are negatively reinforcing.

**Monetary Union**

To fully understand why the European economy was highly vulnerable to the global financial crisis in 2009 and took much longer time than the rest of the world to bring it back on track.

The European Union is a group of countries with outstanding natural resources, human resources, and infrastructure. It is also a region of territorial and national diversity, with 550 million people in 28 member states sharing 4.4 million square kilometers. Its economic strengths range from technology and complex manufacturing to agriculture and world-renowned tourism. This diversity in economic strengths is arguably Europe’s greatest asset yet is also its greatest challenge. Europe’s economic diversity and the tension between unity and collaboration has driven the economic crisis in 2009.

The impacts and threats of the crisis were great. Five of the member states faced intense sovereign debt and ensconced in cycles of bailouts and austerity since 2009. This has led to intense discord in the region, causing some to question the sustainability of the EU and to suggest the secession of individual member states from the Union. Faulty investments and real estate banking bubbles, which originally started from the United States in 2008, have cost some people their life savings, particularly in hard-hit countries

---

11 The European Financial Crisis: Analysis and a Novel Intervention, Harvard University
such as Spain. Since the crisis, more and more country leaders have questioned the reliability and sustainability of the European Union and discussed secession. In 2016, the United Kingdom left the European Union and the Union currently has 28 member states.

The European Union is a Monetary Union (Currency Union). A monetary union is when two or more countries share a common currency or decide to peg their exchange rates to keep the value of their currency at a certain level\(^\text{12}\). Moreover, the member states of the monetary union tend to have one, unified central bank which decides and implements monetary policies. For example, the European Central Bank (ECB), the central bank of the European Union controls the interest rate and the federal funds rates of the countries which use Euro as their currency.

**Asymmetric Shocks**

Asymmetric shock refers to a change in economic conditions that affects differently the different parts of countries. This is often mentioned as a source of difficulty for countries that share a common currency like the European Union. For example, let us suppose there are two countries: Germany and France and they formed a monetary union. They have abandoned their national currencies and use a common currency, the Euro, which is managed by a common central bank, the European Central Bank (ECB). Let us assume further that for some reason consumers shift their preferences away from French-made to German-made products. As a result, the demand for French products decreases, shifting the demand curve of France left. The price and total output in France decline. On the other hand, the demand for German products increases, shifting the demand curve of Germany right. Their price and total output of the economy also increases. However, both countries will have an adjustment problem. France is plagued with reduced output and higher unemployment. Germany experiences a boom, which also leads to upward pressures on its price level.

**Mergers & Acquisitions Trends in Europe**

**Total Values & Deals**

[Figure 1] shows the total value and number of Mergers & Acquisitions in Europe for the past 30 years. The total value of Mergers & Acquisitions that

\(^{12}\) Currency Union, Investopedia, [Available at: https://www.investopedia.com/terms/c/currency-union.asp]
occurred in Europe has highly fluctuated since 1999 when it reached an all-time high of 1814 billion euros. In 2007, it recorded the second highest of 1781 billion euros due to an investment boom followed by an increase in business confidence, however, it plunged to an all-time low of 521 billion euros in 2009 when the global economy crisis hit the Eurozone. It has recovered from its lowest point but remained less than half its highest record in 2007.

The total number of Mergers & Acquisitions deals in Europe has not decreased dramatically compared to the total value of M&A. While the total value of M&A in Europe decreased by 70% during the financial crisis in 2009, the total number of M&A decreased only by 14.3%. Although a number of European corporations did not lose their competitiveness in the global market, especially in manufacturing and non-financial services sectors, investors’ distrust of financial stability and a high risk of defaults discouraged M&A in the Eurozone during the financial crisis. Investors showed a tendency to make only small investments in order to minimize their loss in case of default.

Cross-border M&A

Eurozone is one of the regions where cross-border M&A activities are brisk. Cross-border M&A can be classified into two different types depending on the flow of investment; inbound and outbound. Inbound M&A refers to investment made by a foreign acquirer to a domestic shareholder while outbound M&A indicates deals made by a domestic acquirer to a foreign shareholder. The total value of inbound M&A deals in Europe was 900.62 billion US dollars in 2017 while outbound transactions recorded 789.79
billion US dollars in the same year.\textsuperscript{13} Cross-border M&A in total accounts for about 10\% of the total M&A deals in the Eurozone and expected to stay around the current value. This paper will focus solely on the impact of inbound M&A deals to Europe in order to examine the role of them in the recent recovery in European economy.

**M&A in Europe by Industries**

[Figure 2] shows the total dollar value of inbound M&A deals in Europe by industries: non-financial services and financial services. Non-financial services include business services, energy and utilities, industrials and chemicals etc. and financial services consist of commercial and investment banking, real estate, venture capital/private equity, etc.

The total value of financial services has always exceeded that of non-financial services, however, the financial sector experienced a much more dramatic decline during the debt crisis in 2009. Both non-financial and financial sectors reached their all-time high in 2007 and plunged during the crisis of 2008-2009, hitting the lowest points. The total value of financial services outperformed non-financial services by 386.49 billion dollars in 2007 when both of there were at their all-time high but the gap dramatically decreased during the crisis. The total value of deals in the financial sector plummeted by 58\% while the non-financial sector experienced only a 26\% decrease in its total value.

Regression Analysis

Theoretical Framework

This paper argues that the cross-border M&A deals have played a key role in bringing the European economy back on its track. It assumes that there is a positive correlation between the cross-border M&A and the recent European economic growth. The basic principle under the main argument of this paper is that the amount of Foreign Direct Investment (FDI) brought by the cross-border M&A deals could facilitate the circulation of money in the economy, solving the liquidity and insolvency issues in the European area where the implementation of monetary policies is limited.

For example, in the United States, when the financial market is hit by a debt crisis where a number of investors sell out their bonds, the Federal Reserve Bank, the central bank of the United States, can adjust their interest rate to avoid any additional shock in their economy. However, for the member states of the European Union, they do not have a control over any monetary policies and therefore, they have to seek for other solutions that can be practiced at a national level. In this case, cross-border M&A could revitalize the stagnant economy by increasing the inflow of investment, especially when no one can adjust their interest rate or exchange rate.

Regression Analysis

This research is based on the regression analysis to understand which among the independent variables are related to the dependent variable, and to explore the forms of these relationships. In restricted circumstances, regression analysis can be used to infer relationships between the independent and dependent variables. In this research, the multiple regression model was used in order to test the correlation between the value of cross-border M&A in the European Union and their economic growth represented by real GDP growth rate, disposable income, government debt, debt to equity ratio, etc.

Although there are 28 member states in the European Union, this paper will focus on 13 countries: Austria, Belgium, Czech Republic, Finland, France, Germany, Ireland, Italy, Netherlands, Poland, Portugal, Sweden, and the UK. Even though the UK left the EU in 2016, this study includes because it still has a significant economic impact of the rest of the member states. The 13 countries were selected based on their economic impacts on the rest of Europe, the amount of M&A activities, and most importantly, the degree of asymmetric shocks they received due to the recession in 2009. Those countries were the regions that were significantly affected by the economic
crisis and also have abundant data about cross-border M&A. Among the 13 countries, this study selectively chooses two sets of the countries: Spain and the UK and Germany and France to further examine the impact of cross-border M&A in terms of reducing asymmetric shocks and promoting the economic growth in the regions.

**Dependent Variables**

This research includes three different multiple regression model, setting Real GDP Growth Rate, Disposable income, and Debt to Equity Ratio as their dependent variable respectively.

a. **Real GDP Growth Rate:**
One of the key factors that shows the economy is growing is Gross Domestic Product (GDP), which is a monetary measure of the market value of all final goods and services produced in a period of time. In this research, the “real” value of GDP was used to reflect the effect of inflation in the economy and “growth rate” was used to include the general increasing trend of GDP merely due to the effect of “time”. When the economy is growing, the total output including consumption, investment, government spending, and net exports also increases and the effect is shown as an increase in real GDP growth rate.

b. **Disposable income:**
The economy of a country grows when the aggregate demand (AD) of the country increases. The aggregate demand consists of disposable income, investment, government spending, and net exports so when the total disposable income in the economy goes up, the aggregate demand also increases.

c. **Debt to Equity Ratio:**
Debt to Equity Ratio is a debt ratio used to measure a company’s financial leverage. It is calculated by dividing a company’s total liabilities by its stockholder’s equity. It indicates how much debt a company is using to finance its assets relative to the value of shareholders’ equity.

\[
\text{Debt/Equity Ratio} = \frac{\text{Total Liabilities}}{\text{Shareholder’s Equity}}
\]

This study used Debt/Equity Ratio as one of the dependent variables in order to evaluate the performance of the European banks in terms of maintaining a certain level of liquidity. Also, the regression model is designed to examine whether the cash inflow generated by the cross-border M&A deals has helped the banking sector perform better.

**Independent Variables**

83
The main independent variable is the real value of cross-border M&A. However, in order to examine the sole impact of the cross-border M&A, the regression models contain other independent variables as control variables. The control variables are macro-economic variables that could distinguish the effect of the cross-border M&A in the economic growth from “lucky coincidence” caused by macroeconomic factors.

**a. Real Value of Cross-border M&A:**

The real value of cross-border M&A is calculated by dividing the annual dollar value of cross-border M&A (Billions, USD) by CPI index. It shows the real money value of cross-border M&A practiced in the target countries. The study uses the real value of it in order to catch the effect of the inflation after the recession.

**b. Investment(Non-M&A):**

It includes private sector investment including household investments but excludes the investments initiated by mergers and acquisitions. This variable is one of the essential control variables to see the sole impact of the cross-border M&A on the economic growth.

**c. Government debt:**

Government debt is one of the key economic indicators that shows the performance of the economy. As the government debt increases, the economy becomes more vulnerable to a financial crisis.

### Interpretation of the Regression Models

**a. Real GDP Growth Rate**

The first regression model [Appendix A] shows that the value of M&A does have a significant impact on the real GDP growth rate. (Real GDP Growth Rate = 1.360448 + 1.194792 Value of M&A - 0.3293211 +e) The model suggests that as the value of inbound M&A deals increases by 10%, the real GDP growth rate also increases by 1.15.

**b. Disposable income**

The regression model suggests that the value of M&A has a significant impact on the total disposable income in the economy (Disposable Income = 2.588219 + 0.2500613 Value of M&A - 0.1711217 Unemployment rate - 0.242065 Interest rate +e). It shows that if the total value of M&A increases by 10%, the amount of disposable income in the economy also increases by 0.25%.

**c. Debt to Equity Ratio**

(Financial Institutions)

The regression model indicates that the real value of cross-border M&A in the financial sector has a significant impact on the debt to equity ratio of the
European banks (Debt to Equity Ratio (Financial Institutions) = 4.969636 - 0.1770556 Value of M&A)

It suggests that as the value of M&A increases by 10% the debt to equity ratio decreases by about 17%. The debt to equity ratio shows how much liabilities a bank holds against its shareholders’ equity. Therefore, the lower the value is, the more liquidity and stability the bank has. An increase in the value of M&A decreases the debt to equity ratio, which indicates the performance of the European banks could be stabilized by an increase in M&A deals.

**Conclusion**

When the economy is recovering from a devastating recession, there must be more than one driver that brings the economy back on its track. It is hard to say that the cross-border M&A is the only driver that stimulates the recent recovery in Europe, however, the research shows that it has played an important role in bringing the economy back to the boom. Especially, considering the recession in 2009 was mainly initiated by the debt crisis in the banking sector, M&A can contribute to enabling the economy to keep building on the current recovery trend by reducing the risks of illiquidity and insolvency and increasing the foreign investment inflow.

However, since most countries in the European Union have experienced asymmetric shocks due to the recession, there has been a mild tendency of strengthening the regulation for Foreign Direct Investment including cross-border M&A, especially from outside of the European Union. However, the foreign investment inflow brought by cross-border M&A will help the European economy hold a certain level of assets essential to continuous recovery by circulating money among the countries. Therefore, the current regulations on cross-border M&A, which is in favor of inbound foreign investments should remain unchanged or modified only in a way that supports cross-border deals.
Appendix

Appendix A.
Dependent Variable: Real GDP Growth Rate
Independent Variables: \log(\text{real value of M&A deals}), \text{unemployment rate}, \text{interest rate}, \text{disposable income}, \text{government debt}

\[
\text{Real GDP Growth Rate} = 1.360448 + 1.194792 \ln(\text{Value of M&A}) - 0.3293211 \text{Unemployment rate} + e
\]

```
xtrg realgdpgrowthrate lnrealna unemploymentrate interestrate rate disposableincome govdebt, fe
```

|                    | Coef.   | Std. Err. | t     | P>|t|   | [95% Conf. Interval] |
|--------------------|---------|-----------|-------|-------|----------------------|
| realgdpgrowthrate  | 1.194792| .1645927  | 7.26  | 0.000 | .8686727 to 1.520911 |
| lnrealna           | .088379 | .0629197  | 1.45  | 0.150 | -.0193488 to .296055  |
| unemploymentrate   | -.3293211| .1391745 | -2.37 | 0.020 | -.6050776 to -.0535646 |
| interestrate       | .0554311| .1345489  | 0.41  | 0.681 | -.2111603 to .3220225 |
| disposableincome   | -.0238564| .0138304 | -1.72 | 0.087 | -.0512595 to .0035468 |
| govdebt            | 1.360448| .1324818  | 1.03  | 0.307 | -1.264509 to 3.985405 |

\(F(5, 112) = 16.18\)  \(\text{Prob} > F = 0.0000\)

\(\text{corr(u_i, Xb)} = -0.1329\)

F test that all u_i=0: \(F(15, 112) = 2.09\)  \(\text{Prob} > F = 0.0151\)

Real GDP Growth Rate = 1.360448 + 1.194792 \ Value of M&A - 0.3293211

Unemployment rate + e
Appendix B.
Dependent Variable: Disposable Income
Independent Variables: log(real value of M&A deals), unemployment rate, interest rate, real GDP growth rate

Disposable Income = 2.588219 + 0.2500613 Value of M&A - 0.1711217 Unemployment rate - 0.242065 Interest rate + e
Appendix C.
Dependent Variable: Debt to Equity Ratio (Financial Institutions)
Independent Variables: log(real value of M&A deals in the banking sector)

```
xtdreg financialcorporationde lnrealbank, fe
```

Fixed-effects (within) regression
Number of obs = 160
Group variable: codenum
Number of groups = 16

R-sq:
within = 0.0350
between = 0.1017
overall = 0.0075

Obs per group:
min = 6
avg = 10.0
max = 11

F(1,143) = 5.18
Prob > F = 0.0243

corr(u_i, Xb) = -0.2339

| financialc~e | Coef.  | Std. Err. | t     | P>|t|   | [95% Conf. Interval] |
|--------------|--------|-----------|-------|-------|----------------------|
| lnrealbank   | -0.1770556 | 0.0777939 | -2.28 | 0.024 | -0.3308302 to -0.023281 |
| _cons        | 4.969636    | 0.199466   | 24.91 | 0.000 | 4.575353 to 5.363919  |
| sigma_u      | 2.5043575   |           |       |       |                      |
| sigma_e      | 1.4958632   |           |       |       |                      |
| rho          | 0.73704336  |           |       |       | (fraction of variance due to u_i) |

F test that all u_i=0: F(15, 143) = 26.12
Prob > F = 0.0000

Debt to Equity Ratio (Financial Institutions) = 4.969636 + -0.1770556
Value of M&A

in the Banking Sector +e
References

Barbaglia, Pamela. Cross-border M&A between U.S. and European Firms at 10 Year High, Reuters, May 22, 2017

Currency Union, Investopedia, [Available at https://www.investopedia.com/terms/c/currency-union.asp]

Economic Crisis in Europe: Causes, Consequences, and Responses. Economic and Financial Affairs, European Commission, 2009


“Real GDP Forecast” OECD Data. Web April 23, 2017

Watson, Towers. Cross-border M&A Deals for Companies in Europe, Points

White, Lucy. Cross-border M&A between the United States and Europe Hits Decade High Following Huntsman-Clariant Tie-up. CITY A.M. 22 May 2017

Corporate Messaging: The Role of Diversity and Inclusion on Company Communication

Mario Menendez

Foreword by Research Mentor and Robert H. Smith Chair in Organizational Behavior, Dr. Gilad Chen

When I first met with Mario, it was clear from the get-go that he cares deeply about diversity in work organizations. After a few discussions, we have agreed that his SURE project should focus on what companies do to signals to outsiders (through their websites and mission statements) that they value and care about diversity. What ensued is this research project, whereby Mario examines whether firms recognized by the Diversity 100 list differ from Fortune 500 firms (as well as overlapping firms) in how they convey diversity in their mission statements and other aspects of their websites. Although Mario’s findings show little evidence for differences between these firms, this research opens up new and important questions, regarding what companies do – and/or should be doing – to attract and select a more diverse workforce. Working with Mario on this project has been a joy. Through this project, Mario has truly demonstrated the excellence expected from SURE students. I hope you enjoy reading this article, summarizing Mario’s project.

• Mario Menendez is a SURE Fellow in the Robert H. Smith School of Business at the University of Maryland, College Park, MD. Their email address is menendez@terpmail.umd.edu.
Abstract

This paper aims to explore the objective and meaning behind the topic of diversity and inclusion in corporate messaging. By exploring the translation of value-driven characteristics (in the form of diversity and inclusion practices) into surface-level characteristics (in the form of external accomplishments, recognition [i.e., ranking on Fortune 500 or Diversity 100 lists], and mission statements), I address the following question: what value/role does corporate messaging play in relaying an organization’s purpose and intentions?

In comparing the mission statements of Fortune 500, Diversity 100, and Overlapping Companies (those that appeared on both rankings) to an adapted list of “diversity-related” terminology, companies were found to be primarily customer-centered and lack communication of value-adding diversity efforts (such as employee diversity or inclusion goals). When qualitatively ranking relevance and importance placed on acknowledging diversity and inclusion, Diversity 100 companies (those already recognized by their employees for their initiatives) were found to be more likely to showcase strategies (i.e., sustainability, sponsorships, or charitable giving) aimed at impacting overall communities. Although rankings like Fortune 500 and Diversity 100 lists benchmark company success on two different scales, their corporate messaging gives no indication to who is doing versus simply communicating or showcasing the most of their diversity and inclusion (or lack thereof) programs and initiatives.

Keywords: diversity, inclusion, diversity and inclusion, corporate messaging, mission statements, Fortune 500, Diversity 100

Introduction

Diversity is a hot, buzzword topic impacting all aspects of decision making in corporate America. Companies and organizations, big and small, have the option of communicating diversity through various outlets. In particular, mission statements give a holistic look at an organization’s nature of work, and list of tangible, guiding goals (Ketchen, 2015); also revealing an organization’s priority of objectives. The wording of a mission statement can give clues as to what the organization values and how they communicate programs and initiatives that may or may not be in place. This paper aims to compare the corporate messaging (i.e., mission statement and related signaling) of “Fortune 500,” “Diversity 100,” and overlapping companies to determine whether and how diversity (or lack thereof) is translated into initiatives and objectives.
Diversity in Corporate America:

In the 1990’s, U.S. federal equal employment opportunity laws introduced protections for minority and under-represented groups, suggesting a shift from assimilation to a focus on managing diversity (Roberson et al., 2017). The term diversity is broadly defined as “compositional differences and similarities among individuals in a unit (group, department, organization)” (Roberson et al., 2017, p. 483), whereby affiliations to said differences and similarities can be adopted or abandoned.

Today, internationally, the bar for a company’s competitive advantage through differentiation (by means of diversity) continues to be on the rise. McKinsey & Company’s “Diversity Matters” project publication (2015) found that, from a proprietary dataset of 366 public companies, in the United States, there is a positive association between ethnic/racial diversity and positive financial performance. In fact, in the United States, when compared to gender diversity, ethnic and racial diversity has a greater significance on financial performance - previous pushes for women’s representation have already yielded maximum, positive returns (Hunt et al., 2015).

Great Place to Work’s, “‘For All’ Workplaces: Better for Business” report (2017), finds that in an effort to foster trust and maximize employee morale (a mutual feeling of respect and value), top companies strive for environments consistently promoting diversity. A significant amount of research findings has praised that the advantages of diversity lie in its information benefits (Roberson et al., 2017). As proposed by Cox & Blake (1991) value-in-diversity hypothesis, and Williams & O’Reilly (1998) informational/decision-making perspective, range in perspectives and opinions comes from variance in work unit makeups. Research further suggests that variance exposes team members to minority opinions, allowing groups to access broader, varied social networks that ultimately lead to creative solutions.

However, noted by Douglas (2008) as a social movement a generation ago, workplace diversity today, has become business as usual. Beyond numbers and a choice of race or gender, the goal of diversity has shifted towards inclusion- “a conscious, systematic business strategy to make certain that everyone in an organization shares the same advantages” (Douglas, 2008, p. 11). In order to achieve a state of inclusion, companies must employ many forms of employee involvement initiatives.

An organization’s focus on equity and developing employees of all backgrounds is key to attraction and retention of a demographically changing workforce. Year after year, research and consulting firm, Great Place to Work, notes that organizations that value the creation of a strong work experience for their employees grow at a faster rate than their competitors.
and outperform them in stock value (Frauenheim & Lewis-Kulin, 2017). Great Place to Work’s “Executive’s Guide to Engaging Millennials” (2017) looked at a list of “100 Best Companies to Work for” and found that companies with a commitment to inclusion and equal treatment, an advantage as diversity levels in the workforce increase, achieved three times median revenue growth. They point out Millennials in particular - a highly diverse generation (compared to any other generation) that expect equal treatment for all employees across the organization.

**Two Rankings of Corporate Success:**

In an effort to name “The Best Workplaces for Diversity” (2016), more widely known as the Diversity 100 list, Great Place to Work analyzed 448,456 surveys from employees across industries. Their findings conclude that companies inspiring and promoting under-represented employees make them equitable places to work and, as a result, rank highly on Diversity 100 list. Important to note were their findings in regard to diversity by numbers and actual fostering of diverse environments (Frauenheim & Lewis-Kulin, 2016). Their analysis does not show a correlation between increased headcount diversity and an organization’s revenue growth. Rather, genuine inclusion as experienced by employees (measured by high scores in “fair treatment” and “caring environment” survey areas) better-predicted revenue growth. Great Place to Work notes the idea of radical inclusivity (Frauenheim & Lewis-Kulin, 2016), where recognition and a simple welcoming environment for every employee are testaments to an organization’s authentic commitment to inclusion and fairness.

More widely monitored, Fortune, in their “Fortune 500” listings, ranks the 500 largest United States corporations by total revenue. Notably, this year’s list contains a 21% increase in the number of female chief executives in comparison to last year, 32 (McGrit, 2017). Although in 63 years of publishing, this is the largest number of women CEOs, they only make up 6.4% of the 500 list (McGrit, 2017). In an ongoing data collection program targeting transparency of diversity and inclusion in Fortune 500, Fortune’s investigation found that companies in the upper quartile for racial/ethnic diversity were 35% more likely to have returns above industry medians (in the United States) (Donnelly, 2017).

Strikingly, although most of the organizations that made the Fortune 500 list have landing pages indicating the importance of diversity to company culture and success, only 1 out 5 companies provide any type of trackable diversity information to measure their progress (Donnelly, 2017). While Fortune 500 companies employ a total of 17.5% of the U.S. workforce, Fortune’s data collection program shows that only 3% of companies (16 out of the 500) are fully transparent in regard to the demographic makeups of
their workforces (Donnelly, 2017). A closer look at this 3% of companies revealed that 72% of their senior executives were white men (Jones & Donnelly, 2017). Overwhelmingly, out of the 2017 Fortune 500 list, most companies chose to share no data regarding the gender or ethnicity of their employees.

Mission Statements:

Spearheading a company’s brand, image, and overall messaging, mission statements are cornerstones of organizational objectives and goals. Campbell’s (1997) article on “Mission Statements”, notes that mission statements are sometimes seen as required pieces of a company’s work of literature. Jones & Kahaner, co-authors of Say It and Live It: The 50 Corporate Mission Statements that Hit the Mark (1995), broadly define corporate mission statements (also referred to as value statements) as, “the operational, ethical, and financial guiding lights of companies.” Diving deeper, Campbell (1997) adds that, at times, mission statements do not necessarily add value but can cause harm.

Specifically, Campbell (1997) analyzes mission statements-containing values and behavior standards-as stimulants to three different responses. (1) The yawn of boredom, a neutral response where the mission statement is generic and of no benefit; (2) Emotional support, a positive response in which the reader recognizes and shares the values stated and associated with the mission statements; and (3) Emotional resistance, the most harmful and damaging response whereby the reader recognizes that the values stated and associated with the mission statement are different than their own- this response makes the person feel persecuted- it is almost an attack on their personal beliefs/values. Denton (2001) finds that research on mission statements shows variability in their value along with disagreement about their value. While mission statements are created in the hopes of uniting and pushing an organization towards a common goal, not every employee has the same clear objectives in mind. Denton (2001) further proposes that, while ineffective organizations will spend 90% of their time writing rules and regulations, organizations looking to be successful should instead spend their 90% of time keeping their employees focused and only 10% figuring out the rules and regulations to get there.

For their collective purposes, mission statements need not be public. Denton (2001) argues that mission statements can be an internal, private process as they are an expression of an organization’s purpose and objectives. More than slogans or mottos, mission statements “articulate the goals, dreams, behaviors, culture, and strategies of companies more than any other document” (Jones & Kahaner, 1995), giving a into emotional and value-based sides of an organization. In researching for their book, Jones &
Kahaner found that mission statements by themselves were of no help; relying on mission statements was what helped organizations make hard decisions and make it through tough times. More than concepts and philosophies, mission statements are thought out ideas that will ideally, guide organizations to “meet and exceed their financial dreams, treat their employees well, break free of a crisis, and stake out a piece of ‘the right thing to do’” (Jones & Kahaner, 1995). The undoing of an organization’s diversity efforts, however, point to actions, ultimately leading to results that do not align with their messaging.

**Essentials**

Organizational diversity and inclusion has revolutionized the corporate agenda and set the bar as a key competitive advantage in any industry. Beyond diversity (differences in the way we look, think, or events we have experienced), companies are making the conscious, systematic choice to promote a spirit of inclusion; in turn, reaping the benefits of positive employee engagement, increased citizenship behavior in the workplace, and greater revenue growth. Different from the “Fortune 500” listing (which ranks solely based on total revenue), the “Diversity 100” list is an alternative take on the outdated idea of revenue growth, employee satisfaction, and overall achievement as being tied to size, dominance, or brand recognition.

Today, diversity and inclusion are a new definition of what it means for an organization to be innovative and the new bar for competitive advantage matching. Fueling this movement is diversity messaging in the form of mission statements, for example, that set a unifying goal and the basis for an environment the company would like to foster. Giving a peek into the value-based side of an organization, corporate messaging and other objectives, while well-intentioned, have turned diversity into an empty word (Bush & Peters, 2016). Although companies invest in diversity initiatives and appoint Diversity Officers, they come up short of inclusion and are quickly disappointed by inadequate, insufficient results. Extensive research at Great Place to Work has shown that employees internalize what they see in the environments around them (Bush & Peters, 2016). For employees wanting their voices and opinions to be heard, they want to connect with and see themselves in the makeup and initiatives put forth by organizations.

In sum, the scope of this paper can be categorized into three distinct buckets: (1) diversity, its popularity, and the potential advantages it offers to organizations that pair it with inclusion; (2) the diverse (or lack thereof) makeup of organizations and their actions that may or may not match their diversity messaging; and (3) mission statements, a written document of an organization’s objectives, values, and goals that if relied and called upon,
guides organizations to do the right thing. These buckets provide solid foundations of research for societal, group, and individual factors: societal-concepts of diversity and inclusion; group- organizational values, programs, and initiatives leading to increased profitability and success; and individual-outlets and ways (mission statements) by which individual organizations communicate.

**Topic of Interest:**

Based on this research, it is important to explore the relationship between deemed-successful organizations evaluated on different scales/levels of achievement; Fortune 500: ranking based on revenues and scale, and Diversity 100: ranking based on fostering diverse and inclusive environment. What role does messaging (i.e., mission statements) play in communicating an organization’s initiatives? Putting a value on diversity and inclusion as something that every company “should” do, what makes only Diversity 100-ranking companies unique? How are some companies able to rank highly on the two lists, both Fortune 500 and Diversity 100? This study aims to provide a connected view of how surface-level characteristics-external accomplishments, recognition (such as ranking on Fortune 500 or Diversity 100 lists), and mission statements- are indicators of value-driven characteristics in the form of diversity and inclusion practices and initiatives.

**Methodology**

To begin, Fortune 500 (2017) and Diversity 100 (2017) lists were compared to find companies that overlapped both rankings. As a result, 29 companies were found that appeared on both Fortune 500 and Diversity 100 lists. This created three new lists:

1. **Fortune 500 Companies** (now 471)
2. **Diversity 100 Companies** (now 71)
3. **Overlapping Companies** (29)

From each of the 3 lists, a small, random sample of 25 companies (Appendix A) was drawn and further analyzed. For each of the 75 companies on the combined list, their mission statements were found and taken directly from their websites. In the case where mission statements, specifically, were not located, vision, or alternative “purpose,” statements were used. For 18 companies, mission, vision, or alternatively worded statements, were not found on company websites or official communication; instead, the statements of these 18 companies were taken from popular sources.

To analyze the dataset, a text tool for frequency and top words were used. From each list, words with three or more occurrences were considered significant for the analysis (Appendix B). Word frequencies from each of the three listings were compiled to form a master frequency list across all
mission statements (Appendix C) of 44 words. A vocabulary list (Appendix D) of 116 “diversity-related” terms was adapted from “Diversity Vocabulary Word List” (Cook & Cook, 2018) to match master occurrences and determine the frequency in which these words appeared in the 75 mission statements.

**Data findings and results**

**Release of Diversity Data:**

For companies ranking on the Fortune 500 list (which held true for two out of the three lists analyzed), the 2017 release of diversity data was tracked (Jones & Donnelly, 2017). In researching the communication of diversity and inclusion efforts on company platforms, the public release and availability of demographic data were analyzed from two lists; **List 1:** 471 Fortune 500 companies, and **List 2:** 29 Overlapping Companies. As defined by Jones & Donnelly (2017), data availability has three measures:

1. **Full Data:** company publicly releases full employee diversity data (matches Employer Information Report EEO-1 fields)
2. **Partial Data:** company publicly releases some demographic information regarding employee makeup
3. **No Data:** company release no data in regard to employee diversity

Out of the 29 overlapping companies, one released full diversity data (3.44%) and six released partial diversity data (20.68%). On the other hand, out of the Fortune 500 (not counting the 29 that overlap, therefore 471) companies, 13 released full diversity data (2.6%) and 78 released partial diversity data (16.56%). Altogether, the total number of companies that released any type of employee demographic or diversity data was 98 (19.6%). When comparing the results of diversity data practices, neither of the lists had more than 5% of their companies release full diversity data. Additionally, only the Overlapping List (companies ranking on both the Fortune 500 and Diversity 100 list) had more than 20% of their companies releasing some information regarding their employee makeup—Fortune 500 only had 16%.

For both, Fortune 500 and Overlapping lists, over 80% of companies made the decision not to release employee diversity data. Regardless of what lists companies did/did not rank on, showcasing and relaying their employee makeup, diversity, and inclusion (or lack thereof), might have ultimately been a decision based on organizational relevance, importance, and weight given to these objectives and goals.

**Screens Accessed:**

Throughout the data collection process, the average number of screens a user would have to go through to find a company’s mission statement was also measured. The number of screens ranged from one to four pages across
several tabs labeled “Company Overview,” “Quick facts,” and “Ethics.” It is significant to note that the average number of screens accessed for Diversity 100 Companies was one, whereas the number of screens for Fortune 500 and Overlapping Companies was two.

**Output from Word Analysis:**

For Overlapping Companies, the total number of words with at least three occurrences in their mission statements was twice the number of words found in Fortune 500 Companies. The highest-ranking word per list was the following:

- **Fortune 500:** world
- **Diversity 100:** service, way, and world
- **Overlapping:** customer and service

<table>
<thead>
<tr>
<th>Frequency of Top Three Words Across All Companies</th>
<th>Frequency of “Diversity-Related”(^1) Words Across All Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word</td>
<td>Occurrences</td>
</tr>
<tr>
<td>World</td>
<td>23</td>
</tr>
<tr>
<td>Health</td>
<td>18</td>
</tr>
<tr>
<td>Customer</td>
<td>17</td>
</tr>
<tr>
<td>Mission</td>
<td>17</td>
</tr>
</tbody>
</table>

*Above: Frequency comparison of the overall top three words across all company lists versus highest ranking “diversity-related” words.*

(Cook & Cook, 2018)

**Measuring Efforts:**

To further explore corporate messaging, a qualitative scale was created to measure the relevance and ease of access to company landing pages showcasing their diversity and/or inclusive efforts. Beyond focusing on mission or vision statements, the scale sought to measure how striking the importance of diversity was in the 75 company’s “About Us,” “Our Company,” or similarly labeled sections of their websites. To determine the level of diversity efforts, each company was qualitatively rated using a 4-point Likert scale.

<table>
<thead>
<tr>
<th>Unimportant</th>
<th>Little Importance</th>
<th>Important</th>
<th>Very Important</th>
</tr>
</thead>
</table>

Examples ranking on the “Unimportant” point, were companies with no type of corporate landing page (i.e., “About Us,” “Our Company,” etc.) in general. On the “Little Importance” point, companies had landing pages, but no links or further development of their diversity and inclusion (or lack
Companies on the “Important” point also had corporate landing pages with some acknowledgment of diversity and inclusion within their firms. Lastly, companies ranking on the “Very Important” point, had corporate landing pages with established, built-in sections or further links that highlighted their diversity and inclusion efforts.

When it comes to levels of diversity efforts and focus, Diversity 100 companies have the lowest ratings (“Unimportant” and “Little Importance” combined). From this sample, companies that only appear in Fortune 500, seem to be placing a greater importance on acknowledging their continued efforts to remain diverse and inclusive. The established presence of specific, diversity-oriented sections on Fortune 500 landing pages, showcase a counterargument to only being revenue or bottom-line driven.

To examine the consistency of responses, attitudes, and agreement towards the relevance and ease of access to pages showcasing diversity and inclusion, a second rater was asked to provide the same rating (using the same, 4-point Likert rating scheme) for a small, random sample of 15 companies (5 from each of the 3 lists were drawn). The new rater was a female, University of Maryland student with a focus in psychology. The same landing pages used in the original qualitative analysis were presented to the new rater.
Notably, based on the new rater, the distribution of Overlapping Companies’ perceived levels of diversity efforts and focus are similar to my ratings. For all lists, however, discrepancies arose between the “Little Importance” and “Important” points on the scale. Differences in what the rater considered to be “enough” diversity and inclusion development or acknowledgment led to the alternation of ratings among companies who fell between these points. These differences stemmed from what the rater’s perception and definition of “diverse” meant. For example, in rating up (from “Little Importance” to “Important”), deciding factors may have been specific causes or minority group in the spotlight (i.e., women’s advocacy and empowerment specifically). On the other hand, in rating down (from “Important” to “Little Importance”), deciding factors may have been a lack of focus or too wide of an intended breadth of impact (i.e., having all-encompassing core values or goals in lieu of targeted objectives and specific communities). Collectively, these results suggest no evidence for more emphasis on diversity across firms from different lists. If anything, companies in the Diversity 100 ranking showed less of an emphasis on diversity on their landing pages.

Discussion

The purpose of this study was to explore the relationship between organizations evaluated on different scales of achievement and the role of corporate messaging in communicating the relevance, importance, and weight of a company’s diversity and inclusion efforts. Ultimately, this study provides a connected view of how surface-level characteristics (ranking on Fortune 500, Diversity 100, or both lists) and corporate communication are
an indicator of value-driven characteristics (diversity and inclusion practices and initiatives) by asking three questions. (1) What role does messaging (i.e., mission statements) play in communicating an organization’s initiatives? (2) Putting a value on diversity and inclusion as something that every company “should” do, what makes only Diversity 100-ranking companies unique? And (3) how are some companies able to rank highly on the two lists, both Fortune 500 and Diversity 100?

In analyzing the availability of demographic data amongst all companies, the public release of this information was measured on three points; full data, partial data, and no data. For both lists analyzed, Fortune 500 and Overlapping lists, over 80% of companies released no data regarding employee diversity-meaning that, the total number of companies that released any type of employee demographic or diversity data was 98 (19.6%). In comparing the results of data practices, neither of the lists had more than 5% of companies releasing full diversity data. Showcasing and relaying employee makeup, diversity, and inclusion (or lack thereof), was ultimately a decision based on the organizational relevance, importance, and weight given to these goals and objectives.

When comparing word frequencies from all mission statements to a vocabulary list of 116 “diversity-related” terms (Cook & Cook, 2018), the highest ranking “diversity-related” words were: people, care, innovative, and success-forward thinking words, not necessarily with the purpose of showcasing diversity and inclusion efforts. Throughout the mission statement collection process, the average number of screens users had to go through to find a company’s mission statement was also measured. The number of screens overall ranged from one to four pages; however, significant to note, the average number of screens accessed for Diversity 100 Companies was 1, whereas the number for Fortune 500 and Overlapping Companies was 2.

Lastly, in examining the consistency of responses towards the relevance of pages showcasing diversity and inclusion, the Overlapping Companies’ perceived levels of diversity efforts and focus was found to be similar. There was no evidence to suggest more of an emphasis or focus on diversity among companies from different rankings. When comparing my own ratings with another rater, discrepancies in agreement of which point in the qualitative scale (“Unimportant,” “Little Importance,” “Important,” or “Very Important”) each company deserved, differed depending on what each rater considered to be “enough”- differences stemmed from what the rater’s perception and definition of “diverse” meant.

Limitations and further research

This study is limited to two distinctive surveys, (1) Diversity 100: a survey that companies choose to have their employees take, measuring the
perceived value, prevalence, and environment of inclusion and fairness, and (2) Fortune 500: a measure of largest United States corporations by total revenue - but many more rankings exist. Furthermore, only the Diversity 100 list is based on the qualitative responses of actual employees - not just bottom-line numbers. Given the 471 companies on the Fortune 500 list that do not overlap on the Diversity 100 ranking, it would be of interest to note how these employees would rate the value given to diversity and inclusion efforts.

Moving forward, questions to ask are: What is the relationship between Fortune 500 ranks and employee perceptions of diversity and inclusion programs and initiatives? If the pool of companies from which the Diversity 100 list was chosen from was reduced to only the Fortune 500 list, would the top 100 companies make the ranking? Why or why not? For all companies, it is important to know and value the relationship in ranking highly based on numbers, merit, effort, or all.

Concluding thoughts

Although lists like Fortune 500 and Diversity 100 serve as a benchmark to rank companies in the United States, these ratings are not a determining factor of who is doing the most to create inclusive, diverse environments. From an outsider’s perspective, true development and focus on these initiatives cannot be measured by simply looking at a mission statement or browsing corporate landing pages; this would be an untrue representation of employee attitudes to what actually happens behind closed doors. Supporting findings of little importance given to the public showcase of diversity and inclusion, companies that are already recognized by external accomplishments (ranking Diversity 100 list) may consciously make the decision to keep these efforts private. The most important factor is satisfying and being held accountable by employees. If employee surveys of a company’s climate are already positive, there serves no purpose, other than good PR, to try and translate organic, diversity and inclusion objectives into static corporate communication.

On the other hand, for companies who may not have recognition of being diverse and inclusive from corporate-environmental evaluations, going above and beyond to showcase efforts and goals may be a mechanism for showing the public that they are trying. In the revenue-determinant world of the Fortune 500 list, corporate messaging that goes beyond a bottom line can humanize and show the value these companies place on representing their customers through their employees and practices.

For all companies, mission statements serve the purpose of being forward-thinking and aspirational. Beyond the concepts of diversity and inclusion, they are entirely customer-centered and focused on what value the company will deliver - not necessarily how they will get there. In all, although
value-driven characteristics of diversity and inclusion goals are of the utmost importance, relaying them through the surface-level means of corporate messaging, is a decision left up to each company and their purpose.
References


**Appendix A**: List of the 25 Companies Analyzed from Each Ranking

<table>
<thead>
<tr>
<th>Rank</th>
<th>Fortune 500 Companies</th>
<th>Industry</th>
<th># of Employees (“Fortune 500,” 2018)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Exxon Mobil</td>
<td>Oil And Gas</td>
<td>72,700</td>
</tr>
<tr>
<td>24</td>
<td>Boeing</td>
<td>Aerospace Defense</td>
<td>150,540</td>
</tr>
<tr>
<td>28</td>
<td>Microsoft</td>
<td>Computer Software/Hardware</td>
<td>114,000</td>
</tr>
<tr>
<td>44</td>
<td>PepsiCo**</td>
<td>Beverages, Food Processing</td>
<td>264,000</td>
</tr>
<tr>
<td>52</td>
<td>Walt Disney</td>
<td>Mass Media, Entertainment</td>
<td>195,000</td>
</tr>
<tr>
<td>56</td>
<td>Lockheed Martin</td>
<td>Advanced Technologies, Information Security, Aerospace Defense</td>
<td>97,000</td>
</tr>
<tr>
<td>61</td>
<td>HP</td>
<td>Information Technology</td>
<td>49,000</td>
</tr>
<tr>
<td>62</td>
<td>Dow Chemical</td>
<td>Chemicals</td>
<td>56,000</td>
</tr>
<tr>
<td>64</td>
<td>Coca-Cola</td>
<td>Beverage</td>
<td>100,300</td>
</tr>
<tr>
<td>70</td>
<td>Cigna</td>
<td>Managed Health Care</td>
<td>41,000</td>
</tr>
<tr>
<td>82</td>
<td>Tyson Foods</td>
<td>Food Processing</td>
<td>114,000</td>
</tr>
<tr>
<td>93</td>
<td>CHS</td>
<td>Wholesale Agriculture Products, Fuels</td>
<td>12,157</td>
</tr>
<tr>
<td>107</td>
<td>Tech Data</td>
<td>Distribution, Technology, Electronics</td>
<td>9,500</td>
</tr>
<tr>
<td>114</td>
<td>Northrop Grumman*</td>
<td>Aerospace &amp; Defense</td>
<td>67,000</td>
</tr>
<tr>
<td>131</td>
<td>Starbucks</td>
<td>Coffee Shop</td>
<td>254,000</td>
</tr>
<tr>
<td>150</td>
<td>Kohl's</td>
<td>Retail</td>
<td>85,000</td>
</tr>
<tr>
<td>243</td>
<td>Henry Schein</td>
<td>Health Care Supplies</td>
<td>21,000</td>
</tr>
<tr>
<td>281</td>
<td>Baxter International</td>
<td>Medical Equipment</td>
<td>48,000</td>
</tr>
<tr>
<td>306</td>
<td>Ball*</td>
<td>Packaging, Aerospace</td>
<td>18,450</td>
</tr>
<tr>
<td>310</td>
<td>eBay</td>
<td>Internet</td>
<td>12,600</td>
</tr>
<tr>
<td>312</td>
<td>Oneok**</td>
<td>Natural Gas Utility</td>
<td>2,384</td>
</tr>
<tr>
<td>315</td>
<td>American Family Insurance Group</td>
<td>Insurance And Finance</td>
<td>10,471</td>
</tr>
<tr>
<td>322</td>
<td>Tenneco*</td>
<td>Auto Parts</td>
<td>31,000</td>
</tr>
<tr>
<td>Rank</td>
<td>Diversity Companies</td>
<td>Industry</td>
<td># of Employees</td>
</tr>
<tr>
<td>------</td>
<td>---------------------</td>
<td>----------</td>
<td>---------------</td>
</tr>
<tr>
<td>2</td>
<td>Hyatt Hotels Corporation</td>
<td>Hospitality</td>
<td>35,309</td>
</tr>
<tr>
<td>9</td>
<td>Texas Health Resources, Inc.</td>
<td>Health Care</td>
<td>21,686</td>
</tr>
<tr>
<td>12</td>
<td>Workday</td>
<td>Software</td>
<td>5,473</td>
</tr>
<tr>
<td>17</td>
<td>T-Mobile USA**</td>
<td>Telecommunications</td>
<td>-</td>
</tr>
<tr>
<td>22</td>
<td>Arby's Restaurant Group, Inc.**</td>
<td>Restaurants</td>
<td>24,954</td>
</tr>
<tr>
<td>25</td>
<td>Quicken Loans</td>
<td>Mortgage Lending</td>
<td>15,122</td>
</tr>
<tr>
<td>37</td>
<td>Build-A-Bear Workshop</td>
<td>Retail</td>
<td>3,399</td>
</tr>
<tr>
<td>41</td>
<td>Zillow Group</td>
<td>Real Estate</td>
<td>2,908</td>
</tr>
<tr>
<td>46</td>
<td>BayCare Health System**</td>
<td>Medical</td>
<td>23,459</td>
</tr>
<tr>
<td>49</td>
<td>Accenture**</td>
<td>Professional Services, Technology Services</td>
<td>50,000</td>
</tr>
<tr>
<td>50</td>
<td>EY</td>
<td>Professional Services</td>
<td>43,874</td>
</tr>
<tr>
<td>55</td>
<td>Northwell Health</td>
<td>Health Care</td>
<td>52,007</td>
</tr>
<tr>
<td>58</td>
<td>MOD Pizza</td>
<td>Restaurants</td>
<td>3,198</td>
</tr>
<tr>
<td>59</td>
<td>First Horizon National Corporation</td>
<td>Financial Services</td>
<td>4,300</td>
</tr>
<tr>
<td>63</td>
<td>Transwestern</td>
<td>Professional Services</td>
<td>2,062</td>
</tr>
<tr>
<td>64</td>
<td>American Fidelity Assurance Company**</td>
<td>Supplemental Benefits</td>
<td>1,826</td>
</tr>
<tr>
<td>68</td>
<td>Roth Staffing Companies, L.P.</td>
<td>Staffing And Recruiting</td>
<td>611</td>
</tr>
<tr>
<td>73</td>
<td>Old Navy**</td>
<td>Retail</td>
<td>51,619</td>
</tr>
<tr>
<td>82</td>
<td>Cws Apartment Homes LLC**</td>
<td>Real Estate Development</td>
<td>707</td>
</tr>
<tr>
<td>84</td>
<td>Goodway Group</td>
<td>Digital Media Services</td>
<td>413</td>
</tr>
<tr>
<td>90</td>
<td>Regal Entertainment Group**</td>
<td>Leisure</td>
<td>25,543</td>
</tr>
<tr>
<td>91</td>
<td>CA Technologies</td>
<td>Enterprise Software</td>
<td>5,785</td>
</tr>
<tr>
<td>Rank (100)</td>
<td>Rank (500)</td>
<td>Overlapping Companies</td>
<td>Industry</td>
</tr>
<tr>
<td>------------</td>
<td>------------</td>
<td>-----------------------</td>
<td>----------</td>
</tr>
<tr>
<td>4</td>
<td>326</td>
<td>Salesforce.com**</td>
<td>Cloud Computing, Software</td>
</tr>
<tr>
<td>6</td>
<td>85</td>
<td>Publix Super Markets</td>
<td>Retail</td>
</tr>
<tr>
<td>7</td>
<td>163</td>
<td>Marriott International*</td>
<td>Hospitality</td>
</tr>
<tr>
<td>11</td>
<td>102</td>
<td>USAA</td>
<td>Insurance, Banking, Financial Services</td>
</tr>
<tr>
<td>13</td>
<td>58</td>
<td>FedEx Corporation</td>
<td>Courier</td>
</tr>
<tr>
<td>14</td>
<td>241</td>
<td>Hilton Worldwide</td>
<td>Hospitality</td>
</tr>
<tr>
<td>20</td>
<td>86</td>
<td>American Express*</td>
<td>Banking, Financial Services</td>
</tr>
<tr>
<td>26</td>
<td>26</td>
<td>Bank of America Corp.</td>
<td>Banking, Financial Services</td>
</tr>
<tr>
<td>27</td>
<td>443</td>
<td>Adobe Systems Incorporated**</td>
<td>Computer Software</td>
</tr>
<tr>
<td>28</td>
<td>174</td>
<td>CarMax</td>
<td>New And Used Car Retailer</td>
</tr>
<tr>
<td>36</td>
<td>188</td>
<td>Nordstrom Inc.</td>
<td>Retail</td>
</tr>
<tr>
<td>39</td>
<td>252</td>
<td>Stryker</td>
<td>Medical Technology</td>
</tr>
<tr>
<td>40</td>
<td>9</td>
<td>AT&amp;T</td>
<td>Telecommunications</td>
</tr>
<tr>
<td>44</td>
<td>185</td>
<td>Synchrony Financial</td>
<td>Financial Services</td>
</tr>
<tr>
<td>48</td>
<td>464</td>
<td>First American**</td>
<td>Financial Services</td>
</tr>
<tr>
<td>57</td>
<td>378</td>
<td>Alliance Data Systems**</td>
<td>Loyalty Marketing Services</td>
</tr>
<tr>
<td>61</td>
<td>78</td>
<td>Goldman Sachs</td>
<td>Financial Services</td>
</tr>
<tr>
<td>69</td>
<td>348</td>
<td>Foot Locker*</td>
<td>Clothing</td>
</tr>
<tr>
<td>71</td>
<td>463</td>
<td>Burlington Stores, Inc.</td>
<td>Retail</td>
</tr>
<tr>
<td>72</td>
<td>126</td>
<td>Aflac, Inc.**</td>
<td>Insurance</td>
</tr>
<tr>
<td>74</td>
<td>214</td>
<td>CBRE**</td>
<td>Real Estate</td>
</tr>
<tr>
<td>Rank</td>
<td>Code</td>
<td>Company</td>
<td>Industry</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>80</td>
<td>75</td>
<td>Liberty Mutual Insurance**</td>
<td>Mutual Insurance</td>
</tr>
<tr>
<td>93</td>
<td>434</td>
<td>St. Jude’s Research Private Hospital</td>
<td>18,000</td>
</tr>
<tr>
<td>95</td>
<td>80</td>
<td>TIAA</td>
<td>Financial Services</td>
</tr>
<tr>
<td>97</td>
<td>111</td>
<td>AbbVie</td>
<td>Biopharmaceutical</td>
</tr>
</tbody>
</table>

*Vision or alternative “purpose” statement used.

**Statements sourced from popular sources.

**Appendix B: Frequency and Top Words by List**

<table>
<thead>
<tr>
<th>Fortune 500</th>
<th>Diversity 100</th>
<th>Overlapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word</td>
<td>Occurrences</td>
<td>Word</td>
</tr>
<tr>
<td>World</td>
<td>10</td>
<td>Service</td>
</tr>
<tr>
<td>One</td>
<td>7</td>
<td>Way</td>
</tr>
<tr>
<td>People</td>
<td>7</td>
<td>World</td>
</tr>
<tr>
<td>Health</td>
<td>6</td>
<td>Health</td>
</tr>
<tr>
<td>Mission</td>
<td>6</td>
<td>Care</td>
</tr>
<tr>
<td>Product</td>
<td>6</td>
<td>Lives</td>
</tr>
<tr>
<td>Company</td>
<td>5</td>
<td>Mission</td>
</tr>
<tr>
<td>Inspire</td>
<td>5</td>
<td>People</td>
</tr>
<tr>
<td>Care</td>
<td>4</td>
<td>Build</td>
</tr>
<tr>
<td>Team</td>
<td>4</td>
<td>Customer</td>
</tr>
<tr>
<td>Business</td>
<td>3</td>
<td>Improve</td>
</tr>
<tr>
<td>Create</td>
<td>3</td>
<td>Making</td>
</tr>
<tr>
<td>Customer</td>
<td>3</td>
<td>Provide</td>
</tr>
<tr>
<td>Innovative</td>
<td>3</td>
<td>Serve</td>
</tr>
<tr>
<td>Better</td>
<td>3</td>
<td>Price</td>
</tr>
<tr>
<td>Company</td>
<td>3</td>
<td>Retailer</td>
</tr>
<tr>
<td>Create</td>
<td>3</td>
<td>Serve</td>
</tr>
<tr>
<td>Hospitality</td>
<td>3</td>
<td>Baby</td>
</tr>
<tr>
<td>Product</td>
<td>3</td>
<td>Better</td>
</tr>
<tr>
<td>Quality</td>
<td>3</td>
<td>Company</td>
</tr>
<tr>
<td>Through</td>
<td>3</td>
<td>First</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Focused</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Home</td>
</tr>
</tbody>
</table>
Appendix C: Frequency and Top Words of Lists Combined

<table>
<thead>
<tr>
<th>Word</th>
<th>Occurrences</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>23</td>
<td>1</td>
</tr>
<tr>
<td>Health</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>Customer</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>Mission</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>Service</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td><strong>People</strong></td>
<td><strong>15</strong></td>
<td><strong>6</strong></td>
</tr>
<tr>
<td>Product</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>Company</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>Quality</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td><strong>Care</strong></td>
<td><strong>9</strong></td>
<td><strong>10</strong></td>
</tr>
<tr>
<td>Serve</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Through</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>High</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>One</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Way</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Better</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>Create</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>Apparel</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>Client</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>Inspire</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>Lives</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>Store</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>Value</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>Build</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>Term</td>
<td>Frequency</td>
<td>Location</td>
</tr>
<tr>
<td>------------</td>
<td>-----------</td>
<td>----------</td>
</tr>
<tr>
<td>Financial</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>Improve</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>Making</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>New</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>Price</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>Provide</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>Retailer</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>Team</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>Baby</td>
<td>3</td>
<td>34</td>
</tr>
<tr>
<td>Business</td>
<td>3</td>
<td>34</td>
</tr>
<tr>
<td>First</td>
<td>3</td>
<td>34</td>
</tr>
<tr>
<td>Focused</td>
<td>3</td>
<td>34</td>
</tr>
<tr>
<td>Home</td>
<td>3</td>
<td>34</td>
</tr>
<tr>
<td>Hospitality</td>
<td>3</td>
<td>34</td>
</tr>
<tr>
<td><strong>Innovative</strong></td>
<td><strong>3</strong></td>
<td><strong>34</strong></td>
</tr>
<tr>
<td>Member</td>
<td>3</td>
<td>34</td>
</tr>
<tr>
<td>Offer</td>
<td>3</td>
<td>34</td>
</tr>
<tr>
<td>Opportunities</td>
<td>3</td>
<td>34</td>
</tr>
<tr>
<td>Partners</td>
<td>3</td>
<td>34</td>
</tr>
<tr>
<td><strong>Success</strong></td>
<td><strong>3</strong></td>
<td><strong>34</strong></td>
</tr>
</tbody>
</table>
### Appendix D: Vocabulary List of "Diversity-Related" Terms (Cook & Cook, 2018)

<table>
<thead>
<tr>
<th>Ability</th>
<th>Cooperation</th>
<th>Ideology</th>
<th>Perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptance</td>
<td>Cultural</td>
<td>Immigration</td>
<td>Potential</td>
</tr>
<tr>
<td>Action</td>
<td>Culture</td>
<td>Impact</td>
<td>Procedure</td>
</tr>
<tr>
<td>Activism</td>
<td>Decision</td>
<td>Inclusion</td>
<td>Process</td>
</tr>
<tr>
<td>Adjustment</td>
<td>Development</td>
<td>Innovative</td>
<td>Progressive</td>
</tr>
<tr>
<td>Admiration</td>
<td>Dialogue</td>
<td>Intelligent</td>
<td>Race</td>
</tr>
<tr>
<td>Advocacy</td>
<td>Difference</td>
<td>Interchangeable</td>
<td>Recognition</td>
</tr>
<tr>
<td>Affect</td>
<td>Different</td>
<td>Involvement</td>
<td>Relationship</td>
</tr>
<tr>
<td>Affirmation</td>
<td>Discipline</td>
<td>Joy</td>
<td>Resource</td>
</tr>
<tr>
<td>Altercation</td>
<td>Discovery</td>
<td>Judgment</td>
<td>Respect</td>
</tr>
<tr>
<td>Analysis</td>
<td>Diverse</td>
<td>Kind</td>
<td>Responsibility</td>
</tr>
<tr>
<td>Ancestry</td>
<td>Diversity</td>
<td>Kindness</td>
<td>Rights</td>
</tr>
<tr>
<td>Artificial</td>
<td>Education</td>
<td>Knowledge</td>
<td>Significant</td>
</tr>
<tr>
<td>Assessment</td>
<td>Effect</td>
<td>Leader</td>
<td>Skillful</td>
</tr>
<tr>
<td>Assistance</td>
<td>Embrace</td>
<td>Learning</td>
<td>Social</td>
</tr>
<tr>
<td>Behavior</td>
<td>Encounter</td>
<td>Legalize</td>
<td>Stride</td>
</tr>
<tr>
<td>Bias</td>
<td>Environment</td>
<td>Lifestyle</td>
<td>Success</td>
</tr>
<tr>
<td>Broadening</td>
<td>Equality</td>
<td>Majority</td>
<td>Support</td>
</tr>
<tr>
<td>Care</td>
<td>Evolve</td>
<td>Minority</td>
<td>Teaching</td>
</tr>
<tr>
<td>Challenges</td>
<td>Exchange</td>
<td>Mix</td>
<td>Tolerance</td>
</tr>
<tr>
<td>Change</td>
<td>Experiences</td>
<td>Movement</td>
<td>Understanding</td>
</tr>
<tr>
<td>Character</td>
<td>Family</td>
<td>Nation</td>
<td>Unique</td>
</tr>
<tr>
<td>Citizen</td>
<td>Foresight</td>
<td>Natura</td>
<td>Universal</td>
</tr>
<tr>
<td>Civil</td>
<td>Freedom</td>
<td>Obstacle</td>
<td>Values</td>
</tr>
<tr>
<td>Collaborate</td>
<td>Genius</td>
<td>Opportunity</td>
<td>Variety</td>
</tr>
<tr>
<td>Collegial</td>
<td>Handicaps</td>
<td>Opportunity</td>
<td>Variety</td>
</tr>
<tr>
<td>Communication</td>
<td>Heterogeneous</td>
<td>Patience</td>
<td>Vision</td>
</tr>
<tr>
<td>Community</td>
<td>Homogeneous</td>
<td>Peace</td>
<td>Wisdom</td>
</tr>
<tr>
<td>Conversation</td>
<td>Identification</td>
<td>People</td>
<td>Zeal</td>
</tr>
</tbody>
</table>
ports marketing is a growing field offering exciting career opportunities. Alden knows that the kinds of data now available for analysis allow researchers to ask really interesting questions that also can have practical implications for decision-making by players and teams. Alden, already a NBA fan, wanted to look at the relationship between market size and brand equity. As he started researching his project he realized that there was a lot of data however, it wasn’t compiled or formatted in a way that was useful to him. Alden put significant effort into identifying and synthesizing data sources so he could run correlations and explore the relationship between market size and team valuation. Understanding how to find, clean, and structure data is a great learning experience for any researcher. I suspect that Alden is just getting started exploring these relationships and we can expect to see more great contributions.
Abstract

The purpose of this study is to measure the financial advantages of playing in a large market for both NBA franchises and players. I hypothesized that market size predicted greater franchise valuation, and also more valuable brand equities for players. For this study, market size is quantified using number of television homes in a designated area and metro area population. Franchise evaluations are determined by Forbes annually. Brand equity is quantified as off-court earnings, and social media followers. To test my hypothesis, I performed a series of correlational analyses. I found a correlation coefficient of 0.65 for the relationship between market size and team value. I found a correlation coefficient of 0.522 between market size and Twitter followers on a team's page. I did not find a significant relationship between market size and number of Twitter followers for Sports Illustrated's Top 50 NBA Players of 2018. Additionally, I determined that a disproportionate number of players from large market teams are represented among the highest off-court earners in the NBA. I also examined a few case studies on the effect that a transition to a different market has on off-court earnings. From my analysis, I determined that market size is not as significant of a predictor of a player’s brand equity than I had hypothesized. This is likely due to the increasing viewership of the NBA through social media, a platform where talented and unique players can get exposure regardless of where they play. However, I determined that market size is a strong predictor for team valuation. But it is possible for smaller market teams to compete financially with the large market teams, mainly by acquiring one or a few highly marketable players.

Keywords: Franchise value, market size, marketability, brand equity, off-court earnings, social media

Introduction

Professional sports are a multi-billion dollar industry. Team owners, front office staff, coaches, and players can become very wealthy by working for a professional sports franchise. However, there are many other lucrative industries that have developed around professional sports. Media, merchandise, and ticket sales companies have all benefited from a marriage with professional athletes and franchises. Other companies are willing to pay great deals of money for advertising because of the exposure that athletes and teams can provide. Historically, the sports franchises that play in the largest markets, like Los Angeles or New York, have been able to capitalize the most
on the financial opportunities involved with professional sports. Logically, it makes sense that teams in large markets would have greater viewership, and therefore would be able to sell a larger audience to companies looking to advertise. In this study, I examined the effect of market size on franchise value and on individual athletes’ brand equity in the modern NBA. I chose to study the NBA as opposed to other professional sports leagues because of its astronomical growth in recent years, and also because of the greater exposure of athletes relative to other professional sports leagues. In an NBA game, there are only five players on the court, and twelve players total, on each team. As a result, each player earns more attention than athletes in a sport where there are more athletes are playing at once.

The purpose of this study is to determine the effect of market size on franchise value, and on the brand equity of individual athletes. I hypothesized that market size would be strongly correlated with greater franchise valuation, and also with a more valuable brand equity for players. I tested this hypothesis through a series of correlational analyses to determine the strength of the relationship between market size and both player and franchise values. The data used for my analysis dates back no later than 2012, because from 2012 to 2018 the league’s average franchise valuation has increased by an average of 25.47% annually. The timeframe of this study focuses on this seven year period of tremendous growth. My hope is that this research helps athletes and agents make decisions that will allow them to maximize potential earnings.

**Literature Review**

Currently the National Basketball Association faces problems regarding the parity between its 30 teams. Not only in terms of competition on the court, but financial inequality also exists among the NBA’s franchises. There are an abundance of variables that contribute to these differences, so pinpointing the primary root of the issue is difficult. The following review will evaluate several sources that discuss this complicated relationship between market size, and how it impacts the value franchises and individual athletes’ brand equity.

Andrew James Housh examines how market size contributes to financial and team performance in his research paper “Large Market Advantage: The National Basketball Association and the Relationship Between Market Size and Success” (2013). Housh first describes some of the structural issues in the NBA’s most recent Collective Bargaining Agreement that contribute to the inequality among the league’s franchises. Housh explains how the luxury
taxes and contract structuring that are supposed to improve parity among NBA teams are not effective enough to compensate for market size. This research suggests that under the current CBA, market size is an insurmountable advantage for the league’s most valuable franchises.

The article titled “The Economic Determinants of Professional Sports Franchise Values” explores which factors significantly contribute to franchise evaluations across the four major American sports leagues. The findings of Donald L. Alexander and William Kern suggest that market size, team performance, and a new facility all significantly contribute to franchise value. Market size and new facilities are factors that can increase franchise value independent from the presence of a superstar, but team performance is positively correlated with the employment of premier athletes. Therefore, Alexander and Kern’s article supports the idea that market size is one of the major determinants of franchise value.

Jerry A. Hausman and Gregory K. Leonard’s analyze the phenomena of the superstar externality in the NBA in their article titled, “Superstars in the National Basketball Association: Economic Value and Policy.” Hausman and Leonard explain how superstar athletes increase the value of television and advertising contracts, contributing to greater revenue for their team. In fact, their findings suggest that NBA superstars actually raise the revenues of other teams in the league as a result of increased television ratings, attendance, and league merchandise. Hausman and Leonard call this effect the superstar externality. These findings suggest that the presence of star players increases a franchise’s revenues.

Similarly to the work of Donald L. Alexander and William Kern, the article titled “Determinants of Franchise Values in North American Professional Sports Leagues: Evidence from a Hedonic Price Model” by Brad R. Humphreys and Michael Mondello aims to determine which factors significantly contribute to franchise value. Humphreys and Mondello are consistent with Alexander and Kern in attributing market size to franchise value. However, Humphreys and Mondello’s findings contradict the findings of Alexander and Kern. Their article suggests that team performance and facility age are not significant contributors to franchise success. This research suggests that large market franchise values are relatively constant, and not significantly impacted by team performance.

The journal article, “Estimating the Value of Brand Alliances in Professional Team Sports” by Yupin Yang, Mengze Shi, and Avi Goldfarb describes how businesses determine which franchises and athletes would be most valuable to associate with their brand. This research recognizes that star athletes improve a team’s on-court performance as well as their marketability, but focuses more on how franchises can impact the brand equity of athletes.
Yang, Shi, and Goldfarb explain how market size is positively correlated with an athlete’s ability to earn money through sponsorships and endorsements.

“Sports Marketing: A Strategic Perspective,” a book written by Matthew D. Shank and Mark R. Lyberger analyzes the sports marketing industry. The chapter titled “How Athletes Are Fighting For Endorsement Dollars” offers insight on which factors make athletes desirable for endorsement deals. Shank and Lyberger quote Jim Tanner, an accomplished sports agent, who believes that an athlete’s performance is the most important factor in determining off-court earnings. The chapter also includes quotes from representatives of Unilever and Under Armour, both of which agree that an athlete’s individual personality and life story are major contributors to his or her marketability. Brands want to be represented by athletes that embody the values of their company. All of these expert sources seem to agree that the individual characteristics of an athlete, not market size, are the major contributor to sponsorship money.

Nielsen is one of the leading sources of information on media consumption and market research. In their article titled, “Cashing In: Most Marketable Athletes of 2016,” Nielsen researchers not only share their list of the five most marketable athletes in 2016, but they also explain which factors make these athletes so likeable and recognizable. Their research seemed to indicate that the most marketable athletes all share compelling narratives that define their personal brand. Peyton Manning earned the top spot on the list after defying age, and winning a Super Bowl in his final season at the age of 39. Lebron James returned to Cleveland, and earned a championship for his hometown city, which had long been a notoriously unsuccessful sports city. The most marketable athletes draw the attention of fans because of their unique narratives. There are also many cases when the most compelling narratives involve small market teams, such as in the case of Lebron James.

Each year Forbes releases valuations of all 30 NBA franchises. In the article titled “NBA Team Values 2018: Every Club Now Worth At Least $1 Billion,” Kurt Badenhausen discusses the most recent franchise values and growth of the league. Badenhausen explains how the league as a whole has grown rapidly in recent years, with the average franchise value up 22% from 2017. On the inelasticity of large market franchises, Badenhausen cites how despite the Los Angeles Lakers experiencing some of their lowest winning percentages in franchise history over the last four seasons, their value increased 10% in 2018. The Lakers are currently the second most valuable franchise in the NBA. On the other hand, the Golden State Warriors surpassed the Chicago Bulls in value, despite Chicago’s larger population.
and richer basketball history. Badenhausen attributes the growth of the Warriors, who currently play in Oakland and are moving to San Francisco next year, to their recent championship, the franchise’s second in the last three years. It is also worthy to note that the Warriors added superstar Kevin Durant to a roster that was already rich with star power. One important findings from Badenhausen’s research are that the value of the largest market teams does not appear to be influenced by a lack of star players or team success. Also, the Golden State Warriors have shown that middle-tier markets can be among the most valuable franchises in the league as a result of repetitive success and the presence of many star players.

While the National Basketball Association as a league has experienced tremendous growth in recent years, the inequality among the thirty franchises remains. The literature that I have reviewed above serves to analyze how market size contributes to these inequalities in franchise value, and also the marketability of individual athletes.

Data Analysis

Market Value and Market Size
Hypothesis: Larger markets are more valuable than smaller markets.
Results: In order to test the correlation between market size and a franchise’s market value, I first performed a regression analysis on the relationship between metro area population and Forbes’ 2018 market valuation. The correlation coefficient of this relationship is approximately 0.48. Next, I tested the relationship between 2016 Forbes franchise evaluation the number of television homes in a designated area, as reported by Nielsen in 2016, as a measure of market size instead of metro area population. The regression analysis showed a correlation coefficient of approximately 0.65 for this relationship.
Discussion: These findings confirm my hypothesis that larger markets tend to be more valuable than smaller markets. It makes sense that teams that play in more populated areas would have greater demand for tickets, merchandise, and other forms of revenue for the organization. Additionally, large markets are more desirable for advertisers because they can reach a greater audience. This explains why the New York Knicks and Los Angeles Lakers can remain the most valuable franchises year after year, despite poor team performance and a lack of superstars. Since market size is fairly constant in the short term, this means that smaller market teams must improve the value of their brand, stadium, and performance in order to compete with the franchise values or larger market teams.

Annual Growth in Off-Court Earnings

Hypothesis: If one of the ten highest paid players in the NBA transition from a larger market team to a smaller market team, this will cause that athlete’s off-court earnings to grow less than the average growth of the annual average of the rest of the top ten highest paid players. Also, transitioning from a small market team to large market team will cause an NBA athlete’s off-court earnings to grow more than the average growth of the top ten highest players.

Results: To test my hypothesis, I measured the annual growth of off-court earnings of a select few athletes. I compared the percent change of those athletes relative to the percent change in the growth of the average off-court earnings amongst the annual top ten highest paid players. The players whose
annual off-court earnings I analyzed played for multiple franchises between 2014 and 2018. Lebron James’ off-court earnings in 2014, while he was playing for the Miami Heat, increased 5% from the year before, slightly more than the top ten average growth of 4.75%. However, in his first year after returning to Cleveland, his off-court earnings rose only 4.76% compared to the top ten average growth of 17.58%. But in 2016 and 2017, James’ off-court earnings grew significantly more than the top ten average. And in 2018, James experienced a 5.45% decrease in off-court earnings while the top ten average grew 10.92%.

Playing in Oklahoma City, Kevin Durant’s annual off-court earnings grew substantially more than the top ten average in 2014 and 2015. In 2016, his off-court earnings grew 2.86% compared to the top ten average of 3.76%. But since joining the Golden State Warriors, Durant’s annual growth of off-court earnings were less than the top ten average, despite playing in a larger market. He even experienced a decrease in off-court earnings in 2018 despite the top ten average growing 10.92%.

Carmelo Anthony did not experience any growth in annual off-court earnings from 2014 to 2017 playing for the New York Knicks. In that span, the top ten average increased by an average of approximately 7.22%. In 2018, when Anthony became a member of the Oklahoma City Thunder, his off-court earnings decreased 12.5% while the top ten average increased 10.92%. Discussion: For this study, I would have preferred to work with a substantially larger sample. Unfortunately, I was only able to find data on the off-court earnings of the ten highest paid players each year, reported annually by Forbes. Still, I have some interesting observations about these findings which future studies could explore.

Lebron James is a once in a generation talent, and argued by many to be the greatest basketball player of all time. I expected that an athlete of his caliber would be resistant to changes in off-court earnings as a result of market size. However, in his first year returning to Cleveland from Miami, James’ off-court earnings grew significantly less than the rest of the top ten highest paid players. It cannot be determined that the move to a smaller market caused this finding, but it is a possible explanation. However, I believe it is unlikely since in the following two years James’ off-court earnings increased more than the rest of the top ten highest paid players.

In 2018, Carmelo Anthony moved from the league’s largest market, New York, to one of its smallest, Oklahoma City. Anthony has played just one season in Oklahoma City, but in the same year he changed teams he also experienced a 12.5% decrease in off-court earnings. The transition to the smaller market likely contributes partially to this decrease. Another explanation is that Anthony was paired with two other league superstars (Russell Westbrook and Paul George), and shared much more of the spotlight than he did as the focal point on the Knicks.
Another observation I had is that the growth in off-court earnings for all three athletes, James, Durant, and Anthony, showed a plateau. Despite all three players changing markets, I think this data may be more representative of market saturation than the effect of market size on earnings. These three athletes have been NBA superstars for several seasons, and eventually they will be unable to compete with the growth of the next crop of future league superstars. For these reasons, I cannot definitively confirm nor deny my hypothesis.

**Highest Off-Court Earners by Franchise Value**

**Hypothesis:** NBA athletes who play for the five most valuable franchises are more likely to be among the top ten highest off-court earners than athletes who play for the five least valuable franchises.

**Results:** To test this hypothesis, I examined what percentage of the ten players with the highest off-court earnings played for the five most valuable franchises, and the five least valuable franchises each year. In 2014, 40% of the top ten highest earning players belonged to the five most valuable franchises in 2014. From 2015 to 2017, 30% of the top ten highest earning players belonged to the five most valuable franchises each year. In 2018, only 20% of the top ten highest earning players belonged to the five most valuable franchises.

From 2014-2017, zero players from the five least valuable franchises were among the top ten highest off-court earners each year. However, in 2018 20% of the highest earning players belonged to the five least valuable franchises, which is the same amount as the five most valuable franchises.

**Discussion:** This study shows a four year trend of players from the most valuable franchises being substantially more likely to be among the top ten highest paid athletes than players from the least valuable franchises. This confirms my hypothesis, but also raises a “chicken or the egg” type of question: do the highest earning players increase franchise value, or does playing for a valuable franchise increase an athlete’s marketability and as result, off-court earnings? The answer is likely to be a combination of the two possibilities, but future research should explore ways to determine which effect is stronger.

Another notable finding from this study is the breaking of the trend in 2018. This year, there is an equal number of players in the five most and least valuable franchises represented in the top ten highest off-court earners. Giannis Antetokounmpo of the Milwaukee Bucks and Anthony Davis of the New Orleans Pelicans are the first players since 2014 to break the trend. These two athletes should serve as model examples of how an athlete can defy their market size. The Nielsen article “Cashing In: Most Marketable Athletes of 2016” explained how uniqueness and a strong personal brand can
boost an athlete’s marketability. Both Antetokounmpo, nicknamed the “Greek Freak”, and Davis with his trademarked unibrow, have strong, unique personal brands. Combined with incredible talent, these two young superstars seemed to have figured out the recipe for maximizing their earnings in a small market.

Twitter Followers by Market Size

Hypothesis: Large market teams will have more Twitter followers than small market teams, and NBA athletes that play in large markets will have more followers than smaller market players.

Results: Another way to measure an athlete’s marketability is their social media following. Among Sports Illustrated’s Top 50 NBA players of 2018, we found no correlation between number of television homes in a designated area, reported by Nielsen in 2016, and an athlete’s number of Twitter followers. Among the top 20 picks of the 2018 NBA Draft, there is a correlation coefficient of approximately 0.35 for the relationship between number of television homes and Twitter followers. I also measured the relationship between market size and a each team’s number of Twitter followers. My regression analysis showed a correlation coefficient of approximately 0.52 for this relationship.

Each point on this graph represents one NBA rookie selected in the first 20 picks in the 2017 NBA Draft. The correlation coefficient for the relationship between the number of followers and Forbes market value is approximately 0.522.
Discussion: Opendorse is an athlete marketing platform that analyzes the advertising power of athlete’s social media activity. In their article, “State of Sponsored Social Media: How athletes, teams, and leagues stack up,” they explain how the influence and engagement rate for athlete social media accounts make them so valuable to advertisers. Social media can improve an athlete’s recognition, popularity, and off-court earnings. For those reasons, I believe that social media following is an effective measure of marketability.

Social media can also be a lucrative marketing platform for each NBA organization. My correlation analysis supported my hypothesis, showing that there is an appreciable positive relationship between market size and Twitter followers on a team’s page.

I am surprised to see such little correlation between market size and Twitter followers among the league’s 50 best players, according to Sports Illustrated’s 2018 rankings. That finding cast doubt on my hypothesis. However, that list comprised of players both who had been in the league since the early 2000’s, and others who have been drafted within the last few seasons. There are many confounding variables that influence Twitter followers, like how often a player posts on Twitter, and the content that they are posting. But perhaps the most detrimental confounding variable in my analysis is how long each player had been in the league. Because of these confounds, I cannot draw any meaningful conclusions from this test.

In order to control for the amount of time a player had been in the league, I decided to run the same test with the first twenty picks of the 2017 NBA Draft Class. These players are all in their first year in the NBA during the 2017-18 season. There exist many of the same confounds from the previous test, but this this test was more reliable since all of the athletes have the same NBA experience. The correlation analysis revealed a small, but not insignificant relationship between market size and Twitter followers among these twenty rookies. This test supports my hypothesis, but does not confirm it. Future research should aim to measure this same effect while controlling for some of the other confounds.

Number of Nationally Televised Games

Hypothesis: Market size and franchise value will be stronger predictors of the number of nationally televised basketball games than on-court performance.

Result: In my regression analysis, I found no correlation between the number of television homes from in a designated area and the number of nationally televised games. The relationship between average team value from 2013-2018 and the average number of televised games each season from 2013-2018 has a correlation coefficient of approximately 0.36. The relationship between average wins from 2013-2018 and average number of
nationally televised games has a correlation coefficient of approximately 0.31.

Discussion: I am surprised to observe no correlation between number of television homes and the number of nationally televised games. I had assumed that television networks would want to air their games to the largest possible audiences. But as the data shows, this hypothesis is incorrect.

I also hypothesized that there would be a positive correlation between franchise value and the number of nationally televised games. The regression analysis revealed a weak positive correlation between franchise value and number of nationally televised games. The most valuable franchises are the most relevant and notable teams, so I had imagined that the television networks would want to showcase those teams as often as possible. However, it appears franchise value is not that significant for predicting a team’s number of nationally televised games.

The positive relationship between team wins and number of nationally televised games contradicted my hypothesis that team performance is less likely to predict number of nationally televised games than market size and franchise value. Team performance does positively correlate with the number of nationally televised games, although the correlation is fairly weak. Contrary to my expectations, team performance is a stronger predictor for the number of nationally televised games than market size.

Future research should investigate other variables that are more likely to explain how many nationally televised games each team has. This research could focus on which factors most influence viewership, since I assume that television networks want to air games that will yield the largest audiences.

General Discussion

One of my hypotheses is that larger market NBA franchises were more valuable than small market franchises. My correlational analysis showed a significant relationship between number of television homes in a designated area and franchise value. I also observed a significant relationship between the number of television homes and the number of Twitter followers on each team’s page. These findings align with the works of Alexander and Kern, and also are consistent with Humphreys and Mondello, all of which are consistent in supporting that market size is a strong determinant of franchise valuation.

Despite the massive growth of the league as a whole in recent years, there remains inequality amongst the league’s thirty franchises that is caused by differences in market size. And since team performance does not significantly contribute to franchise value (Humphreys & Mondello), how should small market teams try to narrow the gap? Alexander and Kern suggest that a new team facility can boost franchise value. But the most
effective strategy is likely the acquisition of one, or many highly marketable star players. The work of Hausman and Leonard explains the impact of a superstar NBA athlete on the franchises’ revenues, attendance, and ratings. Of course, these superstar athletes are not easy to find. The league tries to facilitate the balance of starpower by awarding the top draft selections to the lowest performing teams from the season prior. This is the league’s system to control the parity of on-court performance, but is it effective in controlling the financial parity amongst the league? Andrew James Housh argues that it is not, and that even the other control systems like luxury taxes and contract structuring do not properly balance the effect of market size on franchise value.

While market size inequality has not yet been remedied, the league is currently thriving under its current structure. As Badenhausen reports, all thrity NBA franchises are now valued at over one billion dollars. The league is growing each year, and furthering its global reach. So even if the market size gap remains, each franchise is benefitting greatly from the growth of the league. For that reason, I’m not so sure how necessary changes are to the league’s financial structure.

The other part of my hypothesis is that NBA players in large markets have more valuable brand equities than players in small markets. I found this to be much more challenging to collect data for than I had anticipated. I struggled to find concrete data on NBA athletes’ off-court earnings and sponsorships deals. I was primarily only able to find information on the league’s elite players, since Forbes publishes a list each year of the top ten highest paid players and their earnings on and off the court. I used that data, along with much more accessible data on social media following in order to test my hypothesis.

In my study, I determined that players in the most valuable franchises are more likely to be among the league’s ten highest off-court earners. Additionally, my test of the 2017 rookies’ Twitter followers showed an appreciable positive correlation between market size and marketability. However, I failed to show the same relationship when looking at the off-court earnings of Lebron James, Kevin Durant, and Carmelo Anthony since 2013. Also, the examples of Giannis Antetokounmpo and Anthony Davis represent how small market athletes can achieve superstar status and maximum off-court earnings as a result of a unique personal brand, as described by the Nielsen article, “Cashing In: Most Marketable Athletes of 2016.” Shank and Lyberger also agree that a player’s characteristics and personality determine their marketability, regardless of market size.

It seems intuitive that a player in a large market will be more marketable than a player of comparable skill playing in a small market because of increased exposure. The findings of Yang, Shi, and Goldfarb support that theory, but I was not able to find sufficient evidence to confirm
that hypothesis. If future researchers can get ahold of data on the off-court earnings of the majority of NBA athletes, then this hypothesis can be properly tested.


The Use of Blockchain in Waste Accountability

Shiv Patel

Foreword by Research Mentor, Dr. Wedad Elmaghraby

I have had the pleasure of working with Shiv Patel this Spring semester. Our interactions were few, but very effective. In our first meeting, Shiv explained that he wished to do research in blockchains, coming from the Computer Science group and wishing to explore this 'buzz' topic in the area. I discussed with Shiv several of my current research areas, and suggested that perhaps the area of electronics and e-waste as a potential fits between the application of blockchain technology and my research. Shiv took this idea and ran with it - in our next meeting, he had compiled a summary of e-waste issues that face the small electronics industry and an overview of blockchain technology and how it works. In our second meeting, I pushed him to explore in greater detail the benefits of blockchain for the specific purpose of reducing e-Waste in today's global (and very opaque) supply chains. Once again, with no more direction that a brief discussion, Shiv was able to produce an informative outline for how blockchain technology could be used, drawing from examples of its current applications and making parallels when appropriate. The final result of this research project reflects the level of commitment and ingenuity that Shiv possesses. It was a pleasure to work with him.

• Shiv Patel is a SURE Fellow in Computer Science at the University of Maryland, College Park, MD. Their email address is sp99@terpmail.umd.edu.
Abstract

Every year, new technology is released to the public consumer market, sometimes it is an innovation, and other times it is an upgrade to something that already exists. The problem lies in what to do with the electronics that are being replaced as time goes on, and what is happening to the electronic waste (E-Waste) that we as humans are creating. This study aims to explore the possible applications of blockchain technology, to track E-Waste throughout the waste management system, between waste management companies. The study will question if current methods are legal, moral, and also if there are other methods that may have better impacts and long-term effects.

**Keywords**: Electronic Waste, Blockchain, Tracking Waste, Environment, Illegal Dumping

Introduction

The objective of this paper is to dissect the layers of how E-Waste has become such a large problem that we as humans face, and find how E-Waste can result in benefits to everyone throughout the process of technology becoming a product, consumption and being recycled. E-Waste is the concept of any technology being wrongfully discarded, becoming a problem for the environment and the people nearby, due to the toxic materials that go into our technology. Blockchain is a digital technology in which a public log is kept and held, based on any action that needs to be logged. The question being asked with the concept of blockchain in minds is, “How can Blockchain be implemented into the lifecycle of an electronic device, to help eliminate E-Waste?” The importance of this study lies within the fact that E-Waste is recyclable and does not have to pose as big of a threat as it is today, however, responsibility must be taken in properly disposing and recycling the devices, this study shows how responsibility can be assured through the use of blockchain.

Review of Literature

Current Perspectives on E-Waste

As time has progressed, not only have more products been introduced into the market for consumers, insisting we must have them to make our lives easier, but the lifetime of said electronics has become increasingly shorter. In 2003, less than 80 million tiny electronics were sold, in 2008, this
number was 152 million, over a 90% growth in less than 5 years (Khurrum 2011). E-Waste currently has raised concerns because of the toxicity of some of the components in the waste and the environmental impacts that they cause. Currently, E-Waste is seen as hazardous according to the Basel Convention. Based on the assertions of the toxicity, E-Waste is now banned in landfills in many first world countries. Studies conducted also concluded that most E-Waste which was exported was unsafely disposed of in developing countries, leaving problems for countries that could not afford to fix them (American Chemical Society, 2007).

The Problem of E-Waste

A report done by the United Nations Environment Program found nearly 90% of E-Waste is illegally dumped and traded (Gordon, 2015). Alongside being hazardous due to 2.7% composition of pollutants, E-Waste is composed of 60% precious metals, including gold, aluminum, iron, and copper (Widmer et al., 2005). In 2004, at least 100 million personal computers were reported as being replaced, today E-Waste accounts for 70% of the world’s toxic waste (California Department of Toxic Substances Control, 2004). For every 500 million trashed PCs, there is approximately 2,872,000 tons of plastic, 718,000 tons of lead, 1363 tons of cadmium, and 287 tons of mercury (Puckett and Smith, 2002). The EPA reports 416,000 mobile devices and 142,000 computers are either recycled or disposed of every day, to landfills or incinerators, releasing toxins either into the ground, reaching water through runoff, or the air through combustion (Leblanc, 2017). Currently, less than 20% of all E-Waste is recycled in the United States, while more than 80% of the unrecycled waste is sent to Asia.

Current Methods and Standards

The most common methodology of E-Waste disposal is through landfills. Although this is the most popular, it is not the most sound, as substances along the lines of cadmium, lead, and mercury are released into the soil and eventually to water and plants. Incineration is also very common, as it lets the disposer take advantage of the metals that are harvested, including gold and copper. However, this method releases harmful emissions into the air. Lastly, E-Waste can also be recycled, this method takes the most effort as parts are separated and re-used. In some countries, the government operates pick up facilities to collect E-Waste from consumers (Butler, 2013).
Environmental Impacts

E-Waste can pollute the environment through three primary mediums, the air, the water, and the soil. All three routes eventually reach the human body, and heavily affect cycles that we as humans rely on to live. Whether the toxins are reaching the body living through respiration, drinking, or eating plants, humans in the area have no choice but to consume the first world plague of affluence that has been dumped on them in the form of green circuit boards. E-Waste plants often burn the waste whole, as the precious metals inside will not burn, but rather melt, releasing hydrocarbons, brominated dioxins, and heavy metals into the air (Gordon, 2015). Other times, when processing plants are not available, E-Waste can sit in massive piles, while rain can cause the runoff to reach the soil and water sources. When the toxins then reach the soil, food sources can be contaminated for long periods of time, leaving traces in even small rice grains (Grant et al, 2013).

Impacts to third world countries

The question regarding how third world countries that have no infrastructure and no means of consuming electronics end up with electronic waste arises and the answer to that is simple. They buy it. People in third world countries in Africa and parts of Asia are convinced by big companies being held responsible for their E-Waste, that, individuals can profit highly off of the contents of the shipping containers. A 40-foot tall shipping container costs 5,000 USD to transport from the US to Nigeria, while a functioning computer sells for about 130 USD (Schmidt 2006). With this in mind, buyers will buy a shipment of electronics, hoping they will have a portion of working electronics, and a large amount of electronics that would work with salvaged parts from the last portion of electronics, ones that no longer work. Alongside this are other goods that can be found in the shipping containers, including hard drives and most frequently, electronics for parts, for parts to repair first-world electronics with, electronics that would be too costly to just replace. After mountains of E-Waste are transported to great lengths, it sits. It sits in the massive pile erected from a 40 feet tall shipping container, open to the public, once the buyer realizes there is no remaining profit.

Exposure to the toxic metals that are left behind by E-Waste, including lead, leads to pulmonary and cardiovascular disease, as shown by multiple studies (McAllister, 2013). It is difficult to isolate all of the health problems because third world countries already have poor working conditions and sanitation, that do not help alongside the fine lead particulate in the air.
Guiyu is a city in China known as one of the largest E-Waste recycling sites in the world, the cities’ residents are known for substantial bodily functions failing, including in the digestive, neurological, and respiratory tracts. More than 80% of children born to Guiyu’s residents experience respiratory illness (McAllister, 2013). A study done in Guiyu also found airborne dioxins to be 100 times more prevalent than elsewhere (Gordon, 2015). Guiyu is a prime example of the effects dumping first world problems on people that do not have the means of fixing them.

**Profits in E-Waste**

A study done by the United Nations University determined an estimated 48 Billion Euros were being disregarded through the opportunities in recycling E-Waste, converted that equals about 58.92 Billion USD (Baldé et al. 2017). E-Waste contains precious metals that would make extracting the chemicals and removing the hazardous materials profitable. More than 60 elements from the periodic table can be found in complex electronics, and most of them are rectifiable. E-Waste can be seen as a potentially great source of the resources needed for electronics, keeping the resources made for electronics in the same cycle. The gold salvaged from recycled E-Waste equaled 11% of the gold produced from mines in 2013 (USGS 2014).

**Rising popularity of blockchain**

An Ars Technica writer describes the need for blockchain for “when everyone distrusts each other (Dabbs 2016).” However, blockchain revolves less around distrust and more around the concepts of public and decentralized. It aims to ensure that no one person can leverage control over another, due to control over the logbooks that blockchain writes to and confirms with. The idea of no single entity in control of anything has always been an idea, and can be proven by a simple concept in our government - the separation of powers through checks and balances between the three branches.

Blockchain is now growing far beyond just cryptocurrency, according to a study done by IBM about 80% of 3,000 business executives in several industries, including manufacturing, technology, banks, media, and telecommunications indicated they were planning on implementing blockchain technology into their operations (Loeb, 2017).

**How blockchain leads to responsibility**

Blockchain is defined as “a continuously growing list of records, which are linked and secured using cryptography (Narayanan et al, 2016).” While the term blockchain is used heavily around cryptocurrency, it has many other applications. Blockchain is solely meant to decentralize records
and to publicize them. Anyone can access said records, and no one can falsify them, due to the fact that to “write” to the records, you must have confirmation from more than half of the contributing computers. The decentralization while security is very enticing in areas like currency, but it can be applied anywhere to quickly eradicate corruption and make records of responsibility public.

**How blockchain can be implemented in E-Waste Management**

One of the largest problems with E-Waste management is the ability to not track the waste from step to step. At one point, a waste management company has the waste, and at another, it is gone, without a trace, when in reality the waste has been illegally dumped or is being shipped to a country with lax laws that can be exploited. With blockchain, officials, and also consumers are able to track if the waste management companies are doing what they are claiming. Blockchain was designed in 2008 by Satoshi Nakamoto, to solve “double spending” problems, otherwise stated, doing one thing with the currency and falsifying files to show something else was done (Popper 2016). Therefore, all files were publicized and to make a change to them, more than half of all participating computers had to agree that the action was completed. For actions to be recorded in the logs as to have happened the actions must be publicly reported.

If we transfer these constraints into a scenario for E-Waste management, it would ensure that from creation to recycling, the product was not only tracked, but its fate is also public. Blockchain can also help the industry in many other ways, if a recall were to happen, the blockchain logs would be able to track every single unit that had the faulty component, and only the ones that need to be recalled and altered (Haimes, 2017). This would save money for the manufacturer, only having to recall the exact units, and would save a hassle on the consumers part, ensuring that chances are slim there is a mistake and that their product does not actually need to be recalled.

**Theoretical Framework and Research Methodology**

This explorative analysis dissects reasons for why a solution for illegal electronic waste disposal should be implemented. I have used datasets from scholarly articles, other research done on electronic waste, and reports done by the United Nations. From this research, I hope to understand if there truly is benefit to the waste that is overlooked and if the benefits outweigh the simplicity of continuing what is currently happening.

Primarily, I referred to research published in “MDPI” as it leads to many more credible sources and different viewpoints on a plethora of different situations. I also used many different concepts defined by the United Nations, including scales for how hazardous different types of
pollutions were, legalities for disposal of waste internationally, and legalities for pollution that can affect nations not causing the pollution.

I did not choose a location to fixate my research on, as the electronic waste phenomenon is global and the impacts do not discriminate. It was also important for me to keep a wide global approach to ensure I was tackling the issue of exporting waste to developing countries. Had I taken an approach based on a strict list of countries, I would need to ensure a diverse list that incorporates many features that may be unique to certain countries. This would result in a list that would accumulate to the list of countries that releases official reports regarding country statistics, which was the data that I focused on.

**Data Analysis**

As the rate at which technology improves advances, it is easy to forget about the other end of the situation, how we handle removing the old technology from consumers’ hands. There was a 90% growth in electronic sales from 2003 to 2008, raising concerns as technology is being purchased and trashed at alarming rates.

**Correlation Between Affluence and Waste**

As can be seen in figures 1 and 2, there is a direct correlation between GDP of a country and electric waste per capita. This trend can be seen throughout different continents and exists beyond the Americas.
In the research done by Sigrid Kusch and Colin D. Hills, the findings suggested if a country’s GDP was known, electric waste generation was “easily calculated through simple linear correlation” giving emphasis on how well GDP and E-Waste are linked together.
Alongside GDP, population is also shown to have correlation with E-Waste Generation per capita, as countries with high or average GDPs had consistent E-Waste generation per capita, throughout all types of population sizes. For Example, Canada, with almost a tenth of the United State’s population, still managed to produce within 2 kilograms of electric waste per capita, of what the United States produced, as can be seen in figure 3.

<table>
<thead>
<tr>
<th>Country</th>
<th>E-Waste Generation (kt)</th>
<th>E-Waste/Capita (kg)</th>
<th>Population (Million)</th>
<th>GDP (Billion USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>725</td>
<td>20.4</td>
<td>35.5</td>
<td>1,786.7</td>
</tr>
<tr>
<td>United States</td>
<td>7072</td>
<td>22.1</td>
<td>319.7</td>
<td>17,419.0</td>
</tr>
<tr>
<td>Germany</td>
<td>1769</td>
<td>21.6</td>
<td>81.5</td>
<td>3,852.6</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1511</td>
<td>23.5</td>
<td>642.7</td>
<td>2,941.9</td>
</tr>
<tr>
<td>Japan</td>
<td>2200</td>
<td>17.3</td>
<td>127.1</td>
<td>4,601.5</td>
</tr>
<tr>
<td>Switzerland</td>
<td>213</td>
<td>26.3</td>
<td>8.1</td>
<td>685.4</td>
</tr>
<tr>
<td>Belgium</td>
<td>242</td>
<td>21.4</td>
<td>11.3</td>
<td>533.4</td>
</tr>
<tr>
<td>Australia</td>
<td>468</td>
<td>20.0</td>
<td>23.4</td>
<td>1,453.8</td>
</tr>
<tr>
<td>China</td>
<td>6033</td>
<td>4.4</td>
<td>1367.5</td>
<td>10,360.1</td>
</tr>
<tr>
<td>India</td>
<td>1641</td>
<td>1.3</td>
<td>1255.6</td>
<td>2,066.9</td>
</tr>
<tr>
<td>Brazil</td>
<td>1412</td>
<td>7.0</td>
<td>201.4</td>
<td>2,346.1</td>
</tr>
<tr>
<td>Mexico</td>
<td>958</td>
<td>8.2</td>
<td>117.2</td>
<td>1,282.7</td>
</tr>
</tbody>
</table>

Figure 3: Electronic waste generation by country (Kumar, Holuszko, 2016).

Value Within Waste
An important reason as to why E-Waste should not be ignored is because of the value it possesses. Electronics are built out of valuable metals that can easily be recycled. As can be seen in Figure 4, many valuable metals are found in the E-Waste stream, but less than 20% of E-Waste is recycled, leading to less than 20% of the value in the metals being recovered (Kumar, Holuszko, 2016).

<table>
<thead>
<tr>
<th>Material</th>
<th>Amount (kt)</th>
<th>Value (Million USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron/Steel</td>
<td>16,500</td>
<td>10,005.3</td>
</tr>
<tr>
<td>Copper</td>
<td>1900</td>
<td>11,784.0</td>
</tr>
<tr>
<td>Aluminium</td>
<td>220</td>
<td>3,557.4</td>
</tr>
<tr>
<td>Gold</td>
<td>0.3</td>
<td>11,561.7</td>
</tr>
<tr>
<td>Silver</td>
<td>1.0</td>
<td>644.8</td>
</tr>
<tr>
<td>Palladium</td>
<td>0.1</td>
<td>2,001.1</td>
</tr>
<tr>
<td>Plastics</td>
<td>8600</td>
<td>13,673.9</td>
</tr>
</tbody>
</table>

Figure 4: Value of materials found in an electronic waste stream (Kumar, Holuszko, 2016).

While the obvious value in recycling E-Waste comes from the aspect of the valuable metals and their worth, there is another aspect of the resources that can be seen as an abstraction. Before the materials can be used, they must be processed from their virgin forms, raw metals are not used in the production of electronics. However, when the metals are sourced from recycling, they do not need to be processed once more, and as figure 5 shows, the energy savings from using recycled resources is staggering. The energy savings, coupled with the fact that the materials do not need to be purchased once more, results in massive savings for companies that recycle their electronic waste instead of exporting or illegally dumping it.

<table>
<thead>
<tr>
<th>Materials</th>
<th>Energy Savings (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>95</td>
</tr>
<tr>
<td>Copper</td>
<td>85</td>
</tr>
<tr>
<td>Iron and steel</td>
<td>74</td>
</tr>
<tr>
<td>Lead</td>
<td>65</td>
</tr>
<tr>
<td>Zinc</td>
<td>60</td>
</tr>
<tr>
<td>Paper</td>
<td>64</td>
</tr>
<tr>
<td>Plastics</td>
<td>&gt;80</td>
</tr>
</tbody>
</table>

Figure 5: Energy savings of using recycled materials, compared to virgin materials
Figure 6 shows the amount of money that is saved by recycling electronic waste, compared to disposing of it through landfills, which is almost four times the amount. Money can be saved in various parts of the recycling of E-Waste, including energy savings from recycling, and saving money from raw material costs. In Canada, many provinces have already banned landfilling of electronics due to the toxic runoff that is caused by the landfills, but another important factor that can be deduced is the amount of money one saves by not opting to go the route of landfilling. Landfilling is often done due to the aspect of it being both cheap and easy, but if recycling can save money on three different fronts, landfilling can no longer logically be seen as cheap.

<table>
<thead>
<tr>
<th>Provinces</th>
<th>Landfill Disposal (CAD)</th>
<th>Recycling (CAD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nova Scotia/Prince Edward Island</td>
<td>1,422,988</td>
<td>5,538,126</td>
</tr>
<tr>
<td>British Columbia</td>
<td>12,892,167</td>
<td>23,935,296</td>
</tr>
<tr>
<td>Ontario</td>
<td>15,036,631</td>
<td>65,336,476</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>1,756,748</td>
<td>4,568,741</td>
</tr>
</tbody>
</table>

Household Disposal Tendencies

An excuse that is maintained throughout the appointment of responsibility for E-Waste, is the fact that consumers ultimately have the last say in what happens to their devices, and the reasons so many electronic devices end up in places they should not be is because of the actions of the consumer. This excuse removes everyone from responsibility due to the fact that once a consumer purchases the device, it is theirs and they can use and decide when and how they would like to get rid of their electronics. However, research done by Amit Kumar and Maria Holuszko published in “Electronic Waste and Existing Processing Routes” shows that households are more likely to dispose of their electronics through specialized drop-off centers compared to households that did not have access to the same disposal methods. Households are also likely to recycle their devices in other ways, like selling them or repurposing them, or not disposing of them at all. When looking at figure 7, it can be seen that less than 10% of all electronics in the categories given were disposed of through the garbage waste system, which is not meant for electronics.
Figure 7: Methods of disposing electronics in Canada, by category (Kumar, Holuszko, 2016).

**Exporting and Lack of Tracking**

Figure 8 demonstrates main destinations and sources of the electronic waste. Many locations in Asia have started E-Waste recycling operations, due to how profitable it can be. While there are recycling operations, other times, waste is shipped out to Asia on the sole basis that waste management is cheaper. Waste management in Asia is cheaper due to lesser restrictions on pollutants and waste treatment methods. Due to the more lax pollution laws in Asia, companies are allowed to poorly dispose of the materials, which has an obvious impact locally, however, many times the impacts can be felt globally.

In an attempt to reason why E-Waste was being sent to different locations, Karen Lundgren attempted to track the E-Waste overseas and her research published in “The global impact of E-Waste” found:

“In general, small-scale exports go to West Africa while the larger and sometimes more structurally organized transports go to SouthEast Asia (Basel Convention. n.d.(a)). It is estimated that China receives the highest proportion of all E-Waste – about 70 percent and rising. However, there are no confirmed figures available on how substantial these transboundary E-Waste streams are.”
Due to the lax regulations regarding waste and waste management, large developed countries like America and England are top exporters to developing countries, as illustrated in figure 9. Regulations can be seen lax in the importing countries, due to the factor that they are not developed, and they see the possibility of old generation technology to be an influx from what electronic development is happening natively.

The largest proponent to implementing blockchain into the supply chain of any market is the infancy of blockchain. Blockchain is a new technology, however manufacturers from all angles are developing systems to take advantage. In example, IBM has been working alongside blockchain technology since 2016, adapting parts of it into their supply chain, and also into their service based side (Lielacher 2018). Blockchain has also been
implemented in criteria outside of technology, like clothing, clothing companies are attempting to use blockchain to assure the end consumer that their products were made in healthy working conditions (CGS 2018). The only real impediment blockchain faces is it’s own age, which will resolve itself as more companies realize the benefits being seen by early adopters, like IBM.

Blockchain is a free and open source platform, allowing users to conform it to their own liking, and this can be seen with the plethora of cryptocurrencies that launches after Bitcoin’s success - it is easy to implement. Blockchain can be used in many different use cases, and there endless possibilities. Blockchain can lead to opportunities in a plethora of fields, and the largest one in E-Waste is profitability. E-Waste changes the aspect in which manufacturers see waste as a burden and responsibility, into a profitable task that can be marketed towards the being more “green” platforms.

Conclusion

The dangers of amassing electronic waste are present, and the repercussions can be seen globally. We can no longer push this issue to another day because the backlash is felt today. We can no longer turn a blind eye to the third world nations which first world countries have exported their problems to, as the problem has come back to us in the form of imports. We now import foods grown in contaminated soils, doused in infected waters, and osmosed through polluted air. If a solution is present today, why would we wait until tomorrow? An infamous Chinese Proverb, “The best time to plant a tree was twenty years ago, The second best time is now,” explains our current situation, the damage is done and we are overdue in curing the plague caused by first world affluence.

While many may not see environment or global conditions as reason enough for accountability in wasteful habits, implementing blockchain into an electronic device’s life cycle can also provide a plethora of benefits ranging from financially to ease of use. Blockchain implementation can track costs to a precision never before seen and can provide improvements in production, speed, error reduction, and trend following, all through the principle of an electronic ledger that tracks simple actions. Before an electronic even reaches its end-of-life, electronic manufacturers benefit greatly, but benefits can also be found through proper waste management.
References


Dabbs, A. (2016, November 6). What is a blockchain, and why is it growing in popularity? Retrieved from https://arstechnica.com/information-
technology/2016/11/what-is-blockchain/


The Effect of State-Level Corruption on the Likelihood and Success of Corporate Investment in Four Indian States

Ashwin Suryavanshi

Foreword by Research Mentor, Dr. Mircea Raianu

India is one of the world’s fastest growing economies, with an especially vibrant private sector, yet it has also become notorious for widespread bureaucratic corruption. Ashwin Suryavanshi’s paper explores the relationship between corruption and company success or viability in India’s four largest states by GDP. Its main objective is to empirically investigate whether such a relationship exists, and to introduce the factor of state-level variation (often absent in the literature).

Making innovative use of the database Indiastat, and carefully working around its limitations, Ashwin shows how states like Gujarat (widely held up as a model of successful Singapore-style development) and Uttar Pradesh (India’s largest, poorest, and ostensibly most dysfunctional state) are perhaps more similar than different. Maharashtra, the large state surrounding the urban economic hub of Mumbai, leads in both corruption and new company registration.

Ashwin’s inquiry is potentially instructive to corporate decisions about where to invest in India. It should stimulate further research on this topic, using more complete data. Above all, it is a reminder to pay close attention to rapidly shifting political and regional landscapes in emerging markets. Yesterday’s basket case may well turn out be tomorrow’s land of opportunity.

• Ashwin Suryavanshi is a SURE Fellow in Government & Politics at the University of Maryland, College Park, MD. Their email address is asuryava@terpmail.umd.edu.
Abstract

How much of an impact does corruption, at the state level, have on the success of companies and their willingness to invest in the respective state in the first place? Should a company invest its time and money into building an office in a certain Indian state if they know local corrupt practices can eventually hurt their business? Using a quantitative case study analysis, this project aims to answer these questions regarding corporate investment and to inform foreign information technology (IT) industry leaders looking to invest in India. Given India’s federalist system, and high variation between state’s economies, a state-level analysis is necessary to effectively answer the questions this paper poses. This case analysis focuses on the four Indian states with the highest nominal gross domestic product (GDP): Maharashtra, Uttar Pradesh, Tamil Nadu, and Gujarat. This is the first case analysis that focuses on the four most productive Indian states and how corruption in those states affects the likelihood and success of corporate investment. Using data from India’s Centre for Media Studies and IndiaStat, the paper examines the correlation/relationship between corruption levels in the state and the success of IT companies in that respective state in the timeframe of 2012-2016.

Keywords: India, FDI, corruption, corporate investment, information technology

Introduction

The phenomenon of petty corruption can be more than just a nuisance to average citizens who have to bribe local government officials to receive any kind of service. It may also affect how successful businesses are, and in the long run, affect how willing companies are to invest in a given area where various forms of petty corruption are prevalent. Bribery is commonplace across India, especially in large cities where wealth is more concentrated, according to open-source research conducted by Bangalore-based non-governmental organization, Janaagraha. This paper will explore where in India corruption is most prevalent, and what effect this corruption has on the success of new businesses in those states. The four states studied in this paper, Maharashtra, Uttar Pradesh, Tamil Nadu, and Gujarat, have the highest gross domestic product (GDP) (see ‘Research Methodology’ section), and would seemingly be some of the most attractive places for investment in India. As is seen in Figure 1 below, the IT industry in India has more than doubled in the last seven years (NASSCOM). The India Brand Equity Foundation (IBEF) states that this growth will continue because “the internet industry in India is likely to double to reach $250 billion USD by
2020” (IBEF). With such unprecedented growth, IT investment is integral to overall foreign corporate investment into India.

The main variables of this paper’s quantitative analysis are petty corruption, bureaucracy, companies struck off, and new company registration. Petty corruption is a major contributor to the “bureaucratic inefficiency” of a state. Transparency International, an international corruption watchdog that releases an annual Corruption Perception Index, states that “petty corruption refers to everyday abuse of entrusted power by low- and mid-level public officials in their interactions with ordinary citizens, who often are trying to access basic goods or services in places like hospitals, schools, police departments and other agencies” (Transparency International). Bureaucracy, or bureaucratic efficiency and inefficiency, refers to a system designed to maintain uniformity and controls within an organization. Bureaucracy is often associated with slowness, inefficiency, and redundancy in everyday tasks by some governing body. This paper will refer to low- and mid-level bureaucrats to describe government employees who are responsible for providing a public product or service to the average Indian citizen. According to Asuman Altay, the above conditions are “likely to reduce economic efficiency of the public provision” (Altay, 42). When referring to “companies struck off,” according to Business Dictionary, it means that a formerly registered or incorporated company is removed from the government’s registrar of companies due to either cessation of business activities, or because of the inability to file forms on time (Business Dictionary). Conversely, new company registration refers to a corporation officially joining the government’s registrar of incorporated companies.
These variables will be used to determine whether petty corruption by low- and mid-level bureaucrats has any effect on how successful new businesses in India can be, and on the potential impact that this relationship might have on whether such a company decides to invest in India in the first place. Although this paper only analyzes data between 2012 and 2017, it may offer lasting lessons for both scholars and business leaders looking to invest. Corruption in most large bureaucracies, such as the Indian state apparatus, has always been present and very difficult to control. Based on the massive population of India, corruption, in some capacity, will remain a key feature of the Indian economic landscape, and thus will need to be taken into consideration when making investment decisions for the foreseeable future. With the answer to this research question, companies and their executives can make more informed and strategic overseas investment decisions. Studying a country like India is important because of its unprecedented growth and continually increasing number of overseas investments into this newly thriving region. With a plethora of cheap labor and increasing demand from their massive market, India has become a hotbed of corporate investment, boasting annual economic growth rates upwards of 7% in 2016, according to the World Bank. By comparison, the United States’ economic growth rate in 2016 was just 1.5% (World Bank). With such large magnitudes of investment, and a potential correlation between bureaucratic inefficiencies and the success of this investment, there is a large amount of money at stake for companies looking to make the highest return on investment. As more and more companies become attracted to invest in India, knowing where to invest becomes an increasingly salient topic of consideration.

Literature review

Bureaucratic efficiency

German sociologist Max Weber continues to provide the standard definition of bureaucracy. Weber describes bureaucracy “largely as a synonym for a system of relations based on rational-legal authority.” According to Weber, bureaucracies have many characteristics: they are large organizations, they have full-time employees that are appointed, retained, or promoted based on their performance, they have hierarchical structures mandated by written regulations, and they specialize in certain tasks (Niskanen, 21). The employees in this complex matrix of various bureaus thus make up the “bureaucrats.”

One important fact to note, as political scientist Canice Prendergast argues, is that bureaucrats are not rewarded for their work. For example, police officers are not rewarded by the number of people they arrest, but by
the mean in which they do so. If a police officer complies with the rules and regulations of the bureau, he or she will be rewarded as a result. However, Prendergast shows how this type of oversight can often result in inefficiency in the work bureaucrats conduct. Following the above example, perhaps police officers can do their job more quickly if they did not need to read out the Miranda rights of the offender. Rules and regulations such as these keep people come citizens safe from an overpowering government. However, the result is that it takes a lot of time and energy to ensure public satisfaction (Prendergast, 929-931).

India’s bureaucracy

As the world’s largest democracy, India’s massive government is often perceived as slow, inefficient, and plagued by corruption. Based on a study conducted by Political and Economic Risk Consultancy (PERC), India’s bureaucracy was ranked the worst in Asia, behind China, Philippines, Vietnam, and Indonesia. The report cited complaints of inadequate infrastructure, corruption, and expensive bribery (PERC, 1).

Economically, India has grown dramatically over the last two decades. India has soared to become one of the five largest economies in the world, and has shown a strong increase in GDP growth from year to year. They have done this despite, as Gurcharan Das argues, a crippling slow and inefficient government and very little provision of public goods. This is the opposite of India’s former socialist regime, in which most of the output came from government investment and the public sector. Das states that “now, the old centralized bureaucratic Indian state is in steady decline” (Das, 9).

Another key facet of India’s bureaucracy is the federalist system in which it operates. Despite India’s strong overall economic growth, each of the 29 Indian states has varying economic success due to the ability of each state to set its own economic and political agenda. The reason this analysis focuses on state-level data is because of this federalist system in which each state is so different. Looking at India at an aggregate level would not be as useful because the corruption levels and strength of various other institutions vary so greatly.

Corporate Investment In India

Indian economists Ramesh Jangili and Sharad Kumar have identified several factors that influence corporate investment decisions such as “firm size, dividend payout ratio, effective cost of borrowing, cash flow ratio and growth in value of production” (Jangili and Kumar, 2). This paper argues that the business climate at the state level, measured by various corruption indices, also plays a key role in determining the extent of new corporate investment in the IT sector. This is an often overlooked component, even in studies specifically focused on the business environment in India. For
example, Kiichi Tokuoka’s study of the post-financial crisis slowdown in corporate investment in India does not explicitly measure corruption and bribery at the state level as explanatory variables (Tokuoka, 16).

**India’s Software Industry**

John T. McManus shows how, regardless of party affiliation, Indian politicians at both the federal and state levels have been heavily interested in the software industry and place an emphasis on this industry’s growth. As a result, the software industry “significantly benefited from the reforms that the Indian government gradually implemented over a span of two decades, particularly from the policy measures pertaining to de-regulation and economic liberalisation” (McManus, 42). However, McManus’ study focuses on India’s software industry versus China’s at an aggregate level, rather than breaking India down into its highly diverse states. There is so much regional variance from state to state IT sectors that looking at Indian IT on an aggregate level is almost pointless. Bangalore, a large city in southern India, has recently emerged as “India’s Silicon Valley” and according to Public Radio International (PRI), a global non-profit media company focused on the intersection of journalism and engagement, Bangalore will actually overtake Silicon Valley as the largest IT cluster in the world (PRI, 1). Gurgaon, a large city in northern India, has had similar success in the IT industry and now “has every major telecom player” within city lines (BBC). Although there are cities like Bangalore and Gurgaon, there are also cities like Putna, where the economy is largely agriculture-based, or cities like Surat, which is known as the diamond capital of the world (Surat Municipal Corporation, 1). Such diversity in the roles that IT plays in an Indian state’s economy demonstrates the need for a state-level analysis when seeing if corruption has any effect on the success of foreign direct investment in India.

Looking ahead, Anthony D’Costa and E. Sridharan discuss the potential challenges to innovation capacity in India’s software industry, as well as the fact that India’s government is heavily dependent upon the industry for stronger economic growth. D’Costa states that “considerable hope has been pinned on the sector’s ability to address India’s chronic developmental problems of low growth, unemployment, balance of payments deficits and technological backwardness” (D’Costa, Sridharan, 1). It therefore becomes important to study how corruption and bureaucratic inefficiency will affect the success of the IT industry in the long run.
Data Analysis

The four states in focus - Maharashtra, Uttar Pradesh, Tamil Nadu, and Gujarat - were chosen because they have the four highest nominal gross state domestic products (NITI Aayog). As stated earlier, the decision to focus on these states specifically was made to avoid historically low production skewing the results of magnitude of investment and to prevent other uncontrolled factors from negatively affecting the success of investment.

This case study analysis uses datasets from IndiaStat, India's largest resource of socio-economic statistical information. IndiaStat provides secondary level socio-economic statistical information about India, its states, regions, and sectors. Under the “Companies” tab, IndiaStat provides “data relating to a number of government, non-government, and foreign companies classified by paid-up capital and broad industry groups” (IndiaStat). One benefit of this source is the wide variety of information one can gather from the available datasets. IndiaStat offers credible information on 33 socio-economic categories, and dozens of sub-categories of information within those 33. One downfall of these datasets, however, is that they do not have state-level and sector-specific information about the IT sector over time. IndiaStat has information about the IT sector compared to other sectors in India, but does not contain a dataset that compares just the IT sector of individual states.

One of the variables chosen was the number of Central Bureau of Investigation (CBI) Court Corruption Cases, available for the year 2012. The differences between the four states are examined. If the total number of cases in these four states added together represent 100%, Maharashtra has the highest proportion of cases with about 34.5% of the total, while Gujarat has the lowest amount with 18.7%.

The next variables studied were the number of companies struck off in these four states in 2014-2015 (Figure 2) and the number of new companies registered in these four states in 2013 (Figure 3). Maharashtra had a staggeringly high number with 1664 companies struck off, while Uttar Pradesh had just over 500. While a significantly higher number of companies were struck off in Maharashtra compared to the three other states, another notable finding is the very similar number of companies struck off the register in Gujarat and Uttar Pradesh.

Lastly, corruption is measured using data from a Corruption Study produced by India’s Centre for Media Studies (see Figure 4). From this figure, one can see that Uttar Pradesh had a massive decrease in percentage of households experiencing corruption in public services from 2005 to 2017 while the other three states had either much smaller decreases or even small increases in the same statistic. This is actually fitting with the fact from
Figure 2 that Uttar Pradesh also had the least number of companies struck off in 2014-2015.

The working hypothesis of this paper is that the states with a higher number of CBI court cases will have a proportionately low number of new companies registered in the respective state, and a higher number of companies struck off. Figure 3 shows the relationship between the number of CBI court cases in the four states and the number of new companies registered in the following year in the same states. The acronym “TGUM” stands for the initials of the four states in the order they are presented on the x-axis. The percentages on the y-axis represent the percent of cases/companies out of these four states combined. In Gujarat, Tamil Nadu, and Uttar Pradesh, the percent of the of new companies registered are proportionately lower than the percentage of the CBI court cases. However, for Maharashtra, despite the much higher percent of CBI court cases, there is a proportionately higher number of new companies registered the following year.

The actual percentages on the x-axis in Figure 3, and the percentages relative to the other states are less important than the percentage of new companies registered compared to the percentage of CBI court cases of the same state. Theoretically, if these two variables were unrelated, the percentages for the two variables would be similar. For example, no relation between CBI corruption court cases and new companies registered would result in a state with 20% of the total of all four states’ corruption court cases also having around 20% of all the new companies registered among the four states. If the city of Mumbai, for example, represented 50% of the CBI corruption court cases from all four states, it would also have approximately 50% of all the new companies registered from all four states. Representing these figures this way prevents the size of the state’s economy from skewing the results.

Figure 2
Figure 3
Figure 4

Households Experienced Corruption in Public Services (in %)

<table>
<thead>
<tr>
<th>State</th>
<th>2005</th>
<th>2017</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Himachal Pradesh</td>
<td>53</td>
<td>3</td>
<td>-50</td>
</tr>
<tr>
<td>Bihar</td>
<td>74</td>
<td>26</td>
<td>-48</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>59</td>
<td>14</td>
<td>-45</td>
</tr>
<tr>
<td>Odisha</td>
<td>60</td>
<td>19</td>
<td>-41</td>
</tr>
<tr>
<td>Chhattisgarh</td>
<td>51</td>
<td>13</td>
<td>-38</td>
</tr>
<tr>
<td>Delhi</td>
<td>49</td>
<td>16</td>
<td>-33</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>55</td>
<td>23</td>
<td>-32</td>
</tr>
<tr>
<td>Assam</td>
<td>49</td>
<td>18</td>
<td>-31</td>
</tr>
<tr>
<td>Haryana</td>
<td>50</td>
<td>19</td>
<td>-31</td>
</tr>
<tr>
<td>Kerala</td>
<td>35</td>
<td>4</td>
<td>-31</td>
</tr>
<tr>
<td><strong>Uttar Pradesh</strong></td>
<td><strong>50</strong></td>
<td><strong>19</strong></td>
<td><strong>-31</strong></td>
</tr>
<tr>
<td>Jammu &amp; Kashmir</td>
<td>69</td>
<td>44</td>
<td>-25</td>
</tr>
<tr>
<td>West Bengal</td>
<td>46</td>
<td>21</td>
<td>-25</td>
</tr>
<tr>
<td>Jharkhand</td>
<td>48</td>
<td>24</td>
<td>-24</td>
</tr>
<tr>
<td>Punjab</td>
<td>50</td>
<td>42</td>
<td>-8</td>
</tr>
<tr>
<td>Gujarat</td>
<td>43</td>
<td>37</td>
<td>-6</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>59</td>
<td>68</td>
<td>9</td>
</tr>
<tr>
<td><strong>Maharashtra</strong></td>
<td><strong>39</strong></td>
<td><strong>57</strong></td>
<td><strong>18</strong></td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>54</td>
<td>74</td>
<td>20</td>
</tr>
<tr>
<td>Karnataka</td>
<td>57</td>
<td>77</td>
<td>20</td>
</tr>
</tbody>
</table>

Conclusion

The relationship between corruption and the success and magnitude of investment is not definitive. This is primarily due to limitations of the data, in particular, the lack of data that looks at IT sector-specific in various Indian states. The paper has sought to establish state-level variation as a key determinant of business investment and success, but eventually focused more on general corporate investment rather than IT investment specifically. While no direct correlation between the corruption index used and new
company registration was observed, certain anomalous results suggest the need for future research. For example, Maharashtra experienced a high increase in public services corruption, yet still had great success in getting new companies registered. An additional area of study is finding the reason as to why Gujurat and Uttar Pradesh had such similar figures of companies struck off, but Gujurat had a much smaller decrease in the percentage of households that experienced corruption between 2005 and 2017.
REFERENCES


An Analysis of the Relation Between Class Rank on Financial Literacy Levels in an Undergraduate Business School

Jonathan Taylor

Foreword by Research Mentor, Dr. Sandra Loughlin

Jonathan Taylor has been passionate about financial literacy since high school. During my first meeting with him, I was struck by Jonathan's desire to use the SURE research project to impact education the Smith School, so we worked together to craft an action-oriented research plan focused on undergraduate business students. Jonathan began by mapping out the timeline for the project, which caused him to appreciate the complexity of human subjects research. Next, he examined the literature to answer several critical questions: why is financial literacy important for business students, what do we already know about the degree of literacy in this population and what do we still need to learn, and how have previous researchers measured financial literacy. From that grounding in the literature, Jonathan devised a plan to recruit participants and then set out to obtain IRB approval to collect data. At present, Jonathan is engaged with the rigorous, iterative IRB approval process and we anticipate data collection to occur in the Fall 2018.

Jonathan has grown significantly as a result of this SURE process. He has learned how to plan for and manage a complex project, communicate effectively with individuals in leadership positions, manage his time and expectations in an dynamic space, effectively measure a latent construct, apply human subjects research methodology, and write an internally-coherent manuscript grounded in the literature. It has been my pleasure to advise Jonathan this semester and watch him develop toward a bright, professional future.

Jonathan Taylor is a SURE Fellow in the Robert H. Smith School of Business at the University of Maryland, College Park, MD. Their email address is jhay8921@terpmail.umd.edu.
Abstract

Financial literacy is an important and complex issue, forming the foundation for responsible decision-making, adequate savings, avoiding financial stress, and maximizing financial satisfaction. Though a large amount of research has been conducted on the general college population, there is little research focusing on business students; in addition, few studies analyze the correlation between factors such as class rank and level of financial literacy. This study used a comprehensive test instrument to analyze the financial literacy of undergraduate business students, as well as to explore the impact of a traditional business education on student financial literacy. The level of financial literacy among business students is hypothesized to be comparable to that in the literature, with seniors scoring higher than freshman, on average.

Introduction

Financial literacy is important for the success of individuals and society (Brown, Collins, Schmeiser & Urban, 2014; Danes & Hira, 1987; Gale, Harris & Levine, 2012; Hastings, Madrian & Skimmyhorn, 2013). Financial literacy, “... the ability to use knowledge and skills to manage financial resources effectively for a lifetime of financial well-being” (USA, 2007), is associated with desirable financial behaviors, such as paying bills on time and saving for retirement (Chen & Volpe, 1998; Hastings, Madrian & Skimmyhorn, 2013; Lusardi, 2013). Likewise, low levels of financial literacy have been shown to be detrimental to financial well-being in a multitude of ways. Low levels of financial literacy correlate with lower likelihood of having an emergency fund, having a checking account, and saving for retirement (Brown, Collins, Schmeiser & Urban, 2014; Gale, Harris & Levine, 2012). Low levels of financial literacy have also been attributed to higher rates of delinquency on debt, higher levels of debt, and higher participation in high-cost borrowing such as payday loans (Brown, Collins, Schmeiser & Urban, 2014; Gale, Harris & Levine, 2012; Hastings, Madrian & Skimmyhorn, 2013).

Financial literacy has long been important, but it is becoming critical as the burden of financial decision-making continues to shift away from institutions and towards individuals. Whereas defined benefit plans, such as pensions, used to once be the norm, defined contribution plans, such as 401(k)s, have since become standard, requiring individuals to possess financial knowledge and literacy in order to understand and make appropriate saving and investment decisions regarding their retirement savings (Chen & Volpe, 1998; Hastings, Madrian & Skimmyhorn, 2013; Lusardi, 2013; Volpe, Chen & Pavlicko, 1996). This shift from defined benefit plans to
defined contribution plans has also been accompanied by the increase in complexity in the financial markets, due to the entrance of new financial products. Such products include investment instruments such as index and exchange-traded funds (ETFs) as well as credit instruments, such as credit cards, ARMs (Adjustable Rate Mortgages), all of which have been accompanied by changes in financial regulation (Hastings, Madrian & Skimmyhorn, 2013; Lusardi, 2013). These changes in the financial landscape require newer generations of individuals to possess more financial literacy than previous generations, in order to manage their finances appropriately.

As important as financial literacy is, the literature consistently shows low levels of financial literacy among all age groups, with younger age groups demonstrating the lowest levels of financial literacy. The results of the 2012 National Financial Capability Study, administered to over 25,000 Americans, found that only 55% of the Silent Generation (defined as being born before 1945) are “financially literate”, defined as answering four or more questions correctly on a five question test. The financial literacy of historically underrepresented populations is particularly concerning. Racial minorities, females, and those with smaller incomes or without bank accounts consistently score lower on financial knowledge tests (Chen & Volpe, 1998; EverFi, 2015; Gale, Harris & Levine, 2012). Young people entering the labor market particularly need to be financial literate. New employees make important, long-term decisions about their retirement and benefits, have suddenly-increased purchasing power, and are faced with spending and investment decisions. Unfortunately, the financial literacy of young adults appears to be low. Mottola (2014) found that only 24% of Millennials are financially literate and a study by the Jump$ tart Coalition for Personal Financial Literacy in 2008 found the average score of college students on a financial literacy quiz to be a 62%. Even worse, a study on over 40,000 college students conducted by EverFi (2015) found the average score of college students to be a 2.3 out of 6 questions. Despite the importance of financial literacy in this population, the literature is surprisingly limited. A majority of financial literacy studies focusing on college students also contain very little subgrouping of data; those that do are mostly limited to subgrouping by gender and race, ignoring elements such as class rank, major, and type of college attended.

The purpose of this study is to shed light on the financial literacy level of college students, while also analyzing how class rank, financial experience, and demographics relate to the financial literacy of college students. In particular, the study addresses students majoring in business, a subgroup of college students within which the literature is mixed regarding the level of financial literacy compared to that of the general college student population (Chen & Volpe, 1998; Jump$ tart Coalition for Personal Financial Literacy [Jump$ tart], 2008).
Review of Literature

Financial education has existed for over 50 years (Bernheim, Garrett & Maki, 2001), but the construct of ‘financial literacy’ is a fairly recent development from the 1990s (Hastings, Madrian & Skimmyhorn, 2013), which has prevented the creation of a uniform definition. Rather, individual organizations and studies utilize vastly differing definitions, creating an overall lack of consistency in the literature (Hastings, Madrian & Skimmyhorn, 2013; Hung, Parker & Yoong, 2009; Huston, 2010). Such definitions contain varying knowledge, skill, and application components, ranging from “. . . a basic knowledge that people need in order to survive in a modern society” (Kim, 2001) to “. . . the ability to make informed judgments and to take effective decisions regarding the use and management of money” (Noctor, Stoney & Stradling, 1992) and “. . . the ability to use knowledge and skills to manage financial resources effectively for a lifetime of financial well-being” (USA, 2007). To add to the myriad of confusion are different researcher interpretations regarding which definition is most appropriate. Whereas researchers such as Huston (2010) support a definition similar to that of the U.S. Financial Literacy and Education Commission due to its inclusion of both knowledge and application components, other researchers push for a more complex definition that includes perceived knowledge, in order to better analyze the impacts of education and other interventions on financial literacy (Hung, Parker & Yoong, 2009).

Samples

Most studies in the literature contain a sample size of 1,000-2,000 participants, though several studies, such as the National Financial Capability Study, break this norm, including as many as 25,000 participants (Mottola, 2014). This points to a potential discrepancy among the literature, though can partially be explained due to variations in the population size being measured. When analyzing studies conducted specifically on college students, one finds a range of sample sizes generally between 924 and 1,615 participants (Chen & Volpe, 1998; Jump$tart, 2008; US Bank [USB], 2016), when excluding the study conducted by EverFi (2015) which included roughly 43,000 participants. On the other hand, studies measuring more general populations, such as the National Financial Capability Study and the National Adult Literacy Study, contain sample sizes of 25,509 and roughly 26,000 participants, respectively (Kirsch, Jungeblut, Jenkins & Kolstad, 1993; Mottola, 2014). Though these studies contained a large number of participants, the average sample size of all financial literacy research is much smaller. An analysis of the literature between 1996 and 2008 finds a mean sample size of 1,575 participants (Huston, 2010). Given recent studies with
similar sample sizes (USB, 2016), it can be concluded that little change has occurred in the average sampling sizes of financial literacy studies over time.

Methodology

To test the financial literacy of various populations, the literature consistently uses a combined quantitative and qualitative approach through financial knowledge tests and various surveys regarding demographics and behaviors, among other information (Chen & Volpe, 1998; EverFi, 2015; Jump$tart, 2008; Kirsch, Jungeblut, Jenkins & Kolstad, 1993; Mottola, 2014; USB, 2016). Such an approach allows for data collection from a large number of samples, yet reveals specific insights such as various factors that impact financial knowledge and commonly held beliefs and opinions of large sample populations. The largest flaw in this mode of data collection, however, is the generally inconsistent content measured by different studies, hampering comparison between studies. Though financial knowledge is complicated and encompasses many content areas, it is often broken into four categories: Financial Literacy Basics, Borrowing, Saving/Investing, and Resource Protection (Chen & Volpe, 1998; Huston, 2010;). Using this framework, it can be found that while many college studies include Borrowing, Saving/Investing, and Basic content, many studies fail to include measurements of Resource Protection (EverFi, 2015; Mottola, 2014; USB, 2016). With significant differences in student perceived and actual knowledge of different content areas of financial literacy (Chen & Volpe 1998; USB 2016), the lack of certain content areas in instruments meant to measure financial literacy questions the validity of conclusions drawn about overall student financial literacy.

In addition to measuring financial knowledge, most of the literature includes various surveys designed to collect information regarding factors correlated to individual financial knowledge, literacy, and decision-making. These surveys capture information including race, gender, and level of schooling (Chen & Volpe, 1998; EverFi, 2015; Jump$tart, 2008; Mottola, 2014); student experience with financial products such as bank accounts (EverFi, 2015; Mottola, 2014); current/estimated future student income (Chen & Volpe, 1998; Jump$tart, 2008; Mottola, 2014); and student experience with financial literacy and similar classes (EverFi, 2015; Jump$tart, 2008). Such information is important in order to appropriately break samples into subgroups, as mentioned previously.

Though there is a general consensus in the literature regarding the information collected through surveys, there is considerable debate surrounding the design of an optimal instrument to measure financial literacy. There is a large difference in the length of quizzes designed to measure financial knowledge, from five questions (Mottola, 2014) to over 30 (Chen & Volpe, 1998; Jump$tart, 2008). Some of this variation in length can be attributed to external causes such as the logistics involved in distributing
a questionnaire to a large audience, though a considerable amount of variation can be traced to an ongoing debate over an appropriate length of a questionnaire that is comprehensive yet capable of mass distribution. While researchers such as Huston (2010) support an ideal length of 3-4 questions for each of the four main content areas of financial literacy, others cite an increase in reliability with more questions (Hung, Parker & Yoong, 2009), and still others claim that further research is needed to determine an optimal length for financial literacy quizzes (Hastings, Madrian & Skimmyhorn, 2013). Upon reviewing studies conducted in the literature, however, it can be concluded that the mean number of questions is 10-16, with a differing mean, median, and mode (Huston, 2010).

Analysis of Measures and Conclusions

In addition to containing differing numbers of questions to measure financial knowledge, studies in the literature use several differing methods to interpret results. The main methods used to interpret results from knowledge tests include a Pass/Fail threshold (Jump$tart, 2008; Mottola, 2014), division by score into subgroups (Chen & Volpe, 1998; Danes & Hira, 1987; Volpe, Chen & Pavlicko, 1996), and an A-F grading scale (Huston, 2010). These inconsistent scoring methods add to the difficulty in comparing results of studies with each other. For example, how does one compare a threshold of 70% to a C letter grade as a measure of financial literacy? Another issue in the literature is that of the absence of a scoring method in many studies. A review of the financial literacy literature found that 88% of studies failed to include a scoring method (Huston, 2010), leaving results entirely open to interpretation. Though these studies still draw conclusions about the financial literacy of students (EverFi, 2015; USB, 2016), there is little factual basis upon which such conclusions can be drawn without a concrete scoring method.

Though there is general consensus in the literature among important points such as the link between financial literacy and responsible decision-making (Brown, Collins, Schmeiser & Urban, 2014; Gale, Harris & Levine, 2012; Lusardi, 2013), there are several topics in which the literature yields mixed conclusions, likely due to the inconsistent measures and methodologies, as well as the complexity of the numerous factors that impact financial knowledge and financial literacy. For example, whereas Chen & Volpe (1998) find a statistically significant difference at the 0.01 level in the financial knowledge of differing class ranks of college students, the study done by EverFi (2015) finds little correlation between time spent on campus and financial knowledge levels. In addition, the overall efficacy of financial education as a method of intervention is widely debated, with some studies finding statistically significant changes in financial knowledge and behavior as a result of financial education (Pelletier & Hensley, 2015), and other
studies finding little evidence of impact as a result of financial education (Mandell, 2008).

While the literature on financial literacy is detailed, there a need for greater consistency regarding the definition, testing, and interpretation of financial literacy. Specifically, the literature lacks concrete insight regarding the role class rank and major plays in the financial knowledge of college students. In addition, the literature as a whole lacks consistent definitions of key terms such as financial literacy and financial knowledge. In order to avoid such pitfalls, this paper will use the definition of financial literacy proposed by the U.S. Financial Literacy and Education Commission. In addition, this paper will use Huston’s definition of financial knowledge, defined as a "Stock of knowledge acquired through education and/or experience specifically related to essential personal finance concepts and products” (Huston, 2010).

Proposed Methodology

In order to systematically measure the financial literacy of college students majoring in business, a questionnaire measuring all four content areas of financial literacy will be distributed to freshman and senior students at a business school in the mid-Atlantic. The questionnaire will be comprised of 8 questions designed to test financial knowledge and 5 questions on demographic information. In order to test students on questions from each of the main content areas of financial literacy (i.e., Financial Literacy Basics, Borrowing, Saving/Investing, and Resource Protection), the 8 knowledge questions will be randomly drawn from a quiz bank of 31 questions, encompassing of all of the content areas. To minimize systematic issues caused by the questionnaire, the study uses the questionnaire designed by the Jump$tart Coalition for Personal Financial Literacy (2008), which was repeated and analyzed by several studies in the literature.

Students will be recruited for this study in the Spring of 2018 through several channels, with an anticipated sample size of 300 students. Seniors will be recruited from an upper-level required course. In a similar way, freshman will be recruited from a required class for all freshman. In addition to these channels, freshman students will be recruited for the study by an instructor from an additional lower-level core course and the study will be promoted by the undergraduate student association. By including multiple channels to reach students, awareness of the questionnaire will be maximized in order to maximize the sample size and thereby collect statistically significant data.

Data will be analyzed using multiple regression in order to determine the impact of individual characteristics such as race, gender, and class rank on overall financial literacy. This method of analysis allows for the testing
of the hypothesis that upperclassmen will score higher on the financial knowledge section of the questionnaire, as well as the hypothesis that student financial literacy will not be statistically significantly different than that found in the literature. In addition, this method of analysis will allow for the accurate subgrouping of financial literacy scores, controlling for other demographic and personal factors. The multiple regression equation will use the following variables:

CLASSRANK: Used to analyze impact of class rank on student financial literacy.
RACE: Used to analyze the impact of demographic factors on financial literacy.
GENDER: Used to analyze the impact of demographic factors on financial literacy.
BANKED: Analyzes financial literacy between students with and without a checking account.

Though students are asked on their major, this information is not used in the data analysis, but rather to determine student eligibility for the study.

Hypothesized Conclusion and Discussion:

Though the methodology and logistics of the study have been planned out, the study is still awaiting approval from the Institutional Review Board (IRB). As a result, no primary data has been collected to date, and thus no final conclusions have yet been determined. However, based on the lack of financial education classes at the business school from which participants are being recruited, it is hypothesized that students will score similarly or lower than other business students in the literature, on average. The data from the primary research will be compared to this hypothesis upon receipt of IRB approval and the distribution of questionnaires, upon which final conclusions will be drawn.

Future Research and Limitations of Study:

Though this study is helpful in furthering the discussion regarding the financial literacy of college students and the framework through which financial literacy is affected; there are still several questions of the literature to be addressed through future research investigations. Of particular relevance is the question of applicability of financial knowledge tests to accurately represent individual financial literacy and decision-making capability. Though the literature extensively uses financial knowledge tests similar to the one utilized in the study, the accuracy of such instruments in predicting individual decision-making capacity has not been well-studied. Whereas students taking financial knowledge tests are confined to their
individual knowledge, real-world financial decision making does not take place in isolation, but rather after gathering information through friends, the Internet, and other sources not accounted for in the design of financial literacy instruments. Further research is required to determine whether individuals can compensate for a lack of financial knowledge through their access to financial information, and if so, how such access to information affects individual financial decision-making.

A potential limitation of this study has to do with the sample selection used in the primary research. Students from the freshman and senior class ranks were invited to participate in the research; though the samples chosen were random, such random sampling was not done in a stratified manner and thus demographic traits of the sample may not necessarily be representative of the population. With statistically significant differences in financial literacy levels of women and minority groups found in the literature (Chen & Volpe, 1998; Gale, Harris & Levine, 2012; Lusardi, 2013), the disparity between demographic characteristics of the sample and population may lead to conclusions that do not perfectly capture the financial literacy of the overall population.

Another limitation of this study arises from the planned asynchronous delivery of the questionnaires to the student population. Though this method of delivery allows for more convenience and a higher willingness of professors to promote the research, students will not be monitored to prevent students checking answers with each other or the Internet. Though students will be discouraged from engaging in such practices through feedback given to students upon completion of the questionnaire, the risk still exists that results found through the study may be influenced by unmonitored student access to external resources.

Future financial literacy research on college students could consist of samples that match the college student population in demographics, thereby limiting possible sources of error. In addition, future studies could potentially be designed to test financial decision-making rather than simply testing financial knowledge. Such instruments would ask questions based on specific situations, requiring individuals to apply financial literacy concepts rather than simply demonstrate the ability to recall financial information. Students would be allowed to use the Internet and other sources of information to complete the questionnaire, better simulating real-world decision-making while also reducing the limitation created by students cheating on knowledge tests by seeking access to external sources of information.
References


Huston, S. J. (summer 2010), Measuring Financial


169

Appendix A: Financial Literacy Questionnaire

Below are the knowledge and survey questions used in this research investigation:

Part 1 - 31 Quiz Questions - Students randomly assigned 8 questions, from any section. Questions divided into the 4 main content areas of financial literacy; this is simply to show the relative breakdown of questions by type, and not used to stratify questions delivered to students.

Highlight Key:

RED - Financial Literacy Basics
BLUE - Spending/Borrowing
GREEN - Saving/Investing
YELLOW - Resource Protection

1. Inflation can cause difficulty in many ways. Which group would have the greatest problem during periods of high inflation that last several years?
   a.) Older, working couples saving for retirement.
   b.) Older people living on fixed retirement income.*
   c.) Young couples with no children who both work.
   d.) Young working couples with children.

2. Which of the following is true about sales taxes?
   a.) The national sales tax percentage rate is 6%.
   b.) The federal government will deduct it from your paycheck.
   c.) You don’t have to pay the tax if your income is very low.
   d.) It makes things more expensive for you to buy. *

3. Rebecca has saved $12,000 for her college expenses by working part-time. Her plan is to start college next year and she needs all of the money she saved. Which of the following is the safest place for her college money?
   a.) Locked in her closet at home.
   b.) Stocks.
   c.) Corporate bonds.
   d.) A bank savings account.*

4. Which of the following types of investment would best protect the purchasing power of a family’s savings in the event of a sudden increase in inflation?
   a.) A 10-year bond issued by a corporation.
   b.) A certificate of deposit at a bank.
   c.) A twenty-five year corporate bond.
   d.) A house financed with a fixed-rate mortgage.*

14 Correct answer indicated by the * symbol.
5. Under which of the following circumstances would it be financially beneficial to you to borrow money to buy something now and repay it with future income?
   a.) When you need to buy a car to get a much better paying job.*
   b.) When you really need a week vacation.
   c.) When some clothes you like go on sale.
   d.) When the interest on the loan is greater than the interest you get on your savings.

6. Which of the following statements best describes your right to check your credit history for accuracy?
   a.) Your credit record can be checked once a year for free.*
   b.) You cannot see your credit record.
   c.) All credit records are the property of the U.S. Government and access is only available to the FBI and Lenders.
   d.) You can only check your record for free if you are turned down for credit based on a credit report.

7. Your take home pay from your job is less than the total amount you earn. Which of the following best describes what is taken out of your total pay?
   a.) Social security and Medicare contributions.
   b.) Federal income tax, property tax, and Medicare and Social Security contributions.
   c.) Federal income tax, social security and Medicare contributions.*
   d.) Federal income tax, sales tax, and social security contribution.

8. Retirement income paid by a company is called:
   a.) 401 (k).
   b.) Pension.*
   c.) Rents and profits.
   d.) Social Security.

9. Many people put aside money to take care of unexpected expenses. If Juan and Elva have money put aside for emergencies, in which of the following forms would it be of LEAST benefit to them if they needed it right away?
   a.) Invested in a down payment on the house.*
   b.) Checking account.
   c.) Stocks.
   d.) Savings account.

10. David just found a job with a take-home pay of $2,000 per month. He must pay $900 for rent and $150 for groceries each month. He also spends $250 per month on transportation. If he budgets $100 each month for clothing, $200 for restaurants and $250 for everything else, how long will it take him to accumulate savings of $600.
    a.) 3 months.
    b.) 4 months.*
c.) 1 month.
d.) 2 months.

11. Sara and Joshua just had a baby. They received money as baby gifts and want to put it away for the baby’s education. Which of the following tends to have the highest growth over periods of time as long as 18 years?
   a.) A checking account.
   b.) Stocks.*
   c.) A U.S. Govt. savings bond.
   d.) A savings account.

12. Barbara has just applied for a credit card. She is an 18-year-old high school graduate with few valuable possessions and no credit history. If Barbara is granted a credit card, which of the following is the most likely way that the credit card company will reduce ITS risk?
   a.) It will make Barbara’s parents pledge their home to repay Karen’s credit card debt.
   b.) It will require Barbara to have both parents co-sign for the card.
   c.) It will charge Barbara twice the finance charge rate it charges older cardholders.
   d.) It will start Barbara out with a small line of credit to see how she handles the account.*

13. Chelsea worked her way through college earning $15,000 per year. After graduation, her first job pays $30,000. The total dollar amount Chelsea will have to pay in Federal Income taxes in her new job will:
   a.) Double, at least, from when she was in college.*
   b.) Go up a little from when she was in college.
   c.) Stay the same as when she was in college.
   d.) Be lower than when she was in college.

14. Which of the following best describes the primary sources of income for most people age 20-35?
   a.) Dividends and interest.
   b.) Salaries, wages, tips.*
   c.) Profits from business.
   d.) Rents.

15. If you are behind on your debt payments and go to a responsible credit counseling service such as the Consumer Credit Counseling Services, what help can they give you?
   a.) They can cancel and cut up all of your credit cards without your permission.
   b.) They can get the federal government to apply your income taxes to pay off your debts.
c.) They can work with those who loaned you money to set up a payment schedule that you can meet.*

d.) They can force those who loaned you money to forgive all your debts.

16. Rob and Mary are the same age. At age 25 Mary began saving $2,000 a year while Rob saved nothing. At age 50, Rob realized that he needed money for retirement and started saving $4,000 per year while Mary kept saving her $2,000. Now they are both 75 years old. Who has the most money in his or her retirement account?
   a.) They would each have the same amount because they put away exactly the same
   b.) Rob, because he saved more each year
   c.) Mary, because she has put away more money
   d.) Mary, because her money has grown for a longer time at compound interest*

17. Many young people receive health insurance benefits through their parents. Which of the following statements is true about health insurance coverage?
   a.) You are covered by your parents’ insurance until you marry, regardless of your age.
   b.) If your parents become unemployed, your insurance coverage may stop, regardless of your age.*
   c.) Young people don’t need health insurance because they are so healthy.
   d.) You continue to be covered by your parents’ insurance as long as you live at home, regardless of your age.

18. Don and Bill work together in the finance department of the same company and earn the same pay. Bill spends his free time taking work-related classes to improve his computer skills; while Don spends his free time socializing with friends and working out at a fitness center. After five years, what is likely to be true?
   a.) Don will make more because he is more social.
   b.) Don will make more because Bill is likely to be laid off.
   c.) Bill will make more money because he is more valuable to his company.*
   d.) Don and Bill will continue to make the same money.

19. If your credit card is stolen and the thief runs up a total debt of $1,000, but you notify the issuer of the card as soon as you discover it is missing, what is the maximum amount that you can be forced to pay according to Federal law?
   a.) $500
   b.) $1000
   c.) Nothing.
   d.) $50*
a.) You can generally get cash 24 hours-a-day.

b.) You can generally obtain information concerning your bank balance at an ATM machine.

c.) You can get cash anywhere in the world with no fee.*

d.) You must have a bank account to have an ATM Card.

21. Matt has a good job on the production line of a factory in his home town. During the past year or two, the state in which Matt lives has been raising taxes on its businesses to the point where they are much higher than in neighboring states. What effect is this likely to have on Matt’s job?

a.) Higher business taxes will cause more businesses to move into Matt’s state, raising wages.

b.) Higher business taxes can’t have any effect on Matt’s job.

c.) Mark’s company may consider moving to a lower-tax state, threatening Matt’s job.*

d.) He is likely to get a large raise to offset the effect of higher taxes.

22. If you have caused an accident, which type of automobile insurance would cover damage to your own car?

a.) Comprehensive.

b.) Liability.

c.) Term.

d.) Collision.*

23. Scott and Eric are young men. Each has a good credit history. They work at the same company and make approximately the same salary. Scott has borrowed $6,000 to take a foreign vacation. Eric has borrowed $6,000 to buy a car. Who is likely to pay the lowest finance charge?

a.) Eric will pay less because the car is collateral for the loan. *

b.) They will both pay the same because the rate is set by law.

c.) Scott will pay less because people who travel overseas are better risks.

d.) They will both pay the same because they have almost identical financial backgrounds.

24. If you went to college and earned a four-year degree, how much more money could you expect to earn than if you only had a high school diploma?

a.) About 10 times as much.

b.) No more; I would make about the same either way.

c.) A little more; about 20% more.

d.) A lot more; about 70% more. *

25. Many savings programs are protected by the Federal government against loss. Which of the following is not?

a.) A U. S. Savings Bond.

b.) A certificate of deposit at the bank.

c.) A bond issued by one of the 50 States.*
d.) A U. S. Treasury Bond.

26. If each of the following persons had the same amount of take home pay, who would need the greatest amount of life insurance?
   a.) An elderly retired man, with a wife who is also retired.
   b.) A young married man without children.
   c.) A young single woman with two young children.*
   d.) A young single woman without children.

27. Which of the following instruments is NOT typically associated with spending?
   a.) Debit card.
   b.) Certificate of deposit.*
   c.) Cash.
   d.) Credit card.

28. Which of the following credit card users is likely to pay the GREATEST dollar amount in finance charges per year, if they all charge the same amount per year on their cards?
   a.) Jessica, who pays at least the minimum amount each month and more, when she has the money.
   b.) Vera, who generally pays off her credit card in full but, occasionally, will pay the minimum when she is short of cash
   c.) Megan, who always pays off her credit card bill in full shortly after she receives it.
   d.) Erin, who only pays the minimum amount each month.*

29. Which of the following statements is true?
   a.) Banks and other lenders share the credit history of their borrowers with each other and are likely to know of any loan payments that you have missed.*
   b.) People have so many loans it is very unlikely that one bank will know your history with another bank
   c.) Your bad loan payment record with one bank will not be considered if you apply to another bank for a loan.
   d.) If you missed a payment more than 2 years ago, it cannot be considered in a loan decision.

30. Dan must borrow $12,000 to complete his college education. Which of the following would NOT be likely to reduce the finance charge rate?
   a.) If he went to a state college rather than a private college. *
   b.) If his parents cosigned the loan.
   c.) If his parents took out an additional mortgage on their house for the loan.
   d.) If the loan was insured by the Federal Government.

31. If you had a savings account at a bank, which of the following would be correct concerning the interest that you would earn on this account?
a.) Earnings from savings account interest may not be taxed.

b.) **Income tax may be charged on the interest if your income is high enough.**

c.) Sales tax may be charged on the interest that you earn.

d.) You cannot earn interest until you pass your 18th birthday.

**Part 2 - Survey Questions**

32. What is your class standing?
   A. Freshman
   B. Sophomore
   C. Junior
   D. Senior

33. Which of the following best describes your major in college (Select all that apply)?
   A. Arts
   B. Business (In the Smith School of Business)
   C. Engineering
   D. Humanities
   E. Nursing
   F. Science
   G. Social Science
   H. Other

34. What is your sex?
   A. Male
   B. Female
   C. Other

35. How do you describe yourself?
   A. White or Caucasian.
   B. Black or African-American.
   C. Hispanic American.
   D. Asian-American.
   E. American Indian, Alaska Native, or Native Hawaiian
   F. Bi/Multiracial
   G. Other

36. Do you have a checking account?
   A. Yes
   B. No
What Makes a Successful Mobile Money Technology Vendor?

Gareth Weakly

Foreword by Dr. Serguey Braguinsky

Mobile money in the developing world helped create conditions for financial inclusion of the unbanked population. As such, it has played and continues to play an important role in improving the business environment and welfare in some of the poorest nations on our planet. In his research, Gareth worked with Audra Meade (Smith School PhD student) and myself to examine the creative solutions individuals in both developing and developed countries have come up with to address the lack of adequate banking services for the world’s poorest people.

I was very happy to see how much Gareth had grown as a researcher during his engagement with the SURE program. According to his own account, the most exciting thing for him was the freedom to engage with his mentors and to take on some of the project’s more complicated tasks. Upon reading his final paper, I felt that I myself learned something new from the two-case study of mobile money technology vendors, Utiba and Obopay that he had conducted. In particular, it was very interesting to see that neither demand and supply push-pull differences, nor founding firm capabilities by themselves appeared to have made a difference, and that instead, it was the quality of partnership and the business model that vendors came up with that were of first-order importance. I look forward to following Gareth’s future career path wherever it may take him.

• Gareth Weakly is a SURE Fellow in Economics and Mathematics at the University of Maryland, College Park, MD. Their email address is grweakly@gmail.com.
Abstract

Mobile money, a service that allows users to send money via a mobile phone without requiring the user to have a formal bank account, has become an important financial service in the developing world. Many mobile money platform providers, or the firms that interface directly with users, choose to outsource their mobile money technology development to other firms known as technology vendors. Although many individual platform providers offering mobile money services have been well studied, the literature has mostly neglected the role of technology vendors. This project seeks to gain insight into the factors that make mobile money technology vendors successful through a case-comparison methodology. Utiba, a Singapore-based technology vendor founded in 2001, and Obopay, a mobile money platform provider founded in 2005 in the US that transformed into an India-based technology vendor, comprise the cases studied. Analysis factors include the presence of existing demand for mobile money products, founding team capabilities, significant partnerships, and business models.

Keywords: industry emergence, alliances, firm survival, developing contexts

Introduction

The GSMA (Groupe Spéciale Mobile Association), the primary mobile operators’ trade association, defines mobile money as “a service in which the mobile phone is used to access financial services” (GSMA Mobile Money Definitions, 2010). These services often include, but are not limited to, person-to-person (P2P) money transfer, person-to-business (P2B) payment, and airtime top-up for prepaid customers. Mobile money services are distinct from “mobile banking” or “mobile wallet” products because they do not require the user to have a formal bank account, only a mobile phone (Aker and Mbiti, 2010).

Mobile money has been especially prevalent in the developing world. In Africa, although relatively few people have access to formal financial services (i.e. bank accounts), cell phones are ubiquitous. Mobile money has proved to be a social boon in the developing world, allowing for risk sharing across informal networks as families can transfer money over long distances.
with lower transactions costs than would be achieved by sending money through the mail, bus system, or in person (Jack and Suri, 2014). M-PESA in Kenya is the best known mobile money service and has enjoyed great success both within Kenya and internationally through Vodafone (Hughes and Lonie, 2007).

Mobile money platform providers, often banks or mobile network operators (MNOs), offer a mobile money platform that consumers can use to access mobile money services. Often, these platform providers choose to outsource their technology and payment processing tasks to mobile money technology vendors, third party firms that usually partner with many platform providers. These technology vendors are extremely important and deserve further study because of the important role they play in the development, launch, and maintenance of mobile money services. For example, M-PESA founder Susie Lonie speaks highly of Sagentia, the technology vendor that helped Vodafone create M-PESA, saying that the vendor had to be “extremely open-minded and flexible, create a very configurable system, and show a strong willingness to get involved in defining the detailed functionality”, and that they “demonstrated the required skill set and attitude many times during this project” (Hughes and Lonie, 2007). Technology vendors are integral to the success of mobile money platforms worldwide, but very little academic work has been done to explore the factors that contribute to the success or failure of these vendors.

This paper examines the presence or absence of demand for financial services, founding team characteristics, partnerships, and business model as potential factors that could contribute to the success of a mobile money technology vendor.

**Literature Review**

This project seeks to identify factors that influence the likelihood and degree of success for mobile money technology vendors. A rich vein of literature already exists on industry evolution as well as industry specific success factors for mobile money platforms, but there is a gap in the literature as it relates to the technology vendors that partner with these platforms. This project aims to expand the knowledge base by applying known success factors for mobile money platforms as they relate to technology vendors and also examine the effect of various factors on firm success.

**Brief Summary of Industry Evolution Literature**

Industry evolution scholarship observes firm differentiation as a key factor for success in the early stages of a growing industry like mobile
money. Market forces like price and user preference select survivors from heterogeneous firms with differing capabilities and strategies in a process that emphasizes selection on variation (Anderson and Tushman, 1990; Hannan and Freeman, 1989; Jovanovic, 1982; Klepper, 1996; Nelson and Winter, 1982). This process of selection by variation is critically important in relatively new industries like mobile money that are still in the early stages of the industry life cycle. This paper attempts to further explore this concept of selection on variation as it relates to mobile money technology vendors by identifying specific factors that contribute to vendor success.

**Previous Work Relating to Analysis Factors**

This paper seeks to understand the impact of demand pull, founding team capabilities, partnerships, and business model on the likelihood of success for a mobile money technology vendor. Fortunately, the first three factors are well studied in the literature. This paper therefore seeks to determine whether the findings of previous research apply to the technology vendors studied and explore the impact of a technology vendor’s business model on vendor success.

The existence of a demand pull from bottom of the pyramid (BoP) customers can be an important driver of success, particularly for the mobile money industry. Cross and Street (2009) show that goods marketed to the poor can also be good for shareholders. They illustrate this point by examining the consumer goods company Unilever in India, which has achieved success for shareholders from soap sales. In addition, these sales have had an impact in alleviating poverty and combating disease. BoP customers can represent a large and untapped source of demand for companies like Unilever. Maurer (2012) also illustrates that profitability for mobile money firms and financial inclusion are complementary outcomes. In fact, the demand for alternative financial services is so strong in many developing countries that users will actually modify existing systems into an informal mobile money service. Even before the groundbreaking M-PESA platform was launched in Kenya, Kenyans were reselling and transferring mobile airtime credits as an informal remittance (Jack and Suri, 2011). Since demand for mobile money is so strong in the developing world and BoP customers can represent an enticing opportunity for profit, it follows that technology vendors that tap into an existing demand for financial services could enjoy more success than those that do not.

Characteristics of the founding team are also important for a firm’s chance of success. Lazear (2005) finds that successful entrepreneurs must be jacks-of-all-trades, competent in many areas but not necessarily excellent in one. Therefore, it is possible that the founders of technology vendors need to possess a variety of skills in order to be successful, including technical
background, specialized knowledge pertaining to the mobile money or payments industries, and good business sense. In fact, Shane (2000) finds that entrepreneurs with prior information are more likely to capitalize on and exploit new technology. Additionally, he finds that opportunity discovery is related to information that an entrepreneur already possesses. Thus industry specific knowledge and experience may be especially important in helping technology vendors to be successful.

Strategic partnerships are another factor than can drive firm success. Alvarez and Barney (2001) show that while strategic alliances between entrepreneurial and large firms can create economic value for both partners, the larger partner often ends up appropriating a larger share of the economic value. As entrepreneurial firms that by nature are in partnership with larger and more established firms including mobile network operators and banks, mobile money technology vendors can create value through partnerships but also risk losing that economic value to their larger partners. Bad partnerships have already been shown to contribute to firm failure within the mobile money industry as a whole. The Mobipay platform in Spain was limited by regulations that forced cooperation between banks and MNOs. MNOs and banks had different mindsets, terminologies, and technical capabilities, and the issues of forced cooperation ultimately caused Mobipay to exit the market (Mas and Rotman, 2008). It remains to be seen whether destructive partnerships can harm mobile money vendors as well as platforms.

Drawing on previous research, this paper seeks to relate the existing literature on BoP demand for financial services, founding team characteristics, and strategic partnerships to mobile money technology vendors. Additionally, it explores a gap in the literature on the impact of a technology vendor’s business model on their likelihood of success.

Methodology and Data

Case Comparison Methodology

The methodology for this paper is a case comparison process adapted from Eisenhardt’s (1989) work on building theories from case study research. Eisenhardt’s method proceeds as follows: define a research question, select theoretically useful cases, craft instruments and protocols, enter the field, analyze data, shape hypotheses, compare with the existing literature, and reach closure. Eisenhardt suggests that building theory from case study is most appropriate during the early stages of research into a topic and when there is little existing literature on the subject. Thus, a case study
The methodology is appropriate when researching mobile money technology vendors because the existing literature is so sparse.

The first step was to define a research question. In this case, the question was “what factors contribute to the success or failure of mobile money technology vendors?” In order to answer this question, it was necessary to select both a successful case and a failed case. Here, success is measured primarily by firm survival, or the continued existence of a firm in a given industry. However, acquisition by a larger firm that continues to offer the core product and retains key managers is also considered a successful exit. Data on scale (including number of supported services, number of subscribers, transaction volume, and the like) is also taken into account where appropriate and available. Given this criteria, Utiba, a successful vendor, and Obopay, a firm that operated and failed as both a vendor and a platform, were selected as the cases to be studied. Furthermore, there exists a relatively rich set of archival sources on each vendor and founding team. Ideally, a case study would involve the collection of both qualitative and quantitative data, but the lack of available systematic and complete quantitative datasets meant that multiple sources of qualitative data had to suffice. In order to have a relatively broad set of data, qualitative data were collected from numerous sources including work profiles, press releases, third party reports, and, most importantly, archival interviews. The variety of sources allowed for multiple perspectives to be taken into account.

The next step was to do what Eisenhardt calls “entering the field”, or beginning to overlap data collection and analysis. This iterative process involved following interesting leads on people, partnerships, and events connected to the vendors, resulting in a flexible process of opportunistic data collection. Once enough documents were collected, the process of analyzing data in earnest could begin. This analysis involved both within and cross-case analysis, meaning that cases were analyzed on their own merits and then compared to each other. Then, hypotheses were created to explain observations from the within and cross-case analysis process. The topics that were referenced most frequently in the archival sources were deemed to have the greatest influence on the success or failure of a firm and were selected as analysis factors. The most frequently discussed factors were: the presence or absence of a demand pull, founding team characteristics, partnerships, and type of business model. Examining the analysis factors led to the creation of propositions about their relative contribution to the success of mobile money technology vendors.
Cases

In order to establish the context of the study, it is necessary to briefly discuss the histories of the technology vendors studied. Utiba

The technology vendor Utiba was founded in 2001 in Singapore by Australian entrepreneurs Justin Ho and Richard Matotek (Utiba: About Us). Important telecom clients included Globe Telecom in the Philippines, Airtel in India, Maxis in Malaysia, Mobilink in Pakistan, and True in Thailand, among others (Alternet Systems, Inc.; Utiba to Partake in Western Union Digital Vendor Program; Miller, 2012). They launched the first mobile to mobile international remittance system in 2007 with a service that allowed customers of Utiba clients Globe in the Philippines and Maxis in Malaysia to send money to each other (Utiba to Partake in Western Union Digital Vendor Program). In 2011, 30% of the mobile money services in Asia and Africa were powered by Utiba, and their U:Hub platform handled more than $100 million in transactions per month. Their operations supported 400 million subscribers for 32 clients in more than 15 countries (Utiba, Leading Mobile Financial Transaction Platform Provider, 2011). In March of 2014, Utiba was acquired by Amdocs, a large multinational IT corporation, for 20 million dollars (DOX – Q2 2014 Amdocs Earnings Conference Call, Thompson Reuters, April 30, 2012, p. 11). Amdocs then used Utiba’s technology to launch their own Amdocs Mobile Financial Services Solution in December of 2014 (Habib-Valdhorn, 2014).

Although Utiba is no longer extant, they were undoubtedly a successful firm at the time of their exit by acquisition. Near the time of acquisition, Amdocs claimed that Utiba’s platform had more than 50 global implementations and 650 million users, indicating a massive global reach and a broad user base (Amdocs Mobile Financial Services). Additionally, Utiba founder Justin Ho stayed at Amdocs after the acquisition as their Vice President of Mobile Financial Services, a sign that his leadership and knowledge was a valuable resource for Amdocs (Justin Ho LinkedIn).
Obopay

Obopay was founded in 2005 in the United States by Carol Realini and John Tumminaro. Their first product was a managed branded payment processing service for handling transactions (About Us Obopay). They then launched a mobile payments platform which allowed users to send money from a prepaid account via text message for $0.25 and receive it for free (Miller, 2009). After the service failed to take off in the US, Obopay entered India in January 2008 through a partnership with Nokia. In 2009, Nokia acquired a 38% stake in the Obopay (Krishna, 2017). Although they acted as a small platform provider in the US, Obopay’s largest business was as a technology vendor powering Nokia’s mobile financial services product in India (Perez, 2012). In 2012, however, Nokia pulled their mobile money offering from the market, which caused Obopay to go bankrupt. All their assets, including their payments processing technology, were acquired by two Indian entrepreneurs, B Padmanabhan and Rajiv Kuchhal (Krishna, 2017).

However, the new Indian Obopay launched in 2013 leveraged the software assets acquired from Realini and Tumminaro’s firm to become a pure technology vendor capable of managing digital wallet, cardless ATM withdrawal, airtime top-up, merchant payments, savings accounts, and international remittances (Obopay: Mobile Payment and Money Management Solutions). They currently support platforms in 21 African countries while offering business to business payment services in India (Krishna, 2017). Although Obopay failed as Nokia’s technology vendor in
India and as an independent platform in the US, a new iteration of the firm using Obopay’s original technology has enjoyed success as a vendor. Figure 2 outlines the history of Obopay.

*Figure 2: Timeline of Obopay major events and milestones*

**Results**

**Analysis Factors**

There are many possible reasons for the success of Utiba and the failure of the first iteration of Obopay. Here, the explanations proposed in the methodology are examined as they relate to both firms.

**Push/Pull Product**

One reason for Utiba’s success was their successful capitalization on latent demand for mobile money in the developing world. Ho exhibited an acute awareness of the potential of serving an unbanked population. In a 2010 interview, he cited a study from the Philippines revealing that 58% of the unbanked population wanted a financial instrument that would allow them to store their money safely. In the interview, he said that he saw “huge potential for our services picking up in the developing economies and have seen huge traction for our services in the Asian and African markets” (Justin Ho Co-CEO Utiba PTE LTD Singapore, 2010). Ho demonstrated not only an awareness of the market conditions affecting the unbanked, but also a desire to capitalize on that demand. More importantly, he attributed the success of Utiba to their capitalization on the unbanked sector, indicating that having a “pull” product can be a major success factor for a technology vendor.

Obopay’s initial venture in the US met with quite different results. As of 2009, the year Obopay entered the Indian market, only 1.5% of Americans had paid for something with their phone despite more than half being aware that it was a possibility (Miller, 2009). For the American deployment of their mobile money platform, Obopay’s suggested uses for the product included sending allowance money to children or paying babysitters without having to use cash or a check (Miller, 2009). These use cases indicate that Obopay was trying to push a product onto the American market that increased a user’s convenience instead of meeting a pressing need for financial services.

However, Obopay also demonstrated an awareness that serving the unbanked presented an opportunity to meet an unmet demand. According to founder Carol Realini, she came up with the idea for Obopay after visiting Africa and noticing very low levels of access to banking but high cell phone
usage (Obopay: Our Team). She noted that “There are four billion phones, and only one million bank accounts. Our view is you have to have a way for both the banked and the unbanked to participate in the mobile payment system” (Schonfeld, 2009). By powering Nokia Money, Nokia’s mobile financial services platform in India, Obopay demonstrated a desire to be more than just a convenience product (Miller, 2009). Therefore, an awareness of the potential of demand for financial services from the unbanked does not in itself guarantee the success of a technology vendor.

**Proposition 1:** Although there is stronger demand for mobile money from a largely unbanked population than a banked one, offering a pull product does not by itself guarantee the success of a vendor.

**Founding Team Capabilities**

Another factor that could potentially influence the success of a technology vendor is the array of capabilities possessed by its founding team. Interestingly, the founders of both Utiba and Obopay had very similar skill sets, with strong technical backgrounds, industry-specific knowledge, and impressive business acumen.

Justin Ho and Richard Matotek’s Bloomberg and LinkedIn profiles indicate that the Utiba founding team possessed both technical and business skills. Both received Bachelor’s degrees in Mechanical Engineering from the University of Melbourne. Ho brought experience in business as a sales manager and international business development executive. He also served as the director of eCommerce for Compaq in Asia, where he learned about the inner workings of online payment processing and mobile commerce before founding Utiba. Richard Matotek had previously developed prepaid calling card application software for Unidial Australia, a prepaid services provider, so he brought industry specific knowledge as well as technical familiarity. Ho and Matotek also co-authored a patent, “Mobile phone as a point of sale (POS) device” that was held by Utiba (Matotek, Ho, and Barnam, 2007). [add a sentence that describes why the patent is salient]

Carol Realini and John Tuminaro, the founders of Obopay, also possessed very similar backgrounds. However, founder capabilities do not predict firm success, as evidenced by Obopay’s failure as a mobile money vendor and platform. Realini’s LinkedIn profile indicates that she has a Bachelor’s degree in Mathematics from Stanford, a Master’s degree in Computer Science from Stanford, and has taken advanced management courses at Stanford University Graduate School of Business. She had also founded three companies before Obopay, most notably Chordiant Software, a successful enterprise software company that went public in 2000 and whose clients included MetLife, Citi, USAA, and Barclays, among others (Miller, 2009). According to his LinkedIn and Bloomberg profiles, co-founder John Tuminaro served as CTO at Chordiant under Realini and also possessed a
background as an independent provider of IT solutions. After Obopay, he served as a software engineer at Google. The founding teams of both Utiba and Obopay possessed technical backgrounds, a track record of success in business, and industry-specific knowledge, so it appears that founding team capability alone cannot guarantee success for a mobile money technology provider.

**Proposition 2**: Founding team capabilities alone do not guarantee the success of a mobile money vendor.

**Partnerships**

Strategic partnerships seem to be a make-or-break factor for vendor success. The mere existence of partnerships does not guarantee success, but good partnerships can help vendors expand their client base and reach more users. Bad partnerships, on the other hand, can tie up a vendor’s revenue and even lead to bankruptcy. While Utiba was able to capitalize on successful partnerships to create successful mobile money platforms and expand to new markets, Obopay ultimately failed in large part due to their dependence on their partnership with a struggling Nokia.

One of the most successful platforms powered by Utiba’s technology is G-CASH in the Philippines. See figure 3 for an illustration of G-CASH’s partnership model, where Utiba serves as the technology vendor. As of June 2015, G-CASH processed $443 million USD in annual transaction value and had 1.9 million active users (Amdocs Mobile Financial Services Success Stories). G-CASH, Utiba’s first platform, rolled out in 2004 and was the result of a successful partnership between Utiba and Globe Telecom, a telecommunications provider in the Philippines. In 2004, Ho attributed the platform’s successful rollout to “synergy between Utiba’s fluency in mobile transaction software, and the telecommunication expertise of Globe Telecom” (Globe Telecom Launches Pioneering Mobile Commerce Application with Utiba Mobility). Successful partnerships with platforms are by nature crucial for vendors, who do not provide their own customer-facing mobile money platform.

Utiba also leveraged strategic partnerships in order to expand into new markets. In order to bring Utiba’s technology to the Americas region, they partnered with Alternet systems, a Miami based mobile commerce company. This partnership took the form of a joint venture between the two firms called Utiba Americas, and allowed Utiba to expand to 14 countries in the Americas (Alternet Systems). By leveraging the existing presence of a partner in the region, Utiba was able to create a successful joint venture and broaden their client base.
Obopay also relied on strategic partnerships to broaden their client base and reach customers, as shown in figure 4. Their most important partnership was with Nokia in India, where they served as the technology vendor for Nokia Money, Nokia’s mobile money offering, which deployed nationwide in December 2011 (Nokia to shut down Nokia Money in India, 2012). The system was operated by a network of 200,000 Nokia retail stores that doubled as Nokia Money agents, which allowed Obopay to deploy their technology quickly and efficiently. In addition, Nokia and Obopay partnered with Yes Bank to launch Yes Bank’s Mobile Money Service, and with the state-owned Union Bank to launch Union Bank Money (Preethi, 2010).

However, Obopay’s partnership with Nokia ultimately contributed to Obopay’s failure in India. The network of Nokia retail stores actually served to hamper Nokia Money in some ways, as clients were unlikely to engage with a handset retailer like Nokia on a regular basis. This limited interaction with the customer base put Nokia Money at a disadvantage relative to telecom companies offering similar mobile money services because customers frequently and regularly engage with those retailers in order to top up their prepaid minutes (Perez, 2). In 2011, Nokia’s sale of smart phones fell by 20%, causing them to focus on their core services and cut back on side offerings like Nokia Money (Nokia to shut down Nokia Money in India, 2012). In 2012, Nokia announced that it was exiting the financial services business as well as shutting down other side services like Ovi Share, an online content hosting service (Perez, 2012). Nokia was crucial in helping Obopay expand into India in the first place, but ultimately Nokia’s struggles caused them to back off from mobile payments and abandon their vendor Obopay.

**Proposition 3:** Partnerships with successful firms significantly contribute to the success of a vendor, while partnerships with unsuccessful firms can cause the vendor to fail.

**Business Model**

The technology vendor’s business model can also increase the likelihood of success. Utiba acted purely as a vendor, which allowed it to partner with mobile money platforms in multiple countries. On the other hand, while Obopay’s largest business came as the technology vendor for Nokia Money, they also operated their own platform in the US. Obopay became successful after switching to a pure vendor model, despite having virtually the same technology as the first iteration of the firm.

Utiba’s business model of being purely a technology vendor allowed it to serve a broad range of clients in more than 15 countries. In addition, it created opportunities for synergies between the platforms it served. Utiba created the first mobile-to-mobile international remittance service in 2007.
when it allowed G-CASH users in the Philippines to send money to Maxis users in Malaysia (and vice versa), an opportunity that was only possible due to the flexibility of the vendor model (Utiba, Leading Mobile Financial Transaction Platform Provider, 2011).

The second iteration of Obopay also benefitted from employing a pure vendor model. Shailendra Naidu, CEO of Obopay, noted in 2014 that Obopay always “had potential because the technology was there to ramp up any form of fintech service for a financial institution wanting to enter the digital world” (Krishna, 2017). Although the technology itself was never the problem, the second Obopay was able to be more successful in part because they could offer their technology to more partners rather than being heavily tied to a single venture like Nokia Money or the US Obopay platform. **Proposition 4**: Vendors that do not also offer their own independent mobile money platform are able to better focus on their core business and are more likely to be successful.

**Discussion**

Case study methodology comes with a set of both strengths and drawbacks, as detailed by Eisenhardt (1989). The major strength of a case study methodology is that it allows for the building of new theory without having to rely on speculation. Despite the absence of rich literature on mobile money technology vendors, this methodology was able to generate propositions regarding which factors are important in the success or failure of mobile money technology vendors. In addition, these propositions are testable. For example, another researcher could easily test the proposition that good partnerships lead to success for mobile money technology vendors; while, bad partnerships lead to failure. Propositions developed from case study research are likely to be valid because they were developed from a familiarity with the data.

However, developing theory from a case study methodology has limitations as well. Since the propositions have to fit the data, there is a temptation to make the resulting theory overly complex in order to accommodate competing data. In the case of this paper, it took four distinct propositions to explain a reasonable amount of the data, meaning that the theory developed in this paper does a good job of explaining the data found in these two cases but lacks a wide perspective. Another drawback discussed by Eisenhardt is that case study methodology tends to lead to narrow and idiosyncratic theories. It is entirely possible that the results obtained by this paper are not generalizable to technology vendors as a whole, much less to any broader group of industries. Since the theory in this paper was developed to explain the phenomena observed in the cases of Utiba and Obopay, it is
very likely that some elements of this theory are specific to these two firms and do not apply to other mobile money technology vendors. Ultimately, however, determining the generalizability of the theory outlined in this paper is a task for future research.

**Conclusion and Future Work**

Fortunately, there are ways to test the propositions developed in this paper to see if they generalize. The most direct method would be to look for the influence of these success factors in a larger scale dataset of mobile money technology vendors using similar sources (press releases, work profiles, news reports, and interviews). Repeating this process for as many firms as possible would help to weed out some of the idiosyncrasies in the theory specific to Utiba and Obopay. It is also likely that new success factors will be identified by examining other firms, and that these factors could be examined retroactively in Utiba and Obopay.

Another route for future research could be the testing of these hypotheses quantitatively. The initial design of this project called for the collection of data from a large number of firms in order to regress the success or failure of a firm (either as a binary variable or as a number of launches) on explanatory variables. To test the propositions of this paper, these explanatory variables could be a dummy for an emphasis on the unbanked, dummies for the presence of various skills or characteristics of the founding team, the number of significant partnerships, and a dummy for the presence of a “pure vendor” model. However, testing the theory of this paper quantitatively could imply a significant loss of specificity, so any successful quantitative analysis would also have to be deeply grounded in the qualitative sources as well in order to produce useful conclusions.

This paper aims to begin the development of a general theory of why mobile money technology vendors succeed or fail by identifying a few important characteristics. Overall, the case comparison between Utiba and Obopay indicates that vendors are more successful if they target an existing demand for financial services instead of trying to create one, enter into good partnerships while avoiding becoming entangled in bad ones, and act as a technology vendor instead of an integrated platform. In addition, a founding team with technical capability, business experience, and industry-specific knowledge is not enough by itself to guarantee success. While these insights can help to explain the stories of Utiba and Obopay, it remains to be seen whether or not these results can be generalized to the mobile money technology vendor industry as a whole.
References


Justin Ho. LinkedIn. https://www.linkedin.com/in/justinhohol/?ppe=1


2010. Mobile money definitions. *GSMA.*
https://www.gsma.com/mobilefor
development/wp-
content/uploads/2012/06/mobilemoneynodefinitionsnomarks56.pdf

Mobile payment and money management solutions. *Obopay.*
http://www.obopay.com/moneymanagementsolutions/


2012. Nokia to shut down Nokia Money in India, exit mobile financial services. *IHS.*
https://technology.ihs.com/403863/nokia-to-shut-down-nokia-money-in-india-exit-mobile-
financial-services


https://www.vccircle.com/nokia-acquire-obopay-india-operations/

Schonfeld E. 2009. The $70 million Obopay deal is more about the unbanked than the banked. *TechCrunch.*


http://www.marketwired.com/presrelease/utibaleadingmobilefinancialtransactio
ntplatformproviderannouncesinternationalremittanceclearinghouse.htm

Corporate Compliance in a World of Self-Regulation: A Look at Conflict Minerals

Ethan Liu and Jeffrey Yin

Foreword by Research Mentor, Dr. Virginia Haufler

For the last decade or so, I have researched the various ways in which business has been brought into efforts to prevent or mitigate conflict in the developing world. Most people are familiar with the efforts surrounding “blood diamonds” and the Kimberley Process, but are not aware of the other commodities that finance rebel violence in unstable parts of the world. The U.S. government in the 2010 Dodd-Frank financial reform legislation sought to discourage the use of four minerals—tin, tungsten, tantalum and gold—by requiring companies to report on whether they obtained these from certain conflict-ridden areas. When Jeffrey Yin came to me with a request to mentor him in his SURE project, I immediately suggested he use the three years of available reports as the basis for original research. He brought in fellow student Ethan Liu to work with him on the project. Despite knowing little to nothing about conflict minerals, they threw themselves into the research and analysis with relatively little supervision. The final results exceeded my expectations. I am proud to have been their SURE mentor.

Ethan Liu and Jeffrey Yin are SURE Fellows in Robert H. Smith School of Business at the University of Maryland, College Park, MD. Their email addresses are thnliu288@gmail and jeffyin99@gmail.com, respectively.
Abstract
In the wake of the Dodd Frank Act of 2010, brand new regulations emerged in the business world. Amidst the statutes and enforcement, there was a groundbreaking emphasis on self-regulation that was embodied by Section 1502 of the legislation. The aim was to reduce the reliance on conflict minerals (collectively known as the 3TG: tin, tungsten, tantalum, gold) sourced from the Democratic Republic of Congo. However, instead of directly regulating the minerals, Dodd Frank Section 1502 required companies to make good faith efforts in identifying and reporting the conflict minerals present in their supply chains, with the hope that the resulting transparency would incentivize reform. This study aims to shine a new light on the area of corporate regulation by analyzing the extent to which Section 1502 was able to reduce conflict minerals and increase compliance. In addition, we seek to understand the specific factors that influence a company’s compliance rate. Our analysis quantifies the relationship between CFSP (Conflict-Free Smelter Program) compliance score and the company’s revenue, age, investor volume, smelters, and industry. We found significant correlational evidence that can be used to predict and improve the future of conflict mineral reporting.

Executive Summary
Although primarily known for its focus on the banking and financial industries, the Dodd–Frank Wall Street Reform and Consumer Protection Act, passed in 2010, also included Section 1502, which required companies to report on their use of conflict minerals (3TG: tin, tantalum, tungsten, gold) sourced from the Democratic Republic of Congo and surrounding covered countries. While there remains intense controversy over the legislation’s effectiveness in mitigating violence in the Congo, the conflict mineral reports themselves have provided us with valuable data that can help us better understand the role of conflict minerals in corporate supply chains. In our study, we specifically seek to address the following question: what factors push companies towards conflict-free supply chains?

To properly address the question, we investigated data from 42 different companies in the technology sector, from the industries of communications, computer equipment, IT software, and semiconductors. For each company, we obtained a compliance rate, as measured by the percentage of smelters in the supply chain that are compliant with CFSI (Conflict Free Sourcing...
Initiative) standards. Companies with higher compliance rates use less conflict minerals and are more responsible in their sourcing initiatives. We also built a profile for each company, which included dozens of variables that could potentially influence a company’s compliance rate. By building a multiple regression model, we were able to determine that collectively, a company’s revenue, age, investor volume, number of smelters, and industry could predict 81% of the variation in the company’s compliance rate, corresponding with a Multiple R value of 0.8955.

Moving forward, we believe that given the reduction in regulatory scrutiny under the Trump administration and the potential repeal of Section 1502 altogether, our understanding of the drivers of compliance is crucial for the future of conflict free supply chains. In light of this, our findings have important legislative and regulatory implications. By pinpointing what exactly makes companies compliant, we will be able to better structure incentives for companies to become conflict free, encouraging greater corporate social responsibility in the future.

**Introduction**

To better understand the issue of conflict minerals, it is important to contextualize the forces that drive conflict mineral reporting and the ultimate significance of reducing corporate reliance on conflict minerals, as it pertains to the Democratic Republic of Congo as well as the world.

**SEC Policy**

The Dodd Frank Act was signed into law by President Obama in July of 2010. This law was also named the Wall Street Reform and Consumer Protection Act due to its significant amounts of financial regulation. The part of the act that will be focused on in this study is section 1502, the area on conflict minerals. Commonly associated with diamonds, the 3TGs of conflict minerals comprise of Tin, Tantalum, Tungsten, and Gold. Under section 1502, companies are required to conduct a due diligence analysis of their supply chain to determine if there are any so-called conflict minerals.

However, because of the length of global supply chains and the nature of the mineral transformation process, the most crucial step in the due diligence process (a company’s obligation to take reasonable steps in order to fulfill a legal requirement) is identifying the smelters. The main refinement and

transformation process occurs with smelters, and determining where a
smelter is sourcing its minerals from.

This involves first contacting in-scope suppliers who deal more directly with
smelters in order to determine which ones are involved in the supply chain.
After identifying the smelters, companies often contact said smelters to
determine whether they source from regions of conflict (Central African
Republic, Democratic Republic of the Congo, Burundi, South Sudan and
Darfur). Because of section 1502, companies must use the smelter data to
submit an annual SD filing report to the SEC to both summarize the
discovered information, as well as to propose how the company can reduce
usage of conflict minerals.

On April 7th 2017, the federal courts suspended section 1502 declaring that
the rule was costly for businesses and unconstitutional under the first
amendment\textsuperscript{16} as it forced companies to launch full scale investigations of
supply chains and, “State on their website [if] any of their products have or
have not been found to be “DRC conflict free.” This process infringed on a
company’s right to free speech. As a result the SEC has decided not to
enforce this policy. Although sections of the conflict mineral rule have been
suspended, it is nonetheless a fascinating case study which can be used to
draw implications going forward of the policy’s suspension of enforcement.
The data collected from the years that section 1502 was enforced is necessary
to understand why companies report and how to encourage them to continue
despite the lack of regulation.

\textbf{Situation within Central Africa}

In 1845, Africa was divided between the many European colonial powers at
the Berlin Conference. These nations drew arbitrary borders around the
continent, splitting cultural groups down the middle and forcing rival parties
together. With the end of direct colonization following World War II, these
areas suffered large amounts of conflict due to independence movements and
civil wars within borders. Authoritarian movements like the Bokassa Coup\textsuperscript{17}
within the Central African Republic saw the elimination of any former
democratic institutions. Similar violent action in the neighboring nations of

\textsuperscript{16} Horvath, Jennifer. “Latest Updates in Conflict Minerals Law.” \textit{Lexology}, 20 Nov. 2017,

\textsuperscript{17} Britannica, The Editors of Encyclopaedia. “Jean-Bédel Bokassa.” \textit{Encyclopædia Britannica},
Angola, Sierra Leone, Rwanda, DRC, and Sudan has caused the area to be labeled as a conflict region, with conflict spilling across borders.

In rural regions of these countries, the distribution of highly profitable artisanal mines has fueled violence and oppression. In order consolidate power, warlords and terror groups are compelled to seize control of these mines for a stable source of revenue. With this newfound capital, the warlords are able to fund their militias and take control of even more mines. In addition to conflict though, these groups also impose forced labor under squalid conditions in order to lower their costs and funnel more capital into violence. African groups like the Lord’s Resistance Movement and the M23 have been reported of using these methods to obtain conflict minerals for their own benefit. These human rights violations brought conflict minerals to the national spotlight. In his novel “The Dynamics of Violence in Central Africa”\(^\text{18}\), René Lemarchand elaborates on the interactions between the rivalrous armed groups within this region and describes the disorder caused by violence. For years, the procurement of conflict minerals has financed the training of soldiers and the purchasing of thousands of weapons creating the largest death toll since World War II with a death toll of 5.4 million\(^\text{19}\) giving it international attention. According to Enough Project\(^\text{20}\) in 2008 alone, armed groups made 185 million dollars off of conflict minerals.

Due to the levels of conflict and human rights violations, the US government sought to find a way to intervene in the conflict. However, the government also desired to refrain from violating the sovereignty of such nations. One of the solutions to the dilemma was to pass Dodd Frank Section 1502, which required companies to conduct due diligence\(^\text{21}\) searches of their supply chains to determine whether any of their products were sourced from conflict regions. Through this legislation, the United States hoped to increase company transparency and accountability in an attempt to deter conflict mineral usage. Ideally, section 1502 encourages companies to ensure that their products are not funding conflicts. With proper implementation, the policy would allow the United States to exert positive foreign policy influence and uphold human rights without a direct intervention.

\(^{21}\) Due Diligence: Reasonable steps taken by a person in order to satisfy a legal requirement, especially in buying or selling something.
Conflict Mineral Filing Process

If the company determines that any of the four conflict minerals (Gold, Tin, Tungsten, Tantalum) are integral to their production, then they must file a Reasonable Country Of Inquiry Report (RCOI Report)\(^\text{22}\). While there are no rigid guidelines for what this Inquiry must do, the SEC requires that the RCOI be “reasonably designed to determine whether the issuer’s conflict minerals originate in the Covered Countries and it must be performed in good faith” (SEC Final Rule, 2012). Should the RCOI prove to be negative or inconclusive (due to a large and complex supply chain), then the company need only file the RCOI Report with the SEC and state their conclusion. On the other hand, should the RCOI yield evidence that suggests the company uses conflict minerals originating from the designated conflict regions, then the company must proceed to the third step. It is important to note that since the RCOI establishes no clear framework or compliance rules, many companies with larger supply chains simply file inconclusive results and never proceed onto due diligence.

Any company that has determined their supply chain includes conflict minerals from covered regions must now perform due diligence per the SEC or OECD framework. This means the company must take reasonable attempts to fulfill the government's inquiry. At the end of the due diligence process, a company will have determined whether its products are “Conflict Free” or “whether they directly or indirectly financed or benefited armed groups in the Covered Countries”\(^\text{23}\). These covered areas are composed of areas within the DRC and bordering zones. This policy covers rebel groups but not violent governments in the region. Because of the significantly stricter guidelines for compliant due diligence reports, companies that advance to this step often obtain extensive and valuable insight into their supply chains.

At this point, the company will file one of two reports with the SEC. If their due diligence was inconclusive, they file a Special Disclosure Report explaining their due diligence process and why they could not determine the specific origin. If their due diligence determined that their products are not “DRC Conflict Free”, they must file a Conflict Minerals Report with the SEC disclosing their process, conclusion, and steps they plan on taking to minimize conflict mineral usage (these steps are not enforceable). However, if the company conducts due diligence and determines that the smelters are


\(^{23}\) “Conflict Minerals: What you need to know about the new disclosure and reporting requirements”, Ernst & Young, 2012
“DRC Conflict Free”, the company must file with an independent auditor to verify the due diligence process and report to the SEC. Once the SEC approves, the company can use the designation “DRC Conflict Free” on its products. Otherwise their products are publicly disclosed in the SEC filing as containing conflict minerals from the DRC region for all investors and consumers to view. In addition companies must declare on their website that they are using conflict minerals.

Corporate Supply Chains

To understand what the due diligence process entails, we need to know how companies source their conflict minerals. Most conflict minerals come from artisanal mines run by individuals or small groups with little to no government oversight. Despite the name mine, artisanal mining does not typically utilize traditional mining techniques. Most mining is done in very small scales at ground level usually by a stream. Many low income individuals in rural areas are dependent on this kind of mining for their basic income. According to the World Bank, 100 million people worldwide are dependent on artisanal mining while only 7 million people worldwide are dependent on industrial mining.

Due to the proliferation of these mines, their affiliation can be difficult to determine, and many are controlled by warlords or other illegal groups. Once the minerals leave the mine, they are typically traded between dealers with each one refining the product incrementally. For example, artisanally mined gold ore is usually taken to the black market where dealers will purchase and refine it by removing some of the excess material in the gold ore. Because the vast majority of these transactions take place without government oversight or knowledge, it is exceptionally difficult to trace the exact path of a particular mineral ore until it resurfaces in the hands of an identifiable smelter.

The smelter will finish any necessary refinement and extract the pure metal from the ore. At this stage, it is virtually impossible to trace the metal to its original source; there is no fundamental difference between a piece of gold from a legitimate mine and one from an artisanal mine. With the metal now free from any evidence of conflict, it can be sold to suppliers that use the metal to build electrical circuits and transistors for companies like Apple or Motorola. These large scale companies will then use these materials to produce their products.

This entire process is summarized by the following flowchart.

As previously mentioned, due to the sheer complexity of a conflict mineral supply chain, most companies prior to the passage of Dodd Frank Section 1502 were completely unaware of the origins of their minerals. With the new due diligence frameworks, though, companies were able to establish transparency in their supply chains and understand the specific sources of their minerals.

**Literature Review**

A preliminary literature review was conducted to formulate a stronger understanding of the topic. To conduct an initial review, different scholarly sources were consulted to determine how conflict minerals impact company reports. These sources were organized and interpreted under different categories for clarity.

The Resource Curse

The first area of research pertains to the relationship between valuable resources and violent conflict. Observed in a multitude of countries, the relationship has been called “the resource curse”. Countries reliant on conflict minerals have tended to have weaker economies and we wanted to find out why. This then makes it more difficult for the said countries to continue to fight war groups. The International Monetary Fund has observed that countries that are resource rich, deriving at least 20% of exports from non-renewable natural resources, are typically at the highest risk. On the other hand, researchers like Robinson find different causes to the resource cost. Robinson believes it is because of a lack of future perspective. Countries often don’t consider the limited availability of their resources and as a result drain the resource to the point where it becomes highly demanded and causes violence.

However, newer research finds that this is not necessarily true. Engelbert and Ron find that the resource curse is typically tied to how stable a government is. A nation like Venezuela, whose government has proven unstable over the years, is more likely to experience the resource curse than a nation like the United States which has a strong and stable government. Richard Auty explains that this issue is exacerbated in mineral economies because of the dependence on intense labor to derive their product. This creates greater instability in the product as small changes in labor can have monumental impacts on the economy.

The resource curse often leads to high levels of violence within the respective countries. High value resources in limited quantities entice black markets to flood the area generating conflict. These factors ultimately impact a lot of the countries within the African conflict region with many countries reliant on minerals for a large portion of the federal revenue and with much of their mineral supply being controlled by the black market. This interaction between the government and the black market inevitably results in violence or corruption. Neither of which is good for a nation’s economy.

Whether it’s resource abundance that destabilize economies or it’s weak governments, it remains clear that many countries depend on nonrenewable resources, which ultimately pose a serious threat to both stability and human rights. To understand this in the context of conflict minerals, we must look to the parties affected by Dodd Frank Section 1502.

**Effects of Regulation in Central Africa**

From the perspective in the DRC region, the impacts of the Dodd Frank changes are very uncertain. Former Acting chairman of the SEC Michael S. Piwowar claimed that the regulations have hurt Congolese businesses, especially those uninvolved with conflict minerals. In order to avoid heavy conflict mineral regulation and reputational damage, many companies decided to simply stop purchasing resources from the DRC in order to better ensure conflict-free minerals. Piwowar further contends that the regulation distorts the image of the DRC as a conflict region, causing companies to associate Congo with conflict. However, over time these trends have been reversing with more companies willing to invest in clean sourced minerals.

On the other hand, proponents of the policy point to the fact that Dodd Frank has had massive positive effects on the region. According to US Senator Chris Coons, “The conflict minerals rule has played a critical role in reducing violence in mining areas”\(^{30}\) such as M23 in the DRC by cutting their funding and placing the issue of conflict minerals in the international spotlight. In addition to reducing influence of armed groups, the policy has also led to greater transparency in supply chains. The resulting accountability extends beyond just conflict minerals, and arguably improves supplier relationships in the long run.

The regulation has also had a momentous impact on global governance. The Conflict Mineral Rule has led foreign countries to continue the trend of mineral regulation with the European Union and the Chinese government adopting similar regulation. The United Kingdom has also seen developments with the implementation of the new Modern Slavery Act\(^{31}\) also aimed at reducing usage of conflict minerals. According to the Southern

---


African Resource Watch, “There is no doubt suspending the conflict minerals rule of the Dodd-Frank Act will reverse the progress that has been achieved thus far and facilitate the supply of conflict minerals to international markets. This approach will undermine peace by reviving dying militia and rebel groups that are operating in the Great Lakes region.

All in all, while the legislation’s impact on the socioeconomic stability of the DRC is questionable, the far reaching implications of Dodd Frank Section 1502 have had a decidedly positive impact on the global stage.

The Effect of Dodd Frank - U.S.

All of this begs the question: Who files these reports? The SEC initially predicted in their 2012 Final Rule that “75% of registrants subject to Section 1502 will need to develop a Conflict Minerals Report.” (SEC Final Rule, 2012). In other words, they estimated that 75% of companies using conflict minerals in their products would have to file the report.

The reality was quite different. According to statistics gathered by Development International, 1153 companies filed a Conflict Minerals Report or Specialized Disclosure Report in 2016, down from 1220 in 2015. This is likely due to the lack of a framework for conducting a RCOI Report, which effectively exempts companies with large enough supply chains from conducting entire supply surveys.

Breaking down the specific reports, though, 76% were from companies in the manufacturing industry. The vast majority of these are also sourced to technology companies, principally digital device manufacturers. The remainder of reports come from companies in retail (6%), wholesale (4%), mining (2%), or service industries (7%). In general, the main industry involved with conflict minerals tends to be heavy manufacturing, automotive, or technology.

Another interesting trend covered by Development International is that the reports are becoming more precise and relevant. In 2015, the average compliance score, the number of suppliers that adhere to the Conflict Minerals Reporting Template, was 79% but it rose to 84% in 2016, meaning that more companies are complying with standards and disclosing the most

32 “EXECUTIVE ACTION TO SUSPEND THE CONFLICT MINERALS RULE IN THE DODD-FRANK ACT WILL PLUNGE THE GREAT LAKES INTO A NEW CYCLE OF VIOLENT CONFLICT.” A Message to Acting Chairman Michael S. Piwowar.
accurate information possible to the public. Overall, Development International concludes that “the majority of companies subject to Dodd-Frank Section 1502 remain committed to conflict minerals due diligence.” This may be due to increased social awareness of conflict minerals, which incentivizes companies to strive to be conflict free in order to attract conscientious investors and consumers.

However, many important statistics regarding conflict mineral reports aren’t covered by Development International’s research. In particular, the study doesn’t examine the specific trends as they pertain to the different industries, geographic regions, and consumer markets involved. At the same time, the study’s breadth also overlooked trends for specific companies that share competitive markets. These gaps in the statistical coverage mean there is still significant research to be done in order to properly understand the factors influencing corporate self-regulation.

Dodd Frank Section 1502 highlights this dilemma by asking companies to report their use of conflict minerals, though the impacts of this are still unclear; Parker and Vadheim\(^{34}\) found that the Dodd Frank Legislation only served to increase the, “looting of civilians and shifted militia battles toward unregulated gold-mining territories”. Though regulation of conflict minerals increased, areas not under regulation saw unprecedented growth. Studies, like a report from Harvard International Review\(^{35}\), have come to show that the faults of many of the nations in central Africa are because of a mismanagement of the resources.

Social Influence of Dodd Frank

By itself, the Conflict Mineral Report is just a report. Dodd Frank Section 1502 did not attach any strings to reporting improvement, nor did it restrict the use of conflict minerals. Thus, unlike other types of regulation, Section 1502 placed the responsibility on corporations to enact change. Seen in this light, the policy encourages greater corporate social responsibility and awareness through information rather than regulation.

However, it would be a mistake to assume that the results of the Conflict Mineral Report would be confined to an SEC database. As Michael Piwowar of the SEC finds, “for reporting year 2015, 456 issuers, comprising 37.37%


of CRM filers, discussed “conflict minerals” in their 10-Ks.” (Piwowar, 2017) Forcing companies to report conflict mineral usage increases their cognizance of the risks in their supply chain. It also extends conflict mineral information beyond the report itself, integrating the information into financial reports and investor relations.

Meanwhile, instead of heavy handed regulation that outright bans conflict minerals, the Conflict Minerals Report shifts the regulation to the industry itself and provides the market with the necessary information to regulate itself. Piwowar notes that “the investor class is also increasingly paying attention, fully aware that brands that do not source ethically risk reputational damage.” (Piwowar 2017). The rise of socially responsible investing has further increased the potential of reputational damage. Predictably, companies with compliant, conflict free supply chains attract more investors and capital compared to their conflict-fueling counterparts. According to Forbes 36, social responsibility is linked to good performance. Socially responsible companies are more stable long term investments and are also a much more ethical investment. In other words, by pioneering the concept of a conflict mineral report form, the SEC is able to integrate conflict mineral information as another dimension of a company’s reputation. In recent years, we have seen investment industry giants like Goldman Sachs and BlackRock begin social responsibility initiatives. Investments in these socially responsible companies has increased by over 400% 37 in the past 10 years.

The Future of Dodd Frank

Section 1502 made big change in the usage of conflict minerals. For once, companies were required to search through their supply chains to find traces of conflict minerals. What did companies actually do? According to Sarfaty 38, there was a due diligence gap among firms. All firms must conduct a survey of their supply chains, but the true extent of this effort is more or less left to the discretion of the companies themselves. As a result, even though most company made a good faith effort to determine the origin of

their minerals, only 7%\(^6\) of companies reported applying a strong due diligence framework and carrying out an exhaustive analysis of their supply chain.

When conducting due diligence searches, there are several factors that help determine whether or not a company is using conflict minerals. These factors are decided by a variety of different compliance frameworks. This includes the OECD, the SEC, or the CFSI. The most common framework used and the one we will use for our research is CFSI (Conflict Free Sourcing Initiative). CFSI is part of a non-governmental organization that determines whether or not certain smelters are sourcing from conflict regions. A smelter may apply for CFSI approval and if CFSI finds that the smelter is not using conflict minerals, that smelter may be labeled as CFSI compliant. Tech companies will often prefer companies that are marked as compliant. When reporting to the SEC, these companies will often have a compliant score i.e. 87%. This would mean that 87% of that company’s smelters are considered compliant under the CFSI.

In general, Sarfaty identifies three constraints that hold Section 1502 back from success: the infancy of international norms on supply chain due diligence, the slow evolution of certification standards, and the inadequate local security and weak governments that make it difficult to accurately map mineral trade. He suggests that because of these reasons, it is difficult for companies to conduct thorough investigations of their supply chains.

The question then becomes, what causes certain companies to voluntarily conduct more extensive searches compared to their peers? We believe there are three main variables affecting the due diligence decision: amount of resources that can be used to conduct the investigation, amount of investigation that needs to be done, and brand value. Each variable may correlate with a company’s ability to perform an effective search.

With regards to the literature, there are three main hypotheses.

1) Companies with strong brands are subject to large consumer pressure to change their sourcing of conflict minerals

2) Large companies are more capable of conducting due diligence searches of their supply chain

3) Long supply chains that involve numerous out-of-scope suppliers become very difficult to investigate.

After analyzing 967 conflict mineral reports for companies, Sarfaty finds a statistically and practically significant relationship between brand size and OECD compliance. Sarfaty also finds a less powerful but still significant relationship between company size and OECD compliance. In other words,
larger companies and companies with significant brand recognition (such as Apple, Google, etc) are more likely to provide conflict mineral reports that are compliant with OECD standards.

Although Sarfaty provides a strong foundational framework for understanding conflict mineral reporting, there still remain dozens of other variables such as industry, scale of supply chain, financial means, etc. that aren’t accounted for. In addition, the analysis provided by Sarfaty only focuses on the quality of the report itself, without addressing the impact of reporting on the development of conflict-free supply chains. Becoming conflict free is a significantly better result than providing a more detailed report of conflict. For example, companies like Intel who do not want to deal with the burden of searching through lengthy supply chains have chosen to source from conflict-free areas, avoiding the need to provide any conflict mineral report.

Companies that take active steps towards conflict free supply chains present a more optimistic outlook of the conflict mineral issue. The reports themselves are only the first step in the process of corporate social responsibility: increasing awareness ultimately generates positive action and movement away from conflict mineral reliance. According to Enough Project\(^{39}\), there have been improvements in the DRC corresponding to the goals of Section 1502. These advancements include: increased security for civilians, reduction of armed group control of mines, and improved safety and health standards for miners. The DRC has further reported a record high for the amount of conflict-free exports, with a 19% increase in conflict-free tantalum.\(^{40}\)

On the other hand, home countries need to play a larger role in implementation by coordinating in-region sourcing initiatives and certification standards and supporting companies struggling with compliance. In order to properly address such issues, though, it is necessary to pinpoint the specific conditions and variables that lead to conflict-free sourcing. This study will aim to provide predictive analysis that can account for conflict mineral usage discrepancies between companies with the ultimate goal of pushing conflict minerals out of our supply chains.


Research Framework and Methodology

Theoretical Framework

While the literature identifies broad trends in conflict mineral disclosures, there is not sufficient analysis on the underlying factors that influence corporate-reporting. In particular, significant gaps in the literature remain in understanding why certain companies comply with regulations while others continue to report large quantities of conflict minerals. This study aims to focus analysis on the factors that influence corporate supply chain compliance.

To properly address this issue, there are three questions to be answered.

1. What incentives do companies have to improve their supply chain compliance?
2. Which companies and industries tend to have greater compliance?
3. What factors play the greatest role in determining compliance rate?

This study will aim to establish preliminary analysis on those three questions. By synthesizing the plethora of variables that influence corporate reporting in the realm of conflict minerals (company size, profit, PE ratio, brand value, company age, etc.) we hope to shed some light on the issue of corporate compliance rates.

Methodology

Having reviewed the literature, it is apparent that some companies have conflict free supply chains and others find their suppliers mired in conflict. It’s insufficient to merely measure overall industry-level differences, though. To properly understand the supply chain variance between companies, it is necessary to pinpoint where the differences occur and what factors influence a company’s compliance rate.

As mentioned previously, smelters are the crux of the mineral supply chain. They are the earliest link that can be easily pinpointed; any suppliers between the smelters and the artisanal mines tend to involve black market dealers. Furthermore, the sheer quantity of minerals processed by a given smelter results in a mix of conflict minerals, conflict free minerals, and recycled minerals. Thus, determining whether smelters are compliant is the closest we can get to determining whether a given supply chain is conflict free.
This compliance rate is obtained from the percentage of identified smelters in a corporate supply chain that are certified to be compliant. In order to obtain compliant designation from the CFSI, a smelter must undergo an audit process determined by the CFSP (Conflict Free Smelter Program). This process evaluates the extent to which a smelter’s sourcing policies are responsible and avoid conflict. The full process can be found in Appendix E.

While compliance status does not directly measure whether a smelter uses conflict minerals from covered countries, it guarantees that the smelter has made a dedicated effort to avoid conflict minerals in their procurement and sourcing process, especially with respect to the areas of highest risk per audit testing.

In light of this, we focused on the technology sector for data collection, gathering over 60 conflict mineral SD forms. Within the technology sector itself, we drew a representative sample of companies from four industries: communications, computer equipment, semiconductors, and IT software. Our selection reasonably mirrors the technology sector, allowing us to make conclusions from our sample that approximate the sector. In other words, our findings are significant not just for our sample, but also for the overall technology industry.

For each company, we obtained data on their compliance rate for each of the 3TG minerals, as well as a variety of metrics including general information, profitability and growth, investor relations, and brand value. The specific compliance rate is pulled from each company’s 2015-2016 conflict mineral report and measures the percent of smelters in the corporate supply chain that are compliant with CFSI standards governing conflict involvement.

For general information, we obtained data on each company’s industry, location, age, number of employees, and number of smelters. These metrics form the foundation of a company profile and describe the basic functionality of the company. For profitability and growth, we used the

---

43 Hoover’s Inc. (2017). *Hoover’s Company Profile Index*, Retrieved from Hoover’s Database

211
metrics of revenue, year on year growth, and return on equity. Approximating profitability is important in order to understand the role financial factors may play in compliance rates. To measure investor relations, we measured investor volume, market capitalization, and price to earnings ratio. And finally, for brand value, we measured brand equity, web traffic, and consumer satisfaction scores.

The compiled metrics allowed us to build a comprehensive profile for each company that includes the possible variables influencing a company’s supply chain compliance rate. The complete data table can be found in Appendix B1.

After adjusting the raw data for missing and indeterminate entries, we were left with 42 companies, each with a complete profile of data points. The adjustment was necessary in order to accurately present our data without missing entries throwing off our analysis. This sample of 42 companies includes a distribution across the four industries of computer equipment, IT software, communication services, and semiconductors. The companies ranged in size, location, and core competency, maintaining the representative selection.

As a result, we were able to collect a diverse sample of the overall technology sector that can model accurate predictions regarding the sector as a whole. The adjusted data table can be found in Appendix B2.

---

54 ACSI (2017). American Customer Satisfaction Index, Retrieved from ACSI Database
Summary

There are a few important findings that are evident in our sample data. First and foremost, by arranging the aggregate data, we can determine the precise distribution of company compliance rates. Looking at the summary statistics, the average compliance rate amongst all the technology companies in our sample was 86%, which means that 86% of an average company’s smelters are compliant with CFSI regulations. Of the 42 companies, 20 companies are above the mean of 86% and 22 are below.

To break down the distribution further, the graph below shows that the data is concentrated near the higher end of compliance rates, with three quarters of the companies boasting 80% to 95% compliance rates. On either end, there are companies with up to 100% compliance (Apple, Dell, Qualcomm, etc) and companies with compliance rates as low as 54.92% (Xerox). The distribution itself has a noticeable left skew, with companies like Pitney Bowes, Teradata, Diebold Nixdorf, and Windstream all below 75% compliance rate.

While the aggregate compliance rates seem randomly distributed, their diverse nature can actually be broken down by industry. Examining the data closely, there exist substantial differences in compliance between industries. The semiconductors industry had the highest aggregate compliance rate at 90%, followed by communications at 87.42%, IT software at 85.39%, and computer equipment at 80.84%. In other words, the range between the most and least compliant industries amounts to 9.16%, a significant discrepancy that could be explained by the unique products and consumers of each industry. The data has been summarized in the graph below:

At the same time, the industries each have very different distributions for the individual compliance rates. For example, the computer equipment industry has companies with compliance rates ranging from 100% to 54.92%, representing a very wide spread in terms of individual company distribution. While this may be due to outliers, it also indicates the diversity of the computer equipment industry itself, whose companies may be less homogenous and more exposed to different variables.

By contrast, the IT and software industry have 75% of its data within a 10% margin. In other words, 75% of companies in the IT and software industry have compliance rates between 80% and 90%, a comparatively tight distribution. This may be due to the natural cohesion of the IT industry,
which, broadly speaking, utilizes the same minerals and the same supply chain structures to deliver software products to consumers. The full distributions for each industry can be found in the box graph below.

It is apparent that there are significant differences between the 4 industries in the technology sector, as exemplified by the data breakdowns. At the same time, there are dozens of other variables that could potentially be influencing the variance in compliance rate between companies. To properly understand the relationships between our variables and smelter compliance rate, a predictive model is required.

**Data Analysis**

**Analysis**

With data on various aspects and metrics of the 42 companies, we tested the influence of each of the variables on smelter compliance rate. This analysis would allow us to accurately predict the conditions that encourage greater smelter compliance in corporate supply chains, which brings the literature one step closer to understanding the incentive structures of self-reporting regulatory systems.

The primary difficulty lies in determining which variables actually contribute to the changes in compliance rate observed in our sample data. Due to the complexity and quantity of metrics collected, many of which are interrelated and dependent, it’s impossible to simply categorize the variables and compare the aggregate data like we did for industries. Rather, this particular model requires a systematic method of determining whether each variable’s correlation is significant with respect to compliance rate.

To quantify this significance, we built simple regression models and calculated the r squared values for all the variables. The testing ultimately determines what percent of the variation in compliance rate can be explained by variations in the given metric, such as revenue or market capitalization. Our full results can be found Appendix B, but through our testing, we were able to uncover the four strongest variables that most influence the variations in compliance rate: revenue, age, investor volume, and number of smelters. The table is shown below:
Each individual variable featured above (revenue, age, investor volume, and number of smelters) has a strong relationship with the respective smelter compliance rate. In other words, the variation in compliance rate that can be explained by the variables is not merely due to chance, but rather significant in terms of statistical modeling and predictions.

Specifically, number of smelters has the highest significance, accounting for 57.11% of the variation in compliance rate. The relationship is negative, predicting that the greater the number of smelters in a corporate supply chain, the lower the overall compliance rate would be. This aligns with our hypothesis as well as intuition: companies with larger, more complex supply chains would be exposed to a greater risk of noncompliant smelters that source from conflict regions. It also makes it significantly harder for companies to identify the noncompliant smelters and remove them from the supply chain due to the sheer quantity of smelter responses required.

Next, age of the company is also highly significant, accounting for 32.42% of the variation in compliance rate. This relationship is also negative, predicting that the older the company, the lower its overall compliance rate. This was actually surprisingly counterintuitive, since we initially hypothesized that older companies would have developed strong supplier relationships that would make it easier to identify and avoid conflict minerals. However, upon further analysis, we determined that older companies tend to have less adaptable supply chains, which locks them into stable relationships. On the other hand, newer companies are much more agile in terms of identifying and changing their suppliers to accommodate for conflict minerals.

Third, the investor volume of a company is likewise significant, accounting for 10.25% of the variation in compliance rate. This relationship is positive, predicting that the higher the investor volume, the greater the aggregate smelter compliance. This reaffirms our hypothesis and intuitively makes sense, since companies that engage with more investors will value their corporate image and investor relations. In turn, they will be incentivized to clean up their supply chains so they can claim that their products are “conflict free” to potential investors.

Finally, the revenue of a company is somewhat significant, accounting for 5.05% of the variation in compliance rate. This particular relationship, though weak, is also positive, predicting that the greater a company’s revenue, the greater the overall compliance rate. We believe such a correlation is intuitive because larger companies command greater revenues,
and are better able to employ resources for internal control and inspection for their supply chains. This ability enables companies with higher revenue to identify and eliminate conflict minerals in their supply chain, boosting their overall compliance rate.

We can summarize the individual relationships with the following table, which orders the variables from strongest to weakest and describes the specific relationships and significance.

<table>
<thead>
<tr>
<th>Variable</th>
<th>R Value</th>
<th>R Squared</th>
<th>Strength</th>
<th>Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smelters</td>
<td>0.76</td>
<td>57.11% of compliance explained</td>
<td>Strong</td>
<td>Inverse</td>
</tr>
<tr>
<td>Age</td>
<td>0.57</td>
<td>32.42% of compliance explained</td>
<td>Moderate</td>
<td>Inverse</td>
</tr>
<tr>
<td>Investor Volume</td>
<td>0.32</td>
<td>10.25% of compliance explained</td>
<td>Moderate</td>
<td>Direct</td>
</tr>
<tr>
<td>Revenue</td>
<td>0.22</td>
<td>5.05% of compliance explained</td>
<td>Weak</td>
<td>Direct</td>
</tr>
</tbody>
</table>

The individual correlations between the variables and compliance rate can be found in the graphs below, which are also broken down by industry for clarity:

The final challenge is integrating all of the variables into a single predictive model that can account for a highly significant portion of the variation in compliance rate. This integrated regression model, also known as a multiple regression model, takes into account each of the variables, their influence on the compliance rate, and their overlap with each other. This is crucial, because instead of merely re-calculating the sum of the data explained by each of the variables, a multiple regression adjusts each variable with respect to the rest in order to remove overlapping correlations. The ultimate model
is able to accurately predict compliance rate given the revenue, age, volume, and smelters of any chosen company.

To construct a multiple regression model, we first selected the variables revenue, age, investor volume, and number of smelters. Based on the simple regressions, we have reason to believe these four variables together will be able to best explain the overall variations in compliance. After selecting the variables, we arranged the 4 metrics on a scatterplot as the X variables (independent) with compliance rate as the Y variable (dependent). In order to display the data on a single scatter plot though, we had to standardize the X axis by dividing each X value by the mean of the variables \(X_i = \frac{(x_i - \mu)}{\sigma}\) to avoid the different scales that our various X variables had (years, dollars, transactions, smelter count). After standardization, the resulting graph is as follows:

As we can see, age and number of smelters have a clear negative correlation with compliance rate while revenue and investor volume have a positive relationship. The scatter plot also shows the relative strength of each correlation, with weaker relationships being more scattered and strong relationships possessing more identifiable patterns. By running the regression, we are able to obtain specific data on the overall model as well as each individual variable.

In order to obtain the most accurate regression possible, though, we had to factor industry into our regression analysis. Even though industry is technically a qualitative variable, we believe the variations between industries is significant and should be an important predictive factor in our final model. Because qualitative variables can’t simply be assigned arbitrary values without voiding their significance, we encoded the industry value through a series of Boolean variables that categorized the company with respect to its industry. By isolating the specific industry through a 1 value, with every other industry holding a 0 value, we were able to measure the exact influence being in a given industry has on the overall compliance rate. The industry-specific coefficient value in the multiple regression equation quantifies this influence. A mapping of the industries to the Boolean dummy variables is shown below:

With all our variables encoded and accounted for, we constructed the multiple regression model. After running summary statistics, we obtained the following information:
In other words, based on our sample of 42 technology companies, 80.196% of the variation in compliance rates can be explained by the variables revenue, age, investor volume, number of smelters, and industry. This corresponds to a strong correlation, with an R value of 0.8955.

By applying an ANOVA test to the multiple regression, it was determined that the results were statistically significant, meaning the explained variation didn’t simply arise from chance.

The extremely small F value (3.737E-10) means that our data is significant even at the 0.01 level, indicating a very strong relationship between our chosen variables (revenue, age, investor volume, smelters, industry) and compliance rate.

In addition, the multiple regression also provides significance values for each of the variables so that we’re able to see how significantly each chosen variable influences compliance rate. In this case, the variables were all significant at the 0.1 level, as evidenced by the full regression analysis found in Appendix C. The table below shows the significance rates of each of our chosen variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>P Value</th>
<th>Significance at 0.1 level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>0.07150</td>
<td>Significant</td>
</tr>
<tr>
<td>Age</td>
<td>0.00140</td>
<td>Significant</td>
</tr>
<tr>
<td>Investor Volume</td>
<td>0.07307</td>
<td>Significant</td>
</tr>
<tr>
<td>Smelters</td>
<td>5.905E-9</td>
<td>Significant</td>
</tr>
<tr>
<td>Communications</td>
<td>0.06920</td>
<td>Significant</td>
</tr>
<tr>
<td>Computer Equipment</td>
<td>0.09179</td>
<td>Significant</td>
</tr>
<tr>
<td>Semiconductors</td>
<td>0.00511</td>
<td>Significant</td>
</tr>
<tr>
<td>IT and Software</td>
<td>0.06921</td>
<td>Significant</td>
</tr>
</tbody>
</table>

To answer our original question of how each variable influences compliance rate, the multiple regression model yields an integrated equation that pinpoints each variable’s influence, given that everything else remains the same.
Estimated Compliance Rate = 1.03732 + 0.00044 (Revenue) - 0.00112 (Age)
+ 0.00125 (Investor Volume) - 0.00076 (Smelters) + 0.03718 (Computer Equipment) + 0.07536 (Semiconductors) + 0.04924 (IT and Software)

This equation not only allows us to directly predict the expected compliance rate of any company, if we have their revenue, age, investor volume, smelters, and industry, but it also allows us to understand how each variable uniquely impacts compliance. For example, for every 1 billion increase in revenue, a company’s compliance rate can be expected to increase by 0.044%. Likewise, being in the Computer Equipment industry increases compliance rate by 3.718%. On the other hand, every extra smelter in the corporate supply chain decreases compliance rate by 0.076%.

Looking at the big picture analysis, each individual variable can be ascribed to a broader category of variables that it approximates. For example, revenue is commonly used as a measure of company size and financial means, while the number of smelters determines the length and complexity of the corporate supply chain. The table below contextualizes and summarizes our predictive model in terms of the broader company profile.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Proxies</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>Company size</td>
<td>Larger companies have more financial means to identify noncompliance and control their suppliers</td>
</tr>
<tr>
<td></td>
<td>Financial means</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control systems</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>Supplier relationships</td>
<td>Older companies tend to have stable supplier relations and aren’t able to adapt to new regulations as quickly</td>
</tr>
<tr>
<td></td>
<td>Supply chain flexibility</td>
<td></td>
</tr>
<tr>
<td>Investor Volume</td>
<td>Investor relations</td>
<td>Companies with more investors prioritize investor relations and are incentivized to become “conflict free”</td>
</tr>
<tr>
<td></td>
<td>Market capital</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perceived value</td>
<td></td>
</tr>
<tr>
<td>Smelters</td>
<td>Supply chain size</td>
<td>Companies with larger supply chains may find it hard to pinpoint and control non compliant smelters</td>
</tr>
<tr>
<td></td>
<td>Supply chain complexity</td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>Target market</td>
<td>Type of product</td>
</tr>
<tr>
<td>----------</td>
<td>---------------</td>
<td>-----------------</td>
</tr>
</tbody>
</table>

**Limitations**

There were a few key limitations to our study. First, we were not able to achieve an optimal sample size. This paper was conducted over the course of a semester and was simply not able to evaluate the large numbers of companies required to make any significant conclusions. Despite this, we believe we have highlighted key trends in the industry that should be researched further.

Additionally, certain company data was not accessible. During the collection and sampling process, some data was private, indeterminate, or unavailable for certain companies. This issue was most significant when it came to measuring brand value. Many variables like company visibility and brand equity were unusable because the measurements were not comprehensive, despite the fact that it did show some level of correlation. We looked into alternative roots of measuring brand value with very little success. This included comparing consumer and non consumer oriented companies as well as looking at company goodwill. Neither provided any significant correlation. A full list of tested variables is found in Appendix D.

Other global companies not based in the United States had extensive gaps in their data and metrics. Even though they may have filed a SD form, we were unable to include them in our analysis, further limiting our data.

In light of this, we had to balance our sample size. We needed to utilize a large enough selection to be representative and significant, but we also required complete company profiles that minimized missing entries. Our final sample of 42 companies was well-balanced but smaller than we would have liked.

As a result, we would like to see more research performed on a larger sample of companies. In the world of regulation and corporate social responsibility, it is absolutely necessary to obtain the best possible data for analysis to ensure both completeness and representation. Specifically, we believe further
testing is necessary for the particular factor of brand value, which definitely has potential to be significant. With a larger sample size and more data points, the regression model could be improved.

There were a few other limitations that narrow the scope of our findings. First, we focus solely on the technology sector, which is only one sector affected by Dodd Frank Section 1502. Further research should be done on various other sectors to produce a model with a larger scope and more comparative analysis. Second, we only examined reports from a single year (2016). To achieve greater context, research could be performed on multiple years to standardize results and mitigate fluctuations that may occur in between years. Finally, we believe that future research could focus on another response (Y) variable: improvement over time. With larger data samples from different years, models could be constructed to analyze different time-frames and the impact various variables may have on a company’s ability to improve its compliance rate.

**Conclusion**

Conflict minerals (tin, tungsten, tantalum, gold, collectively known as 3TG) are extremely important in the US: they have found their way into everything from heavy manufacturing to cell phones and computer systems. However, it is equally important to realize that the use of conflict minerals directly contributes to violence and bloodshed in the Congo region. As a result, Dodd Frank Section 1502 was passed to address the issue and encourage greater accountability in corporate supply chains.

While the debate over Section 1502 continues, we need to understand why some companies have significantly higher compliance rates compared to others. What factors ultimately contribute to a strong compliance score? This study identifies the key variables that influence a company’s willingness or ability to maintain a clean supply chain, free from conflict minerals. Amongst everything else, the variables of revenue, age, investor volume, number of smelters, and industry play an important role in predicting a company’s compliance.

The multiple regression model yielded a strong R value of 0.8955, meaning that nearly 81% of the variation in compliance scores can be explained by the aforementioned variables. Not only is our model able to accurately predict the overall compliance rate, but it also shows the unique influence of each individual variable on the compliance rate. When all else is held the same, revenue and investor volume have a positive correlation while age and number of smelters has a negative correlation. For example, every 1 billion
increase in revenue can be expected to increase a company’s compliance rate by 0.044%.

Intuitively, our findings make sense. Larger companies with more revenue have more resources and controls to comply with regulations. Similarly, companies with high investor volume wish to maintain strong investor relations and are incentivized to strive for conflict-free supply chains. On the other hand, older companies tend to have more stable and inflexible supply chains, meaning they’re unable to quickly adapt to new regulations. In that same sense, companies with more smelters and larger supply networks would find it harder to identify and remove non compliant smelters from the supply chain.

In a broader context, though, our findings are strictly limited to the technology sector, and our sample size leaves much to be desired. Because our preliminary results are only as strong as our data, we recommend future research to focus on a broader sample with more potential variables and metrics in order to construct the best model possible.

**Recommendations**

Given our models and findings, the next important question to answer is: what can be done to help encourage companies to continue complying with CFSI standards and sourcing from conflict free regions despite the repeal of Section 1502? We believe that our data not only describes the present, but also prescribes actionable recommendations that can address this problem and deepen our understanding of industry self-regulation.

1. **Reimplement Section 1502 of Dodd Frank in other forms.**

   Though the current editions of Section 1502 have been stricken as unconstitutional. There are still other methods of implementing conflict mineral policy outside of governmental regulation. Now that companies have communication networks setup within their supply chains, it is much easier to convince them to go and do future analysis of conflict mineral usage.

   One method to bring back section 1502 is to focus on the voluntary aspect of the form, so as to avoid being seen as an infringement on the free market or the first amendment. Companies could be encouraged to submit voluntary reports or receive tax exemptions for their efforts. This way conflict mineral reporting can continue to occur with the right incentive structure. At the same time, it’s important to tread carefully around first amendment requirements since regulatory agencies cannot force companies to report or comply.
Another method of approach is encouraging accountability on a company wide level. This approach relies on consumers continuing to demand that companies report their conflict mineral usage. In other words, the free market would regulate itself through the forces of demand: responsible companies with conflict free supply chains would perform better than their counterparts because they would receive greater support from consumers and investors. Because this method does not require legislation, though, non consumer oriented companies and private corporations are not held very accountable. This method also relies on a certain degree of existing brand recognition because smaller, lesser-known companies would not feel the same pressure as larger, famous companies. Brand apathy could also be problematic because certain commodities and convenience goods don’t command the same brand loyalty or image as do specialty products.

2. **Encouraging strong relationships with suppliers**

Section 1502 of the Dodd Frank act encouraged companies to seek out information from their smelters. As a result, companies have created strong channels of communications with their suppliers. This is excellent going forward. Having strong relationships with smelters that are based on transparency and communication makes it easier for companies to ensure that they are not funding conflict and allows questions to be easily channeled between company and supplier. Fostering stronger relations also establishes infrastructure for all future data collection: it becomes significantly easier to identify non compliant smelters once companies take responsibility of their supply chains.

Even outside of supply chain regulation it is always advantageous for companies to have good relations with their suppliers when it comes to shipment timing and asset management. Having better relations and open lines of communication is good for companies and for reducing conflict. These relationships ultimately encourage greater accountability in general, allowing companies to responsibly source their materials and labor without funding conflict or human rights violations.

3. **Encouraging smaller supply chains**

In order to reduce the production of minerals from conflict origin, we also recommend companies make efforts to reduce their supply chains. Complicated supply chains increase the burden on company management and makes it difficult to provide critical information to investors. Further, we found that companies with higher numbers of smelters tended to have lower quality smelters as well. We would recommend companies remove suppliers...
that are not CFSI (conflict free sourcing initiative) compliant in order to stop supporting conflict and work with suppliers that are more cooperative with international standards. This allows companies to work with fewer more capable suppliers.

Encouraging a shortening of supply chains is also critical. Longer supply chains tend to have less transparency, as some companies outright could not identify their smelters because they had too many out-of-scope suppliers. When companies exert greater control over their supply chains and reduce the number of middlemen, accountability increases and companies will become better able to adapt and comply with new regulations.

At the end of the day, any self-regulation policy is only as strong as the companies that support it. In order to truly address the issue of conflict minerals, simple adjusting policy decisions is not enough. We must also look to the companies and understand the conditions that create conflict free supply chains. Our findings and models have provided the foundation for quantifying these conditions in the context of Dodd Frank Section 1502, but we hope that future researchers will be able to expand our understanding of the role of corporate social responsibility in ensuring compliance and mitigating conflict. Only by understanding the situation can we develop actionable solutions that improve society.
References

ACSI, “American Customer Satisfaction Index”, Retrieved from American Customer Satisfaction Index, 2017


“Conflict Minerals: What you need to know about the new disclosure and reporting requirements”, Ernst & Young, 2012


Edgar Database, 10K Annual Company Report Filing, Retrieved from Edgar Database, 2017


Hoover’s Incorporated, “Hoover’s Company Profile Index”, Retrieved from Hoover’s Online Database, 2017

Kim, Young and Davis, Gerald. “80% of Companies Don’t Know If Their Products Contain Conflict Minerals”, Harvard Business Review, 4 January, 2017


Conflict Mineral Special Disclosure Forms


Booking Holdings. *FORM SD*, UNITED STATES SECURITIES AND EXCHANGE
Booz Allen Hamilton. FORM SD, UNITED STATES SECURITIES AND EXCHANGE COMMISSION, 31 Dec. 2016.


Commscope. FORM SD, UNITED STATES SECURITIES AND EXCHANGE COMMISSION, 31 Dec. 2016.


Dell. FORM SD, UNITED STATES SECURITIES AND EXCHANGE COMMISSION, 31 Dec. 2016.


**Appendices**

**Appendix A**

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Length</th>
<th>Results (Y/N)</th>
<th>Mineral Analysis</th>
<th>Smelter Identification</th>
<th>Region/Mine Identification</th>
<th>Additional Steps</th>
<th>Improvement</th>
<th>Quality Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>30 Pages</td>
<td>Unsure</td>
<td>Use of all 4 conflict minerals, unsure of origin</td>
<td>Provided a list of all smelters using 3TGs</td>
<td>Most smelters located in China</td>
<td>Contacted suppliers that were unable to determine source of minerals, will continue evaluating results</td>
<td>Improvement</td>
<td>3.10 Weak Report, Low in Data. No analysis of smaller companies</td>
</tr>
<tr>
<td>Amazon</td>
<td>10 Pages</td>
<td>Unsure</td>
<td>Use of all 4 conflict minerals</td>
<td>Identified 166 smelters, 188 were compliant based on initial audits and 4 were active undergoing audit by CPSC, 2 are unidentified.</td>
<td>14 DRC-compliant facilities sourced from DRC Region, 14 fails-compliant facilities sourced from DRC. 13 smelter locations from Eastern Congo, 11 smelter from DRC.</td>
<td>Engaged with supply to gain better visibility into our ITU supply chain. Engaged with our supply chain to increase the quality of the data collected on us.</td>
<td>Improvement</td>
<td>9.10 Strong Report: Strong identification but no tangible improvements.</td>
</tr>
<tr>
<td>Alphabet</td>
<td>20 Pages</td>
<td>Unsure</td>
<td>Use of all 4 conflict minerals</td>
<td>Provided a list of all smelters using 3TGs</td>
<td>Most smelters are in gold mining from Asia</td>
<td>Providing regular updates to the audit team and contacted our non-compliant suppliers</td>
<td>Improvement</td>
<td>7.10 Strong report: Provided good due diligence and analysis. Could use more data.</td>
</tr>
<tr>
<td>Microsoft</td>
<td>12 Pages</td>
<td>Yes (not 100%)</td>
<td>DRC Region</td>
<td>Identified 203 smelters, 249 (compliant), 52 (non-compliant or ambiguous)</td>
<td>Provided detailed information on smelters to all ITUs.</td>
<td>Increased number of DRC smelters identified in Microsoft’s supply chain from 2015 to 2016. Increased supplier response rate to 50% in the first year of audit.</td>
<td>Improvement</td>
<td>9.10 Very strong report: Excellent DRC and non-DRC smelters. Shown data improvements in tracking and compliance.</td>
</tr>
<tr>
<td>IBM</td>
<td>20 Pages</td>
<td>Yes (not 100%)</td>
<td>Use in supply chain, but none for mineral components</td>
<td>Identified 73% of smelters verified by CPSC, 78% in DRC, 99% in China.</td>
<td>Provided data on smelters accessible to all ITUs.</td>
<td>Removing suppliers that are not working to eliminate conflict-free initiatives</td>
<td>Improvement</td>
<td>9.10 Strong Report: Provided good due diligence and analysis. Information clearly labeled and suppliers clearly identified.</td>
</tr>
<tr>
<td>Del</td>
<td>3 Pages</td>
<td>Yes</td>
<td>Use all 3TGs but unable to determine origin</td>
<td>Provided a list of all smelters using 3TGs</td>
<td>Most smelters are from DRC.</td>
<td>Creating a risk management plan and utilizing continuous monitoring.</td>
<td>Improvement</td>
<td>9.10 Strong report: Provided detailed data and analysis, but has weak steps for improvement and no tangible risk-reduction outcomes.</td>
</tr>
<tr>
<td>Intel</td>
<td>17 Pages</td>
<td>Yes</td>
<td>Intel sources from third party supplier that provides necessary conflict minerals</td>
<td>Identified 88% of smelters verified by CPSC, 81% in DRC, 99% in China.</td>
<td>Provided data on smelters accessible to all ITUs.</td>
<td>Out of the 54 suppliers that were not under third party audit at the beginning of the year, 40 received the audit. 7 have been validated by Intel.</td>
<td>Improvement</td>
<td>9.10 Very strong report: Excellent due diligence and analysis. Information clearly labeled and suppliers clearly identified.</td>
</tr>
<tr>
<td>HP</td>
<td>15 Pages</td>
<td>Yes</td>
<td>Provided a list of all smelters using 3TGs</td>
<td>Most smelters are from DRC.</td>
<td>Engaging with 3TG smelters and improving data collection and support (eliminate conflict minerals efforts)</td>
<td>No inclusion of data for improvement</td>
<td>Improvement</td>
<td>9.10 Strong report: Provided detailed data and analysis, but has weak steps for improvement and no tangible risk-reduction outcomes.</td>
</tr>
<tr>
<td>Company Name</td>
<td>Length</td>
<td>Additional Info</td>
<td>Quality Score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>--------</td>
<td>----------------</td>
<td>---------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oracle</td>
<td>4 Pages</td>
<td>Yes</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salesforce</td>
<td>7 Pages</td>
<td>Yes</td>
<td>3.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outbrain</td>
<td>15 Pages</td>
<td>Yes</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zoll</td>
<td>8 Pages</td>
<td>Yes</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Korea</td>
<td>11 Pages</td>
<td>Yes</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coda</td>
<td>8 Pages</td>
<td>Yes</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CapitalOne</td>
<td>5 Pages</td>
<td>Yes</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adobe</td>
<td>15 Pages</td>
<td>Yes</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Western Digital</td>
<td>22 Pages</td>
<td>No (probably)</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mocro</td>
<td>12 Pages</td>
<td>Yes</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>App. Migrations</td>
<td>16 Pages</td>
<td>No (probably)</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Box</td>
<td>No Report</td>
<td>No</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liberty Inter</td>
<td>8 Pages</td>
<td>Yes</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caddy</td>
<td>3 Pages</td>
<td>No</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exelbia</td>
<td>1 Page boilover report (103)</td>
<td>No</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harris</td>
<td>5 Pages</td>
<td>Yes</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Additional Info:**
- **Yes:** Indicates the final determination in the company's financial report.
- **No:** Indicates the final determination is not yet available.
- **(probably):** Indicates an uncertain determination.

**Quality Score:**
- 3.3: Indicates a medium level of completeness, with some information missing or not provided in detail.

**Tables:**
- **Revenue:** The revenue of the company in the relevant fiscal year.
- **Net Income:** The net income of the company in the relevant fiscal year.
- **Wireless Analysis:** A rating of the company's performance in the wireless segment.
- **Regulatory Certification:** A rating of the company's compliance with regulatory requirements.
<table>
<thead>
<tr>
<th>COMPANY NAME</th>
<th>LEAGUE</th>
<th>RANKING</th>
<th>MARKETING STRATEGY</th>
<th>MARKET ANALYSIS</th>
<th>MARKET STRATEGY</th>
<th>MARKET CONCLUSION</th>
<th>ADDITIONAL INFO</th>
<th>IMPROVEMENT</th>
<th>QUALITY SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carica</td>
<td>2 Pages</td>
<td>Ensure</td>
<td>probability 90%</td>
<td>Marketers and retailers</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
</tr>
<tr>
<td>Rossick</td>
<td>1 Pages</td>
<td>Yes</td>
<td>probability 90%</td>
<td>Marketers and retailers</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
</tr>
<tr>
<td>Allagent</td>
<td>4 Pages</td>
<td>Yes</td>
<td>probability 90%</td>
<td>Marketers and retailers</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
</tr>
<tr>
<td>Germinia</td>
<td>8 Pages</td>
<td>Probably</td>
<td>probability 90%</td>
<td>Marketers and retailers</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
</tr>
<tr>
<td>NAPCO</td>
<td>3 Pages</td>
<td>Yes (full)</td>
<td>probability 90%</td>
<td>Marketers and retailers</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
</tr>
<tr>
<td>Renaissance</td>
<td>10 Pages</td>
<td>Yes</td>
<td>probability 90%</td>
<td>Marketers and retailers</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
</tr>
<tr>
<td>Relevend</td>
<td>12 Pages</td>
<td>Yes</td>
<td>probability 90%</td>
<td>Marketers and retailers</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
</tr>
<tr>
<td>Astoria</td>
<td>4 Pages</td>
<td>Probably</td>
<td>probability 90%</td>
<td>Marketers and retailers</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
<td>no data available</td>
</tr>
</tbody>
</table>

235
<table>
<thead>
<tr>
<th>Company Name</th>
<th>Length</th>
<th>Is an SD Form Available?</th>
<th>Conflict Status Details</th>
<th>Mineral Analysis Details</th>
<th>Region/Mine Identification Details</th>
<th>Improvement Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>CACI Ltd</td>
<td>16 Pages</td>
<td>Yes</td>
<td>Insufficient data to determine specific conflict regions; 95% of smelters used but unsure of origin.</td>
<td>No data</td>
<td>No data</td>
<td>Continue engaging suppliers and improving due diligence process.</td>
</tr>
<tr>
<td>Citix</td>
<td>16 Pages</td>
<td>Yes</td>
<td>Conflict Minerals were necessary.</td>
<td>Provided a list of all smelters, including which smelters were from CSB or mining companies.</td>
<td>No specific smelter notes</td>
<td>40 more compliant smelters.</td>
</tr>
<tr>
<td>Analog</td>
<td>15 Pages</td>
<td>Yes</td>
<td>Conflict Minerals were necessary.</td>
<td>Identified 105 smelters, of which 24 were compliant and conflict free.</td>
<td>From all around the world</td>
<td>Continue to participate in CSB, data collection, and improve supply chain transparency.</td>
</tr>
<tr>
<td>Primabulova</td>
<td>25 Pages</td>
<td>Yes</td>
<td>Insufficient data to determine specific conflict regions.</td>
<td>Provided a list of all smelters, including those that were compliant.</td>
<td>Most smelters are gold.</td>
<td>High level management oversight.</td>
</tr>
<tr>
<td>Sieverbua</td>
<td>21 Pages</td>
<td>Yes</td>
<td>Probably uses 3TOs.</td>
<td>Use all 3TOs.</td>
<td>117 compliant smelters with 100% compliance and conflict free.</td>
<td>Most in Asia.</td>
</tr>
<tr>
<td>Urnsys</td>
<td>35 Pages</td>
<td>Yes</td>
<td>Insufficient data to determine specific conflict regions.</td>
<td>Provided a list of all smelters, including those that were compliant.</td>
<td>Most smelters are gold.</td>
<td>Removing suppliers that don't align with our goals.</td>
</tr>
<tr>
<td>Vihsky</td>
<td>15 Pages</td>
<td>Yes</td>
<td>Insufficient data to determine specific conflict regions.</td>
<td>Provided a list of all smelters using 3TOS.</td>
<td>No smelter info provided.</td>
<td>Continuing collaboration with suppliers and collecting more data.</td>
</tr>
<tr>
<td>SWC</td>
<td>18 Pages</td>
<td>Yes</td>
<td>Insufficient data to determine specific conflict regions.</td>
<td>Provided a list of all smelters using 3TOS.</td>
<td>Most smelters located in Asia.</td>
<td>2% increase in supplier response.</td>
</tr>
</tbody>
</table>

Qualitative data collected from a thorough review of conflict mineral SD forms. Includes:

- Conflict Status
- Compliance Rate
- Breakdown by Conflict Mineral
- Supplier Information
- Improvement and Analysis

Appendix B

(1)
Unadjusted raw data collected from conflict mineral report forms, 10K filings, and SEC database

(2)
Adjusted data including entries only for companies that possess complete profiles

**Appendix C**

(1)
### Regression Statistics

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple R</td>
<td>0.895524833</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R Square</td>
<td>0.80166427</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R Square</td>
<td>0.72954214</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.05373843</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>41.481217561</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### ANOVA

<table>
<thead>
<tr>
<th></th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>Significance F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>8</td>
<td>0.38591951</td>
<td>0.048239939</td>
<td>19.09099724</td>
<td>7.75672E-10</td>
</tr>
<tr>
<td>Residual</td>
<td>33</td>
<td>0.095298051</td>
<td>0.00288782</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>0.481217561</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Standard Error</th>
<th>t Stat</th>
<th>P-value</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
<th>Lower 95.0%</th>
<th>Upper 95.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.037181647</td>
<td>0.027847814</td>
<td>37.2497538</td>
<td>0.980659683</td>
<td>1.095973271</td>
<td>0.980659683</td>
<td>1.095973271</td>
</tr>
<tr>
<td>Revenue</td>
<td>0.000436278</td>
<td>0.0003942277</td>
<td>1.62227554</td>
<td>0.071429056</td>
<td>-0.04191291</td>
<td>-0.04191291</td>
<td>0.000912919</td>
</tr>
<tr>
<td>Age</td>
<td>-0.00112283</td>
<td>0.0003128177</td>
<td>-3.48838647</td>
<td>0.001399046</td>
<td>-0.0017777</td>
<td>-0.00046797</td>
<td>-0.00046797</td>
</tr>
<tr>
<td>Volume</td>
<td>0.001246536</td>
<td>0.0003673106</td>
<td>1.851454644</td>
<td>0.073070194</td>
<td>-0.0012325</td>
<td>0.026216464</td>
<td>0.026216464</td>
</tr>
<tr>
<td>Smelters</td>
<td>-0.00075822</td>
<td>9.75501605</td>
<td>-7.77260418</td>
<td>5.90448009</td>
<td>-0.00095697</td>
<td>-0.00095697</td>
<td>-0.00095697</td>
</tr>
<tr>
<td>Communications</td>
<td>-0.04293478</td>
<td>0.026217853</td>
<td>-1.8725381</td>
<td>0.06920912</td>
<td>-0.01850579</td>
<td>0.0928609</td>
<td>0.0928609</td>
</tr>
<tr>
<td>Computer Equipment</td>
<td>0.037177558</td>
<td>0.027369341</td>
<td>1.358365105</td>
<td>0.09179</td>
<td>-0.01850579</td>
<td>0.0928609</td>
<td>0.0928609</td>
</tr>
<tr>
<td>Semiconductors</td>
<td>0.07530016</td>
<td>0.025118866</td>
<td>3.000148043</td>
<td>0.00510517</td>
<td>0.024255599</td>
<td>0.126465033</td>
<td>0.126465033</td>
</tr>
<tr>
<td>IT and Software</td>
<td>0.049253781</td>
<td>0.026217853</td>
<td>1.87253806</td>
<td>0.06920912</td>
<td>-0.00040684</td>
<td>0.102584403</td>
<td>0.102584403</td>
</tr>
</tbody>
</table>

### Regression Statistics

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple R</td>
<td>0.837525134</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R Square</td>
<td>0.73332513</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R Square</td>
<td>0.706719812</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.0586761</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>42.481803581</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### ANOVA

<table>
<thead>
<tr>
<th></th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>Significance F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>4</td>
<td>0.353921849</td>
<td>0.08848042</td>
<td>25.6950138</td>
<td>3.0086E-10</td>
</tr>
<tr>
<td>Residual</td>
<td>37</td>
<td>0.127386733</td>
<td>0.003442885</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>0.481803581</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Standard Error</th>
<th>t Stat</th>
<th>P-value</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
<th>Lower 95.0%</th>
<th>Upper 95.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.067531674</td>
<td>0.03055423</td>
<td>38.0521129</td>
<td>2.85108E-31</td>
<td>1.016727988</td>
<td>1.1244136</td>
<td>1.1244136</td>
</tr>
<tr>
<td>Revenue</td>
<td>0.00509387</td>
<td>0.002235132</td>
<td>0.89056728</td>
<td>0.378947962</td>
<td>-0.000267036</td>
<td>0.000685809</td>
<td>0.000685809</td>
</tr>
<tr>
<td>Age</td>
<td>-0.00112899</td>
<td>0.003226295</td>
<td>-3.49934952</td>
<td>0.001233373</td>
<td>-0.001782368</td>
<td>-0.00047281</td>
<td>-0.00047281</td>
</tr>
<tr>
<td>Investor Volume</td>
<td>0.00174118</td>
<td>0.000679517</td>
<td>2.56278205</td>
<td>0.01460009</td>
<td>0.000364347</td>
<td>0.00311012</td>
<td>0.00311012</td>
</tr>
<tr>
<td>Smelters</td>
<td>-0.000633063</td>
<td>0.001022194</td>
<td>-6.78417077</td>
<td>5.4108E-08</td>
<td>-0.00000701</td>
<td>-0.00000701</td>
<td>-0.00000701</td>
</tr>
</tbody>
</table>

### Appendix D

General Information (age, number of employees, number of smelters)
Profitability and Growth (revenue, YOY growth, return on equity)
(3)

Investor Relations (volume, market capitalization, P:E ratio)
(4)

Brand Value (brand equity, employee rankings, consumer satisfaction)
Notes