

The Economics Review at NYU

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## Letter from the Editor

The Economics Review at New York University has experienced significant growth over the last year. As part of an ever-expanding organization, we continue to encourage students to develop analytical, research, and editorial skills through exploring topics such as economics, business, politics, and technology. The dedication and professionalism displayed by each member has been key in attaining our mission and further establishing this organization within the NYU community.

Having been a part of the Economics Review's growth story over the last three years, it is truly my honor to present to you our fifth Printed Publication. Over the last year, the Review successfully expanded its reader base and presence in the economics community at NYU through various on-campus partnerships, such as the Economics Honors Society. By co-hosting a number of events, we hope to create opportunities for members to grow their network and expand their horizons through panels and discussions. Our dedicated marketing and data analytics effort over the last two years, has further allowed us to present more relevant content leading to our highest level of readership and social media engagement in the last three years. We are proud to present our new and improved website with increased user-friendliness, functionality, and relatable content. A big thank you to our webmaster, Abby Diette, for taking on this colossal task, and please do visit our new webpage, [theconreview.com](http://theconreview.com). I would also like to thank Eduard Batash and Yasmine Deswandhy, the Online Managing Editors, who have worked relentlessly to spark curiosity and drive within our team and provide exceptional amounts of high quality content for our website. Last but not the least, our very own Printed Publication Managing Editor, Cameron Taheri, has carefully curated the Fall 2018 edition of the Printed Publication with research papers addressing various economic questions.

I hope that you find each piece we have selected thought provoking and interesting as well as relevant to the current times. I am very grateful for all the effort that my predecessor, Prabhod Mudlapur, put into growing the Economics Review and I am humbled by this new opportunity to work with a group of committed members. I hope you enjoy this publication as much as we enjoyed putting it together.

Happy reading!

Sincerely,

Meghna Rangan

## Letter from the Editor

It is with great pleasure that I present to you this Editorial of the Economics Review at New York University. The Economics Review at New York University is an undergraduate organization that publishes student articles, essays, and research papers, discussing various economic-related topics.

Our goal is to provide all interested NYU students with the opportunity to conduct research, publish their work, and advance their career prospects. Our student-led editorial staff works with in-house and freelance writers to improve research and writing skills and produce content that will encourage debate and awareness among NYU students and our surrounding community. Every semester, we select academic papers from all NYU students to publish in our semi-annual print publication. We encourage not only driven economics majors to contribute to the Review but also all other NYU students, regardless of their school, field of study, or degree level. In our past volumes, the Editor-In-Chief took on the role of reflecting on the works of each author and refreshing the publication's mission statement. This is a very special volume as we share news that have contributed to the growth of our publication.

The printed publication committee has selected five papers for this Fall volume. Distinguished papers have been carefully collected so as to touch on a diverse set of subjects. This publication includes papers on international trade, economic growth, technological innovation, corporate behavior, and health care policy implications. Today's world grows ever more connected through economic expansion and technological innovation. Countries steer growth through policy creation. Analyzing policy's influence on this economic expansion is crucial to positioning long-term growth on a successful trajectory. I would like to thank the authors of these papers for their creative academic endeavors and their special contribution to the Review. This volume was carefully crafted through the collaboration of some of our most active staff editors: I would like to give a special thanks to Janet Lee and David Behrens.

We thank our readers for their support and look forward to further expanding the reach of our publication.

Sincerely,

Cameron Taheri

# How Can the Digital Economy and Blockchain Improve the Real Estate Industry?

By Patricia Medina

## Abstract

*Innovation has been a main driver of the digital economy which enabled the creation of blockchain. This context is leading to unexpected and exciting topics of economic research. Given its design, blockchain has yet to address issues related to security, ease of implementation, and regulation. This paper will assess the opportunities and challenges of each one. This paper will also examine how blockchain works and describe the main steps of a blockchain network. In addition, it will explore how blockchain could be the beginning of a new phase in the evolution of the digital economy, particularly within the real estate industry. Blockchain enthusiasts rejoice as the growing interest in blockchain comes from various stakeholders: from real estate firms to technology entrepreneurs to regulators. Proptech venture capitalists, interest groups, and large real estate developers are allocating resources to materially change aspects of the real estate sector. Blockchain has the potential to increase efficiency and alleviate cost burdens in real estate projects and property transactions. And that's only scratching the surface of what might come.*

**Keywords:** Digital Economy, Collaborative Economy, Peer-to-Peer Economy, Blockchain, Information Technology, Decentralization, Real Estate, Proptech, Digital Price Discrimination, Blockchain Attacks.

## 1. Introduction

The digital economy and digitization have contributed to economic progress and have revolutionized many industries. These two forces have made inroads in real estate activities and processes. Blockchain is a technology based on a decentralized digital ledger allowing users to register, validate, and share data and processes. As blockchain evolves, traditional economic activities are impacted, resulting in new digital business models. Blockchain advocates see blockchain as offering a new compelling value proposition. Technology has enhanced interconnectedness among humans and machines, and the scope keeps widening. Accordingly, technologies like blockchain are contributing to economic progress and can help the real estate industry transition into a new digitally-decentralized era. The positive contributions involve

decentralization, lower transaction costs, and an efficient number of parties in business transactions.

## **2. The Digital Economy**

In the last ten years, consumers have become vastly connected to the digital world through multiple platforms and gadgets: mobile phones, computers, social media, the internet of things, voice activated devices, wearable technology—and the list goes on. Digitization is a broad range of information technology applications leading to new digital business models and products, both of which are changing how humans interact and industries operate. The digital economy reflects the extent to which technology affects economic activity. Similar to transactions of physical goods, all exchange, production, and consumption activities also have a cost in the digital world. In fact, costs often restrict the execution of certain economic activities. However, as the digital economy brings costs lower, business models across industries continue to adapt to this trend. Consequently, certain costs have become more relevant in the digital economy; notably online search costs, digital verification costs, and digital tracking costs.

### **a. Online Search Costs**

Economic research has vastly covered how digital progress reduces the cost of searching. Through the digital economy, online searches are more efficient, thus result in lower costs; however, price dispersion remains. Databases and online content are key elements for the digital economy infrastructure. Unlike offline searches, online searches reach a wider audience and produce increasingly optimal findings. As a result, comparing products or services for potential economic transactions gets easier. The parties involved in online transactions could also benefit from better price-value propositions and higher returns. As in offline searches, online searches also show price dispersion as different service levels have a corresponding price range, which flows into the cost of searching (Goldfarb & Tucker, 2017).

The digital economy creates a framework for direct online economic transactions between the supply and demand sides. The digital economy enables the peer-to-peer (P2P) economic model. In practice, the P2P economy eliminates the intermediary entity between the two sides seeking to conduct an economic arrangement. In this model, access to information is easier, so both sides can negotiate freely and directly. As a result, needs are better matched. P2P platforms facilitate the connection between the supply and demand of goods and services. These platforms also offer an improved probability of finding a better match to one's requirements. For instance, borrowers and lenders, asset owners and asset managers, property owners or property buyers, they can find each other in a quick and cost-effective manner. Indeed, data digitization facilitates the exchange of transaction data and reduces the cost of identity verification required when doing business.

### **b. Digital Verification Costs**

To trust or not to trust? That is a key question in the digital economy. Only in recent years have economists started evaluating the cost of digital verification and the potential implications for economic dynamics. Various aspects of economic exchanges should, or must, be verified to ensure the credibility of a transaction. By using technology, users can mitigate the lack of trust among parties in a transaction. In other words, cost-effective digital methods reduce distrust and address the asymmetric market information of trust. These methods include online ratings, online reputation history, and electronic identification.

In the digital economy, supply and demand side participants actively use online ratings and reviews to let other customers know about their experience. Online ratings are structured data resulting from the average of all ratings received. Meanwhile, online reviews are unstructured data consisting of images, text, and other content that is not organized in a clear method. For clarity, structured data is well-organized information that is easily identifiable by search engine algorithms. However, unstructured data refers to images, text, and other content not organized in a clear method. This type of data requires resources to produce relevant business intelligence.

A ratings system should be based on objective and quantifiable indicators such as stars, points, or likes. Such system can be used to rate suppliers, users, services, and products. For instance, peer-to-peer ride sharing company Uber has a dual rating system where both passengers and drivers rate each other based on their ride experience. Uber uses a 5-star rating system that calculates the average of the 500 most recent star ratings obtained. Similarly, Yelp, a local search forum, leverages crowd-sourced reviews. Yelp uses customer reviews and a 5-star rating system to evaluate services (i.e. restaurants, entertainment, and doctors). After reviewing indicators, Yelp's automated software calculates the star rating for an activity or service only based on reviews it recommends, according to the company's website. Yelp's technology examines several indicators such as quality, reliability, and activity. Yelp's user names, number of friends, location, and the ratings they assign are visible to the public.

Another key point is that low or high ratings have economic value and can influence biases. Ratings and reviews contribute to building an online reputation. The authors of (Wu et al., 2015) calculated the monetary value per user for the restaurants evaluated in the study. In (Qiu, Parigi & Abrahao, 2018), it examines the impact of ratings and reviews in relation to the differentiating power of reputation. The repercussions on reputation "are contingent on and susceptible to the context created by the alternative choices" (Qiu et al., 2018) available to market participants. Also (Qiu et al., 2018) argues that for participants located in an environment where reputation has a differentiating value, having more reviews is remarkably relevant to indicate the trust level. Nevertheless, in many online platforms like Uber, Amazon, and eBay, having low ratings and poor online reviews may jeopardize a product's sales performance or a user's continued participation in the platform i.e. the user's account might be regretfully deactivated.

Accordingly, digital verification technology can be further utilized in other domains. Security protocols make digital verifications a robust alternative to other costly or mechanic verification methods. Blockchain illustrates how the digital technology has evolved in recent years. Blockchain uses a complex verification model that minimizes the need to trust other parties when conducting online transactions. Through digital encrypted verifications, online participants have comfort on the validity of important records. These records may include deeds and contracts of potential transactions. As such, online verifications certify asset ownership changes or transfers—both relevant for buying and selling business activities.

### **c. Digital Tracking Costs**

As noted in the previous section, exploring ways to reduce the cost of verification in the digital economy is a relatively novel theme. Similarly, the topic of digital tracking costs has captured the interest of economic researchers recently.

With “2.5 quintillion bytes of data” (Marr, 2018) produced daily on average in 2016 and 2017, big data is here to stay... and continues to enhance its technological clout. For any curious readers, one quintillion has 18 zeros compared to one million which has six zeros. This exorbitant amount of data is growing at an accelerated pace as more humans benefit from technological inclusion worldwide. Also, machines generate their own additional data. The soon to be sextillion number, which has 21 zeros, includes content from social media platforms, internet of things, digital photos, videos, chats, texts, and emails. Given its fast growth, data is abundant (Wotapka, 2016) and has turned cheaper over time. Admittedly, more affordable and accessible data fosters research and innovation.

Abundant data facilitates data tracking. Moreover, data tracking increases the customization of choices and prompts digital price discrimination based on customer behavior (Goldfarb et al., 2017). Further empirical work should explore and update price discrimination models to include the prevalence of the digital economy. Vendors such as Gospel Technology Limited and Bitfury provide cloud-based solutions allowing institutions to transfer assets across the blockchain and to securely track data. To be sure, digital tracking uses data to personalize user choices, monitor transactions and assets, and streamline processes.

## **3. Blockchain Technology**

The definition of blockchain is still fluid. The fluidity arises from the qualities necessary to call a given technology blockchain. Two of the widely discussed qualities are: the concept of permissioned vs. permissionless networks and the design of consensus mechanisms (i.e. who participates and how they reach consensus) (Van Valkenburgh, 2017).

Notwithstanding the vivid discussions on the subject, a commonly used and simple definition is that blockchain is a decentralized digital ledger allowing users to register, validate, and share data and processes. Put differently, the digital ledger contains pieces of transaction data obtained through hashing. Multiple copies of the ledger are stored across a network of thousands of participant

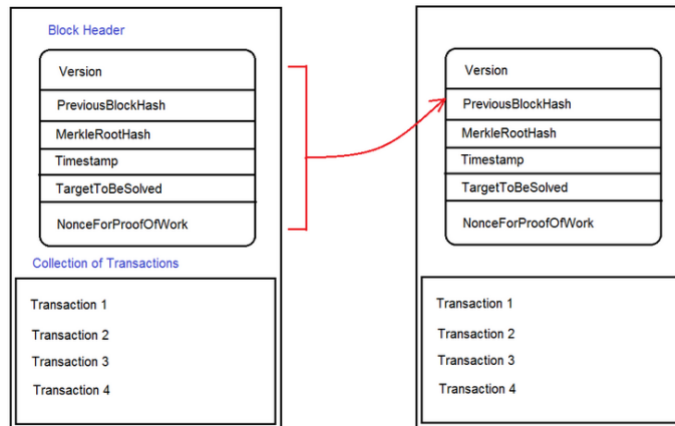


computers known as “nodes” (Orcutt, 2018). Transactions are then validated by a majority of computers in the network. Ultimately, the transactions are added into blocks of a blockchain.

Blockchains can have either private or public access. A permissioned network is private or closed to the public and rests on the central authority concept: only a limited number of validators can authorize transactions. Permissioned networks are typically used by insurance companies and financial institutions given their regulated environment. In contrast, a permissionless network is public or open, has no central authority, and validates transactions based on the concept of consensus mechanism—to be discussed later in this paper. To validate, permissionless network users must have met the consensus rules prior to approving and adding transactions to the ledger. Consensus rules can be in different ways such as proof of work by resolving complex algorithms. Permissionless networks are often used by cryptocurrencies. For practical purposes, this paper applies the commonly used definition of blockchain and refers to a public blockchain.

### a. Decentralization

The name blockchain arises from its design: a group of records, called blocks, chained together in a sequence using cryptography. Each block is unique and decentralized and carries a certain number of valid transactions. The blocks contain a timestamp, a nonce, a piece of transaction data, and an encrypted hash of the preceding block.



Source: Coding Software is Hard, 2017

Decentralization makes blockchain appealing. Blockchain advocates the notion of empowering the network without centralized entities. It is underpinned by the concept of decentralization which is applied in economics, particularly in decentralized economic planning and deregulation. In technological decentralization, information moves from concentrated to distributed forms of production and consumption of goods and services. Blockchain technology

delegates decision-making to each blockchain network community and moves away from a core—be it a location, authority or group.

Through timestamping, data and time information are securely encoded to show when an event or changes occurred. Unlike traditional database data, transactional data stored in a blockchain is deemed to be unchangeable, meaning it can't be deleted or changed. It will stay in the blockchain forever. Therefore, the choice of what data goes into a blockchain is an important business decision. Other considerations for what data to include in a blockchain are: how material the information is and whether it refers to a company's key proprietary processes.

**b. Hashing and Cryptography**

Hashing is an important part of blockchain technology. It refers to the process of solving a complex algorithm to divide input (i.e. data) into output. The input reflects all historical events and new data added to a blockchain. Meanwhile, the output is made of small, unique index values called hash or keys. Given that such process uses cryptography, the keys are also known as crypto keys. Hashing needs significant computational power to support all the hardware; therefore, energy usage is large. The graph below shows a sample input and its corresponding hashing output generated through a secure hashing algorithm called SHA-256.

INPUT	HASH
Hi	639EFCDo8ABB273B1619E82E78C29A7DF02C1051B1820E99FC395DCAA3326B8
Welcome	53A53FC9E2A03F9B6E66D84BA701574CD9CF5F01FB498C41731881BCDC68A7C8

Source: Blockgeeks, n.d.

Hashing makes database searches run very fast by seeking keys rather than the original, longer string of characters. Updating data in one block would require changes in all subsequent blocks and would need majority consensus from participants in the network where it belongs.

A peer-to-peer network collectively manages and maintains a blockchain network. To be added to a blockchain, the majority of computers in the network validates transaction data according to validation rules known as consensus mechanisms—defined by the creators of a given blockchain. The validation process is referred to as mining and is executed by network participants called miners.

Considering these features, blockchain applications can address a variety of issues in many industries. Blockchain is useful to prevent voting fraud, enforce driving rules, track prescription records, and safeguard real estate contracts (NYU Stern SPEX, 2018). Blockchain can increase the effectiveness of the real estate industry by addressing several slow, cumbersome, or costly aspects.

In (Nakamoto, 2008), the research focuses on the steps to run a network to create the bitcoin cryptocurrency. However, drawing from (Nakamoto, 2008), the

following is an attempt to generalize the process to create a basic blockchain network:

1. New transactions are communicated to several nodes
2. A node can receive new transactions into a block
3. A node resolves an algorithm to find a crypto key for its block
4. A node shares the block with the rest of the nodes
5. A node accepts a block only after the transactions in it have been validated
6. The nodes take the previous hash to create the next block

#### **4. Implications of the Digital Economy and Blockchain on the Real Estate Industry**

Blockchain can offer a growing number of practical ways to improve the efficiency of real estate transactions. Though this technology continues to evolve, widespread commercial adoption has yet to materialize. Blockchain can impact three main aspects relevant for transactions in the real estate industry: security, ease of implementation, and regulation. Each of the three aspects has potential blockchain solutions with their own advantages and disadvantages.

##### **a. Security**

Blockchain is advocated as being secure and immutable. Blockchain security features support the creation of “smart contracts” (Wan, 2018). These contracts use a computer program to control economic activities related to assets. Smart contracts transactions between two direct counterparties have no intermediaries. A digital contract can be used in actual real estate transactions: buying and selling property, brownfield redevelopment projects, or land purchases. The security attributes of these contracts can alleviate the legal documentation load. This technology can be applicable to multiple types of real estate contracts such as assignments (i.e. of distressed properties), contractor agreements, lease agreements (between a property owner and a lessee), and a general purchase agreement.

Using blockchain to create smart contracts leads to lower fraud risk, less expensive transactions, and faster contractual execution. For instance, two parties involved in a buy/sell transaction of a condo must incur escrow fees. Initially, the buyer sends funds to an escrow fund. After closing the agreement, the funds are released from the escrow account to the seller. During this process, the escrow company charges a 1% to 3% fee. Smart contracts can eliminate intermediaries such as escrow service companies, cut legal fees, and reduce the overall duration of the real estate transaction. Using blockchain technology, the agreed terms between both parties are put into a smart contract. Then, the buyer sends the funds to the smart contract. The contract validates that all pre-closing terms and conditions were met and subsequently triggers a code to transfer the funds to the seller.

Overall, three features make blockchain secure: the cryptography-based technology, the consensus protocol, and the hash. The definitions of and interaction among these three features were discussed in the Blockchain

Technology section of this essay. The cryptography-based technology used by blockchain addresses security concerns. It contributes to the privacy of user identity and makes past records unchangeable. It also ensures transactions are conducted safely and data is legitimate.

Furthermore, the consensus mechanisms enable mutual agreement on a given data. In other words, they ensure all participants in the blockchain network have a copy of the same ledger. The consensus mechanisms are numerous and yield different outcomes for a given blockchain. This is due to each mechanism having a different mix of security, performance, and economic composition of the cryptographic protocol. One should consider a tradeoff among these three elements when deciding which consensus to choose. Innovation continues to add new types of consensus mechanisms; common ones include (1) Proof of Authority, (2) Proof of Capacity, (3) Proof of Elapsed Time, (4) Proof of Work, and (5) Delegated Proof of Stake (Boaventura, 2018).

As noted in the Hashing section of this paper, a hash joins the blocks sequentially in a chain form. Each block contains a hash of the preceding block. Thus, changing a ledger entry retroactively would require calculating a new hash not only for the block holding the entry but also for all subsequent blocks. In such hypothetical scenario, the new hashes would have to be resolved faster than the speed of new blocks added, otherwise the new blocks will not match existing ones. This process represents a challenge and would require substantial kilowatt hours in calculation power.

Despite these security features, two types of intricate attacks to a blockchain might be possible. First, a “selfish mining” attack (Eyal & Sirer, 2013). The authors suggest that a “selfish mining” attack could be based on collusion. This means that miners could associate in a growing subgroup, which will earn more than the fair amount. In this attack, a miner deceives other nodes making them work on calculating cryptographic keys already resolved. Second, an “eclipse attack” (Heilman et al., 2015). The study states that an “eclipse attack” perpetrator maliciously takes over a significant number of IP addresses to dominate over half of the computers in a node. Then, through a comprehensive process, the perpetrator controls a node’s communication system and manipulates the mining system and the consensus protocol. This type of attack ultimately makes the nodes approve fake transactions. The authors note that potential ways to safeguard a blockchain from an “eclipse attack” involve the use of botnet architecture.

#### **b. Ease of Implementation**

Blockchain offers ways to streamline processes. In the real estate industry, blockchain enables direct interaction between the counterparties. Thus, drastically reducing the number of transaction participants i.e. lawyers, brokers, banks, escrow companies, and subcontractors. The technical complexity of blockchain solutions may impact the ease of implementation. However, large business technology vendors like Amazon Web Services, Microsoft Azure, and IBM sell cloud-based blockchain templates for basic application development. At the same time, At the same time, (Williams, R., 2018) states that Google Cloud and Digital

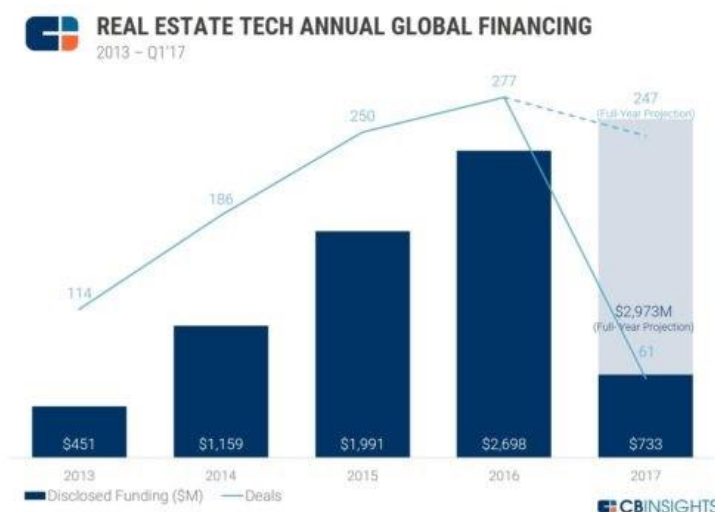
Asset sell blockchain-application tools to facilitate blockchain application deployment. The tools are also accessible via the cloud. Real estate firms can examine these and other vendors' blockchain templates and tools while combining them with cloud technology.

Building a blockchain infrastructure from scratch takes months to complete. The benefits of using these templates and tools are twofold. First, they reduce a basic blockchain application setup time from months to days, vendors claim. Second, the templates cut blockchain implementation costs. Technology initiatives in real estate are focusing on overcoming implementation issues. For example, the Real Estate Board of New York (REBNY) recently launched the PropTech Challenge, a global virtual hackathon. This is an opportunity for software developers to combine technology and their interest in real estate, while creating innovative solutions to issues affecting any aspect of the industry.

“Proptech”—a portmanteau of property technology—is also making inroads into blockchain. Proptech refers to technology integrated into software, materials or accessories used in real estate. For instance, an increasing number of sensors and digital devices are embedded in building structures, making properties more interconnected to a digital network. Proptech advancements have led to energy efficient infrastructures, booking parking spaces, and scheduling concierge services.

A growing level of financial incentives, real estate investor appetite, and real estate innovators is fostering the creation of software and hardware solutions. Innovations are leveraging not only blockchain but also other advanced technology platforms. Founded in 2015, MetaProp NYC operates a leading Proptech accelerator program and a few seed funds. Since its inception, the company has raised over \$2 billion in venture capital funds and has invested in over 90 technology startups, some of which actively combine Proptech and blockchain, according to its website. According to (Williams, C., 2018), in June 2018, the company closed its second VC fund raising \$40 million to invest in Proptech startups. Investors in the second fund, MetaProp Ventures II L.P., included large real estate players RXR, Altus Group, CBRE, Cushman & Wakefield and JLL.

The chart below shows an upward trend in global funds allocated to Proptech from 2013 to 1Q2017, reaching \$2.7 billion in 2016. A similar trend is observed for the number of deals, about 277 disclosed transactions closed in 2016.



Source: Global Real Estate Experts, 2017.

As a result, it is feasible to envision an increased collaboration between PropTech startups, established real estate developers, and blockchain innovators. Investors are increasingly interested in investing funds into PropTech startups with innovative proposals addressing real estate issues. Such PropTech ventures can also create technology solutions to facilitate the ease of implementation of blockchain in real estate. Below is a graph showing the seven most active venture capital investors in real estate PropTech and the list of startup companies they invested in from 2011 to March 2016.

## The Most Active Real Estate Tech Investors

VCs Ranked by Unique Real Estate Tech Investments, 2011 - 2016 YTD (03/04/16)

Investor	Rank	Companies
500 Startups 	1	Compass, Vivatrad, Homelight, 99.co, ZipRecruiter, Remo, Storefront, 42Floors, Lenda, Lovely, Happy Inspector, HAPPYUS
Thrive Capital 	2	Cadre, OpenDoor Labs, Hightower, Harrit Building, Blend Labs, Compass, 42Floors
Frontier Digital Ventures 	3	meQasa, Property-Nexus, iMaxima-Nexus, Property-Indicate, Zameen, VivaReal
SV Angel 	3	OpenDoor Labs, Storefront, Blend Labs, MyVR, 42Floors, Lovely
BoxGroup 	5	Hightower, Storefront, Matterport, 42Floors, Nestio
DCM Ventures 	5	Roomi, Asset Avenue, Matterport, Meisjo, RedScout
Accel Partners 	5	Amies, Lease Accelerator, Common Floor, PropTiger, HWS Intech

CBINSIGHTS

[www.cbinsights.com](http://www.cbinsights.com)

Source: CBInsights, 2016.

Influencing institutions, such as REBNY and MetaProp, as well as leading PropTech investors are showing valuable support for blockchain. These efforts are a clear sign of promoting collaboration among industry organizations, real estate

venture capitalists, and the developer community. Collaboration and innovation could address issues preventing a gradual adoption of the blockchain technology in real estate.

### **c. Regulation**

Decentralized automation must comply with regulation. A recent Deloitte survey (Schatsky, Arora, & Dongre, 2018) shows that security is a key bottleneck for technology executives across industries. Specifically, the survey mentions that about “two in five blockchain-savvy executives cited regulatory” concerns preventing them from allocating more dollars to blockchain development. To address this issue, existing law can further regulate encryption, smart contracts, and mutualized consensus to reach agreements.

Currently, U.S. regulators prioritize regulation over business, which causes controversy among blockchain advocates. The U.S. government’s stance appears to be rightly focused primarily on controlling any cases of blockchain fraud risk and upholding investor rights (Tahir, 2018); rather than fully endorsing blockchain endeavors. Market participants question the prolonged lack of legal clarity for this technology, which, they assert, disincentivizes innovation. Hence, blockchain startups may choose to relocate to other countries. Market participants are also disconcerted by the lack of an official blockchain definition to be used in U.S regulation.

However controversial, nascent blockchain regulation is moving forward in the United States. On October 1, 2018, a bill entitled “Blockchain Promotion Act of 2018” was introduced to the House of Representatives. Through the bill, the U.S government and stakeholders attempt to coalesce on a common definition of blockchain, a positive first step once it happens. The bill will pave the way for business initiatives pulled back by organizations across industries. The U.S. Securities and Exchange Commission is also partnering with task forces to examine methods of payment using blockchain technology. In the future, utilizing crypto methods of payment for real estate transactions may not be far-fetched.

Indeed, the real estate industry can leverage the digital economy and blockchain to become increasingly efficient. Areas in need of a better procedural framework include enforceability of contracts, choice of jurisdiction, data privacy, and intellectual property (Schatsky et al., 2018). Meanwhile, regulators including the U.S. Financial Stability Oversight Council and the U.S. Federal Trade Commission are assessing how the decentralized applications of blockchain will impact their objectives and scope of their roles.

## **5. Conclusion**

To conclude, the real estate industry has already seen benefits from the digital economy in recent decades. This process has translated into tangible economic and operational gains for industry participants. Looking to the future, blockchain offers the possibility of stepping up to a higher level of technological progress, one where the ground is fertile to leverage innovation to create practical blockchain applications. Particularly, these applications can streamline activities

and processes in the real estate ecosystem. Achieving value added improvements will require certain blockchain issues to be clarified and normed before the technology is widely adopted. Economists should continue to understand the new dynamics of the digital economy at the intersection of blockchain and other advanced technologies i.e. artificial intelligence and PropTech. Currently, a blockchain infrastructure requires significant amount of energy to power the computers working on the calculations and to cool them off. Hence, it would be useful to gauge how energy consumption interplays with resource allocation and sustainable economic activity in the blockchain context.

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# Evaluating Corporate Personhood Through Bankruptcies: A Law Firm vs. A Corporation

Audrey Youn

## **Abstract**

*In order to evaluate corporate personhood and the idea of “separateness,” this paper will analyze two types of firms: a partnership, where there is no separation between the owners and controllers, and a corporation, where there is separation. One of the essential ideas behind corporate personhood is that the shareholders are not held liable for their debts, which is a key element when a firm files for bankruptcy. This paper will view corporate personhood through the bankruptcies of Dewey & Leboeuf, the largest law firm bankruptcy, and Lehman Brothers, the largest corporate bankruptcy, to see how the owners of a firm are treated.*

## **1. Introduction**

When analyzing the corporate form and corporate governance, the idea of corporate personhood provides an interesting foundation for these issues. The concept of corporate personhood, which “simply expresses the idea that the corporation has a legal identity separate from its shareholders,” has attracted much criticism, evoking ardent disapproval of a profit-driven corporation having the same rights as a human being (Greenfield, 2015). However, legal scholars have pointed out that “the protestations of such movements. . . do not clearly illuminate how the Court’s decision impacts less disaffected constituencies, such as shareholders of commercial, for-profit corporations” (Nemetz, 2016). The legal doctrine outlining that a corporation is an artificial person distinguishes the legal interests of the entity from those who contribute capital to it, the shareholders. This relationship allows shareholders to be free from liability for the corporation’s debts, an important consideration when analyzing corporate bankruptcies. Although the debate for corporate personhood extends into detailed caveats regarding specific constitutional rights, this paper will not delve into legal or moral arguments regarding free speech, campaign finance, religious freedom, etc. Instead, this paper will reflect on the general interpretation of personhood, which is that corporations are separate legal entities from their owners, and how this separateness plays a part when a business decides to file for bankruptcy.

Although corporate personhood inherently only applies to corporations, this paper will highlight the benefits and consequences of personhood in the United States through the bankruptcies of not only corporations but also of partnerships, where there is no separation of controllers and owners. In particular, the legal industry is primarily composed of partnerships, and so I will compare the largest law firm bankruptcy and the largest corporate bankruptcy, emphasizing the role of

ownership and how the partners/shareholders were treated in both cases with regards to the repayment of debts. The largest law firm bankruptcy occurred when Dewey & Leboeuf collapsed in 2012, and the largest corporate bankruptcy occurred when Lehman Brothers collapsed in 2008. I recognize that these are not perfect comparisons, as the economic context and respective industries of these firms contributed to their bankruptcies in unique ways. However, this analysis highlights the implications of personhood once a firm has begun to collapse, and how the owners are treated once bankruptcy has been filed.

### **2. Understanding corporate personhood**

The idea of corporate personhood traces America to its founding. Contrary to popular belief, “this land was first colonized not by religious dissenters but by a business corporation” (Winkler, 2018, p. 6). Colonists held profit-seeking motives in their journey to America, aiming to earn a return for themselves as well as the shareholders of the corporations sponsoring their colonial expansion. In recent political partisan semantics and Supreme Court cases, corporate opponents have come to abhor the idea of associating personhood with a business enterprise. However, like Harvard Law School dean Robert Charles Clark once wrote, “One of the law’s most economically significant contributions to business life. . . has been the creation of fictional but legally recognized entities or ‘persons’ that are treated as having some of the attributes of natural persons.” Interestingly as well, corporate personhood can also impose restrictions on a corporation. In fact, in 1809, in *Bank of the United States vs. Deveaux*, the lawyer representing the Bank, a corporation, sought to “make the corporation invisible” in order to convince the court to allow the Bank the same rights as its members. The Bank was trying to gain access to the federal court in order to protect itself from local state prejudice, a maneuver similar to what its individual members would have been able to execute. Here, the lawyer tried to “pierce the corporate veil,” a rare concept that is used today only in cases where the corporate form is used to commit fraud or wrongdoing. In this case, corporate personhood *hurts* the corporation, as it would prevent the Bank from using the rights of its owners to its advantage, and rather only gives the corporation its own legal identity at its disposal. Corporate personhood is not simply a greedy, pro-business identity that those in power use to make a profit, but rather a complex legal concept that has its own implications in different contexts (Winkler, 2018).

Even though piercing the corporate veil is rare, corporations can sue other entities or be sued itself. Corporate personhood is evidently “not only a mechanism for the creation of wealth (by encouraging investment), [but] it is also a mechanism for enforcing accountability (by providing a deep pocket to sue)” (Greenfield, 2017). The latter comment is especially relevant when corporations are on the hook for criminal or negligent activity. Instead of forcing shareholders into bankruptcy from crippling litigation settlements and fees, the corporation is used to provide real compensation and real accountability. For most major corporate lawsuits, individual shareholders do not hold enough wealth to fully pay the

settlements anyway—holding the corporation responsible provides the “deep pocket” to adequately settle these lawsuits (and bankruptcy estates).

### **3. Understanding bankruptcy**

Bankruptcy, like the corporate form, has long been instilled in the United States’ history. The United States Constitution places bankruptcy under federal jurisdiction, and Congress has enacted statutes that govern bankruptcy throughout the country, both for individuals and businesses. With regards to corporate governance, “for debt to be an effective source of discipline, it must be backed by an appropriate bankruptcy procedure.” (Paizis, 2018). However, this paper simply uses bankruptcy as a lens to analyze the merit of corporate personhood and its “separateness,” rather than evaluating bankruptcy as a corporate governance mechanism. As shareholders of a corporation are not liable for the debts of the corporation, bankruptcy can highlight the consequences of this relationship that owners have with the firm.

When a publicly listed company declares bankruptcy, the company’s shareholders *may* be entitled to some of the liquidated assets, however the stock itself will become worthless. (Lee, 2018) Although shareholders are not liable for the company’s debts, the only recourse they have is to hope there is money left over after the firm liquidates their assets. A trustee is assigned by the bankruptcy courts and is responsible for handling the business’s bankruptcy estate. Depending on what chapter the business decides to file, the estate is handled accordingly by the trustee.

### **4. Understanding the structures of law firms**

In order to analyze how corporate personhood “separateness” treats owners when the firm goes bankrupt, this paper will look at the collapse of corporations. In contrast, this paper will also examine the case of law firms, where those who control the company are also the owners. In fact, the American Bar Association publishes the Model Rule of Professional Conduct, which “effectively requires every firm in the United States to be owned by its partners.” As owners of the firm, partners get compensated with shares of the profits, as opposed to a fixed salary. Although their liabilities may be limited, they are not necessarily protected from crushing personal liabilities that arise after a collapse. On the other hand, the staff, associates, and any other employee are contractually compensated with a wage or salary and face no liabilities. This industry standard of the structure of law firms plays an important role in how bankruptcy will be used to analyze the implications of separation in a firm (Morley, 2017).

### **5. Largest law firm bankruptcy: Dewey & LeBoeuf**

When Dewey & Leboeuf, a global law firm with over 1,000 attorneys, filed for bankruptcy it became the largest law firm to collapse due to “financial miscues and partner defections” (Lattman, 2012). Some have “attributed Dewey’s sudden and astounding collapse to the fraud of its managers.” However, Dewey & Leboeuf had been founded in 1909, with over a century of prestige and profit to

show for its success. In fact, Dewey was far from being insolvent and actually remained profitable almost up until the day they dissolved. A more likely explanation for Dewey's collapse lies in the ownership structure and "the tendency of partners to run in the face of declining profits" (Morley, 2017).

In early 2012, the firm retained its own bankruptcy attorney and later that same year, filed for bankruptcy. Further insight into their collapse shows that "partner ownership create[d] a set of incentives that might have pushed Dewey to a swift and deadly end even if its manager had been completely honest" (Morley, 2017).

Although businesses commonly go bankrupt due to rising costs and insufficient revenues, "guaranteed partner salaries alone could not have driven the firm to be incapable of paying its debts because, as we have already seen, partner ownership gives law firms freakishly robust capital structures." (Morley, 2017). However, once a firm showcases weaknesses, a domino effect is likely to ensue.

### **5.1. Partner Runs**

Partner runs provide one key explanation for why high-performing law firms, such as Dewey, can collapse with impressive force and speed. Although Dewey decided to pay some partners in salaries as opposed to profit shares, this does not explain why other law firms who follow the standard partner compensation plan have collapsed quickly in a similar fashion to Dewey. In fact, "a focus on partner ownership gives a clearer picture of why exactly Dewey started paying all these fixed salaries." These fixed partner salaries were used as recruitment incentives, particularly as security against the risk of profit decline. The ownership structure of law firms creates a set of incentives that lead to rapid collapses in the firm's financing. Similar to the concept of a bank run, once an important partner leaves the firm and takes their clients, the firm's financial position worsens and incentivizes other partners to leave or negotiate higher compensations, furthering the damage. Departing partners not only take clients, but they will often withdraw their capital and try to absolve themselves of any liability as insolvency looms (Morley, 2017).

The Dewey partners who sought fixed salaries were trying to avoid the damage that is ultimately done to partnership owners when a firm suffers by assuming the role of a creditor, as opposed to an owner. A salary is a "kind of debt because it represents a contractual obligation that has to be paid in a fixed amount at a fixed moment in time" (Morley, 2017). This distinction is especially important during the bankruptcy process, as this is when the courts must decide who is liable and who is owed debts.

### **5.2. Personal Liability**

Partners of a firm also face potentially debilitating personal liability following dissolution. "Although the shield of limited liability will protect the partners from general personal liability for the firm's debts, this shield will be useless against a variety of indirect claims that flow from the partners' status as owners and come out of the laws of fraudulent transfers, preferential transfers, and

unfinished business” (Morley, 2017). The fear of these consequences can further accelerate a partner run.

Once the partner run has occurred and the firm has filed for bankruptcy, many partners are still in danger. One major liability comes from the doctrine of fraudulent transfers, which exposes a partner’s compensation because it is technically a profit distribution and not a wage (*Investopedia*, 2018). Since profits do not *have* to be distributed to the partners, they are considered as gifts and can be recoverable by creditors. Because law firms typically do not have many assets to liquidate, creditors will make claims against the partners themselves, which could even bankrupt them personally.

### **5.3. Dewey’s Bankruptcy Estate**

Dewey’s potential liabilities totaled an estimated \$560 million once they sought Chapter 11 protection. Restructuring experts devised a new settlement option for Dewey, called The Partner Contribution Plan, which asked former partners to contribute a portion of their compensation in exchange for a release from liability from future lawsuits, like those regarding fraudulent transfers (Liftland, 2012). In this respect, the partners contributed their own money to the bankruptcy estate in order to safeguard themselves from future liability. However still, “the partners [were] collectively expected to lose tens of millions of dollars they had tied up in the firm,” while their “devastated” employees were forced to find “work in a difficult market” (Lattman, 2012). In reality, the “settlement require[d] former Dewey partners to pay. . . between \$5,000 and \$3.5 million individually, in exchange for a release from potential lawsuits,” totaling at least \$71.5 million (Sullivan, 2012).

## **6. Largest corporate bankruptcy: Lehman Brothers**

The largest corporate bankruptcy in the history of the United States occurred in 2008 when Lehman Brothers suffered a drastic loss in its stock value, a massive exodus of most of its clients, and devaluation of assets by credit rating agencies. The Lehman Brothers’ collapse “led to the lay-off of 26,000 employees, triggered 80 insolvency proceedings of its subsidiaries in eighteen countries, and resulted in more than 66,000 claims on its insolvency estate (Dosdall & Rom-Jensen, 2017). Lehman, like Dewey, had been around for over a century. This paper does not address the 2008 financial crisis or the reasons for Lehman’s bankruptcy unrelated to its corporate structure since a discussion of financial market crashes is not relevant to this topic.

### **6.1. Lehman’s Bankruptcy Estate**

Ten years after filing for bankruptcy, Lehman’s estate is in its final phase of completion. As of September 2018, the trustee had administered a total of \$123 billion of assets (Lehman Brothers Inc., 2018). In 2016, the estate had a boost in recoveries, which came from gains in the estate’s real estate, derivatives, and private-equity investments. As noted in the earlier discussion on corporate personhood, corporations are able to take responsibility for settling debts with their

own assets, as opposed to dipping into the wealth of individual shareholders. For example, Lehman held a stake in the Formula One racing circuit, in an amount of about \$530 million. Lehman also had about \$5.7 billion in other investments to unwind for more money to pay creditors (Fitzgerald, 2016).

### **6.2. The Shareholders**

As discussed earlier, shareholders, although not held liable for debts, are not entitled to any compensation if the firm goes bankrupt. In 2016, former senior Lehman employees attempted to recoup hundreds of millions of dollars of stock awards that became worthless after the firm's collapse (Stempel, 2016). In 2016, a judge's verdict upheld a similar decision made in 2014 when Lehman argued that the Bankruptcy Code mandates that these types of claims have the same priority as common equity. The court had sustained Lehman's objections, denying the assertions of these employees' claims under section 101(5) of the Bankruptcy Code (Lehman Brothers Holding Inc., 2014).

However, shareholders were still able to sue the corporation. In 2011, "formal officials. . . including Richard S. Fuld Jr., its former chief executive, [had] agreed to pay \$90 million to settle a shareholder lawsuit that accused them of misleading investors about the investment bank's health. Due to the corporate structure, the Lehman officials requested that the bankruptcy judge release the insurance proceeds to settle the lawsuit. In fact, "it is common for insurance proceeds to cover corporate directors and officers in shareholders' lawsuits" (Lattman, 2011).

## **7. Analysis & Conclusion**

When analyzing these bankruptcies separately, the liability, or lack thereof, of debts plays a crucial role in how the bankruptcy estates were handled. First, the partners at Dewey were subjected to damaging personal liability, even if they had left the firm before its insolvency. Not only does this arrangement incentivize partners to leave a declining firm as quickly as possible, but the capital and clients that they take with them further motivates the exodus of more partners. Ultimately, the lack of separation creates bad incentives, yet it is not clear whether it is "bad" that the partners must pay out of their own pockets for the bankruptcy estate. In fact, it is possible that the partner runs are further worsened by the existing bankruptcy rules that impose arguably unfair liability on the partners after insolvency. While the partnership structure does play a large part in the speed at which a firm declines, it is difficult to isolate the effect of the structure as law firms are fairly unique businesses—they are largely human capital driven and do not have many assets to liquidate.

Secondly, it is evident that the legal entity status of Lehman Brothers had a large impact on how its bankruptcy estate was handled. Providing the "deep pocket" it used to pay back its debts, which individual shareholders would not have been able to do, Lehman used its personhood in multiple ways. First, its stakes in other investments contributed largely to the final amount they were able to pay back creditors. These stakes were owned by Lehman Brothers, not its shareholders,

adding to its repayment capability. Secondly, Lehman used its corporate insurance proceeds to cover lawsuit settlements to shareholders. Again, it is difficult to evaluate the morality of this arrangement, however, it is evident that the corporation provided the funds necessary to pay the shareholders, even in the case that the executives would not have been able to. Other shareholders were not so lucky, as their shares became worthless. Corporate executives who owned stock awards at the time of insolvency were not allowed to recoup that compensation, highlighting a potential corporate governance incentive. Regardless, there is nothing comparable in the Lehman case to the partner run that occurs at bankrupt law firms. This paper did not touch on the causes of Lehman's bankruptcy, so it cannot be said how "separateness" played a part in slowing or facilitating their decline.

In conclusion, corporate personhood and the concept of "separateness" evidently does play a role in how firms operate under bankruptcy, whether they are partnerships or corporations. The lack of separation seems to accelerate the decline of law firms, however, other variables could play larger roles. Similarly, personhood seems to provide a net benefit when a corporation is filing for bankruptcy, that is, in terms of accumulating enough wealth and absolving shareholders of liability. However, the ultimate effect of personhood on a firm's success cannot be concluded, due to the differing natures of these firms. Nevertheless, corporate personhood remains a complex and an essential concept that will hopefully give more insight with further investigation.

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# An Infrastructure-Based Poverty Trap and Multiple Equilibria in Zimbabwe's Manufacturing Sector

Virginia Zhang

## Abstract

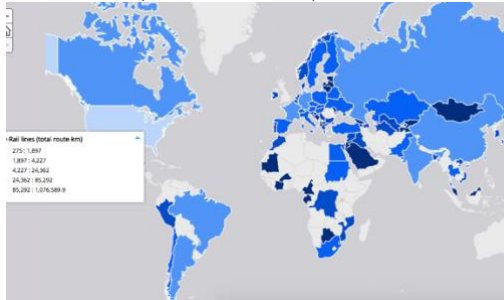
*Poverty traps exist across many developing contexts, from undernutrition and unemployment to corruption and limit to credit access. In such contexts, an economy will experience persistent underdevelopment due to poor initial conditions and coordination failures, until it receives a significant amount of targeted investment. In this paper, I apply the poverty trap theory to the Zimbabwean manufacturing sector to investigate how the sector's decline in recent decades can be explained by poor conditions in necessary infrastructure. I first assess observed data to hypothesize relevant linkages between infrastructure quality and manufacturing sector growth and describe the mechanisms of poverty traps. I then build a model of multiple equilibria for Zimbabwean manufacturing profits as a function of infrastructure capacity, and simulate it using World Bank data on Zimbabwe's infrastructure from 1985-2015. Simulation results show that consistent depreciation in infrastructure capacity inhibits manufacturing sector growth, and the effects become more severe over time. Lastly, I discuss two industrial policy strategies that Zimbabwe and other developing countries facing similar traps can use to offset dynamic depreciation and spur manufacturing growth.*

## 1. Observed Relationships between Infrastructure and Macroeconomic Outcomes

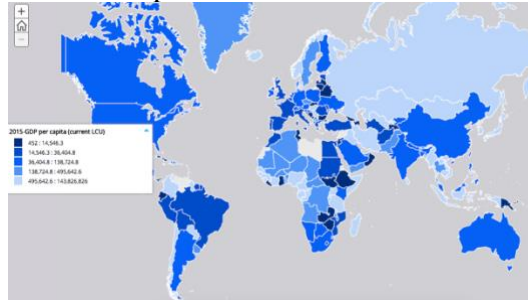
Based on the following observed data from the World Bank, there seems to be a correlation between a country's infrastructure capacity, GDP per capita, and manufacturing productivity. As shown below, countries geocoded with lighter shading have better initial infrastructure conditions (indexed by electricity, internet, and air transport). These countries tend to have higher GDP per capita and manufacturing value added as well. Is an infrastructure-based poverty trap driving these observed correlations? If there is such a poverty trap, how can it explain the patterns in Zimbabwe's declining manufacturing sector in the past few decades?

## Infrastructure Initial Conditions Macroeconomic Outcomes (2015)

Rail Lines (total route-km)



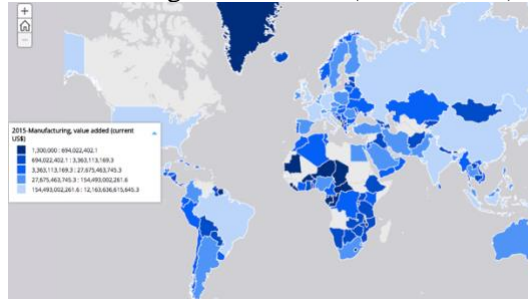
GDP Per Capita



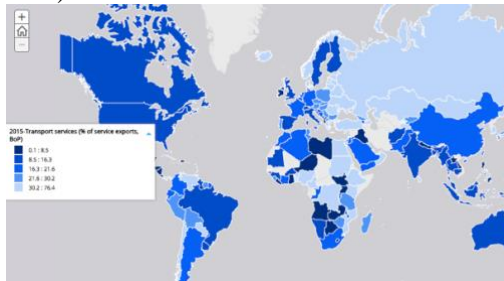
Electricity Access (% of population)



Manufacturing Value Added (current USD)



Transport Services (% of service exports, BoP)



Source: World Bank World Development Indicators

## 2. Observed Macroeconomic Trends for Zimbabwe

According to data from the World Bank's World Development Indicators, Zimbabwe's macro-economy has experienced many boom-bust cycles in recent decades. GDP per capita growth has been negative in many years, especially since the 1990s. During the same time, the manufacturing sector declined.



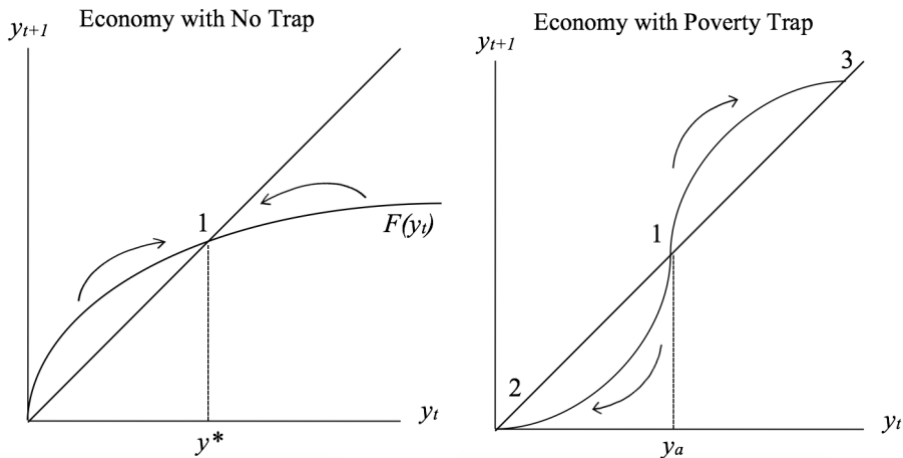
### 3. Linkages Between Zimbabwe's Infrastructure and Manufacturing Sector

Most of Zimbabwe's major roads and electricity networks were built before the country's independence was established in 1980. The roads connect Zimbabwe to all four neighboring countries and trade partners. However, the national government has been unable to adequately repair or update its infrastructure since construction, mainly due to a series of crises. These include a severe drought in 1992, the withdrawal of IMF support after defaulting on \$110 million in loans, reduced FDI, and hyperinflation (Brett, 2005). Zimbabwe currently spends about \$0.8 billion on infrastructure maintenance annually, but \$0.7 billion is lost every year due to various forms of coordination failures (Pushak and Briceño-Garmendia, 2011). There has not been a large-scale power infrastructure expansion since 1988, and only 60% of existing power systems function efficiently. In 2015, Zimbabwe's manufacturing firms operated at an average of only 34% of their capacity. Domestic news reports attribute these inefficiencies to increased power outages and outdated physical capital (Bhebhe 2015).

#### 4. Poverty Trap Mechanisms

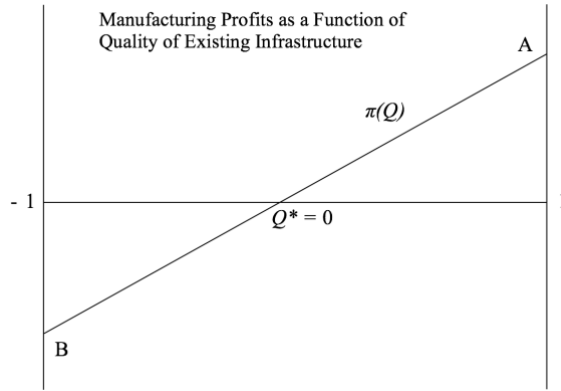
In development economics, poverty trap theories attempt to explain how certain economies remain poor due to self-perpetuating conditions. What distinguishes poverty traps from bad market outcomes like recessions is that poverty traps are dynamic and will persist over multiple periods unless a significant exogenous force pushes the economy past its unstable equilibrium, and out of the trap. It is important to note that not every case of underdevelopment can be explained by poverty traps.

The following graphs compare two economies: one without a poverty trap, and one with. In an economy with no poverty trap, initial conditions are independent of long-run growth, because in the long run, the economy will converge to the stable equilibrium (1) at  $y_{t+1} = y_t = y^*$ . But in the presence of a poverty trap, initial conditions will determine the economy's outcome. If initial conditions are below a threshold ( $y_t < y_a$ ) then the economy will slip to a bad outcome at equilibrium in the long-run (2) and remain there unless there is a significant enough positive exogenous shock (e.g. foreign aid or investment) to push the economy above the 45-degree line and out of the unstable equilibrium. If ( $y_t > y_a$ ), then the economy will remain at the good outcome at equilibrium (3). Point (1) in the economy with a poverty trap is an unstable equilibrium.



#### 5. Building a Multiple Equilibria Model For Zimbabwe

I create a model for multiple equilibria based on the previously cited macroeconomic data, official reports, and news articles. This model explains how Zimbabwe's manufacturing sector profits will be in a good or bad state depending on its initial conditions in manufacturing-relevant infrastructure.



In this model, the profits for Zimbabwe's manufacturing sector are represented as a function of the quality of relevant infrastructure.  $Q^*$  represents the change in quality of existing rail lines, electric systems, and transport services used by manufacturing firms, relative to its current state. At  $Q^* = 0$ , the government provides the minimum amount of investment to maintain constant infrastructure capacity, just enough to avoid depreciation. If infrastructure maintenance falls short of this minimum amount, then over time, infrastructure will continue to decrease, and maintenance costs will increase until the model slides to the bad equilibrium (B). Here,  $Q = -1$ , which indicates that the government has failed to repair its old infrastructure, to the point where existing infrastructure depreciates completely and is useless to manufacturing firms (for example, an increase in power outages and highway potholes will raise operational and transportation costs to the point where manufacturing firms that consume this infrastructure earn negative profits). But if the government invests beyond  $Q^*$  and actively works to improve the quality of its existing infrastructure (e.g. by implementing new technologies, expanding transportation networks), the model will slide to the good equilibrium (A). Here, at  $Q = 1$ , infrastructure capacity is doubled, returns to manufacturing increase, and the domestic manufacturing sector earns higher profits.

## 6. Manufacturing Output

Having well-maintained and higher quality infrastructure will make manufacturing firms more productive. To simplify the model, I assume that labor is the only manufacturing input, and that labor productivity is enhanced by the quality of infrastructure. If manufacturing firms are at equilibrium (B), their output will be  $Y(Q = 0) = 0$ . Here, infrastructure quality is so low (e.g. machines stop working because of unreliable power supply) that the manufacturing firms cannot produce any output. But if manufacturing firms are at equilibrium (A), then their output becomes  $Y(Q = 1) = L$ . Here, high-quality infrastructure allows the firms to produce at their full capacity.

## 7. Manufacturing Profit

I assume prices for manufacturing goods are normalized at 1. Quality infrastructure means that firms will require less labor to be just as productive, so  $L$  becomes  $L/Q$ . As more firms demand infrastructure, and investments are made to improve infrastructure quality,  $Q$  becomes larger. As the sector moves towards equilibrium (A), manufacturing firms that utilize the high-quality infrastructure will see increasing returns to scale, and thus become more attractive to manufacturing workers than the firms who have not yet utilized that infrastructure. As a result, those firms will have to raise their wages ( $1+v$ , where  $v$  is the good infrastructure premium). Firms will face a fixed cost of  $F$  units of labor to adapt to the improved infrastructure (e.g. by designing more complex products with more intermediate inputs, facilitating more outsourcing and procurement contracts with firms in neighboring countries).

Putting this together, the profit for manufacturing firms in the good equilibrium is:

$$\Pi(Q) = QL - [F + L(1 + v)]$$

Bad Equilibrium (B), $Q = -1$	Unstable Equilibrium, $Q^* = 0$	Good Equilibrium (A), $Q = 1$
Manufacturing Profits < 0	Manufacturing Profits = 0	Manufacturing Profits > 0

## 8. Model Simulation Using Data on Zimbabwe's Infrastructure

I create a simple index to measure the quality of relevant infrastructure to manufacturing. As explained above, studies and reports suggest that the concern for Zimbabwe's infrastructure is more about quality than quantity. Because of this, I use data on the existing *quantity* of Zimbabwe's infrastructure, and simulate how manufacturing capacity and thus profits would change if the government were to leave be, maintain, or actively improve the *quality* of this existing infrastructure. I study Zimbabwe's rail lines, electrical systems, and transportation infrastructure from 1985-2015 using data from the World Bank's World Development Indicators.

Existing Forms of Infrastructure	Relevance to Manufacturing Profits
Rail lines (total route-km)	Broader consumer base, foreign exports Outsourcing complex intermediate inputs Efficient transport
Electric power consumption (kWh per capita)	Reliable power source for machines, EOS Higher capacity utilization Less revenue lost to power outages
Transport services (% of service exports, BoP)	Exporting products via highway, air, other forms of infrastructure besides rail

I create a simple index for the *quantity* of existing infrastructure by summing up annual data on Zimbabwe's rail lines, electricity consumption, transport services from 1985-2015, and then dividing the sum by 100 (for the sake

of having simpler values). But the key is to measure the *quality* of this infrastructure. So, I use this annual quantity index to represent  $Q^*=0$ , that is, how useful relevant infrastructure would be to manufacturing firms if its quality remained constant. Then, I multiply the annual quantity index by 0.8, 0.6, 0.4, 0.2, and 0 to simulate a reduction in infrastructure capacity due to bad coordination and depreciation. In the multiple equilibria model, this represents sliding from  $Q^* = 0$  to  $Q = -1$ , or from the unstable equilibrium to the bad equilibrium (B). On the other hand, I multiply the annual quantity index by 1.2, 1.4, 1.6, 1.8, and 2 to simulate improvements in infrastructure capacity due to good maintenance, modernization, and expansion. This represents sliding from  $Q^* = 0$  to  $Q = 1$ , or from  $Q^*$  to (A). I then repeat this process for every year from 1985-2015.

I then plug this modified data on annual infrastructure capacity into the model's profit function. To make numbers simple and uniform, I assume that the typical Zimbabwe manufacturing firm has  $L=500$ ,  $F=\$20,000$ , and  $v=0.3$ . This generates the model for manufacturing profits as a function of infrastructure quality for each year from 1985-2015. The following graph shows the simulation results for four select years.



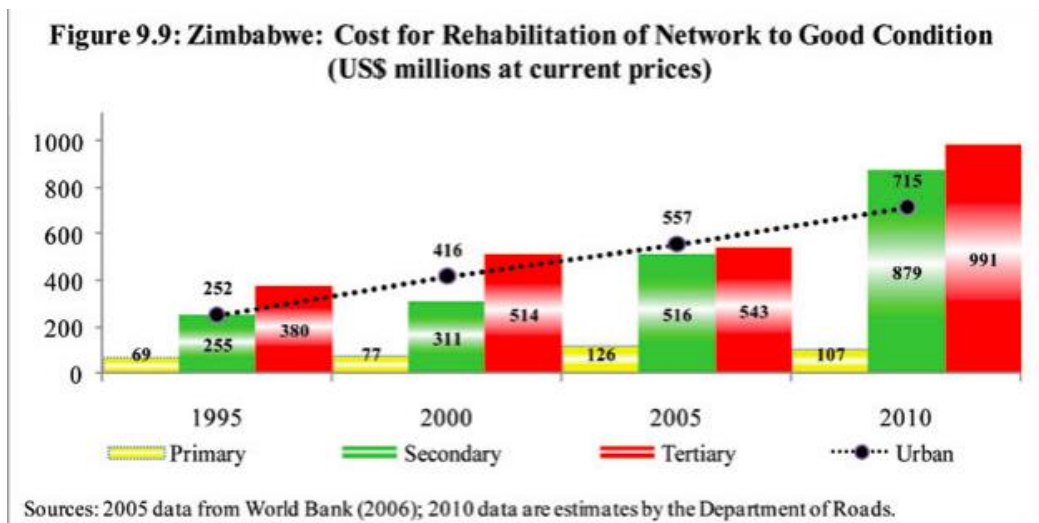
## 9. Discussion of Simulation Results

In the above simulation, the slopes of the manufacturing profit functions become flatter throughout time. The minimum investment threshold  $Q^*$  was only about 0 in 1985 but rose to about 0.3 in 2015. These two findings suggest that as time goes on, larger investments in infrastructure maintenance and quality improvements are needed to deliver the same level of benefit for manufacturing profits. As a result, the longer the Zimbabwean government waits to take action,

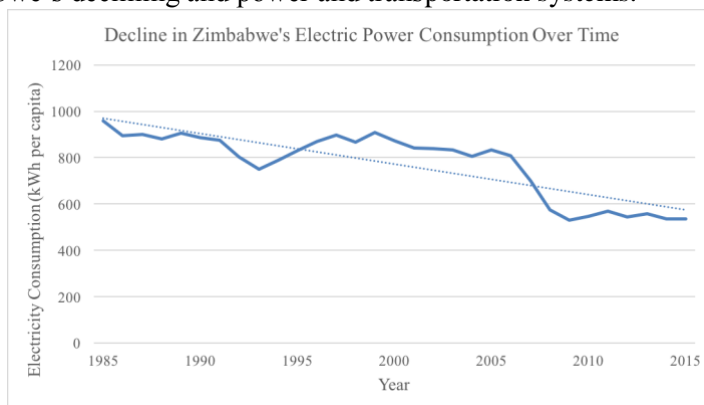


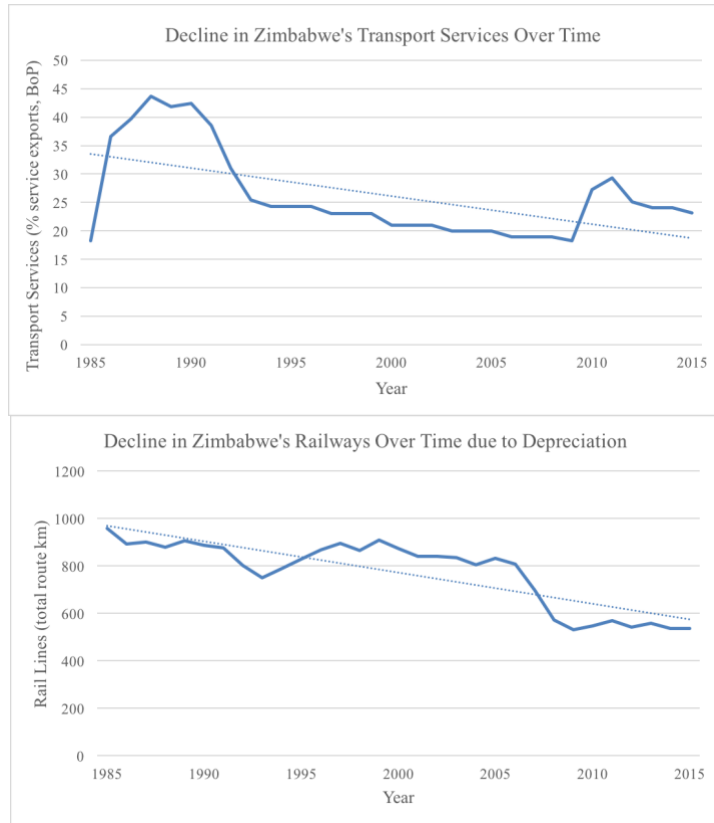
the more difficult it becomes to maintain, not to mention grow, its manufacturing sector. Due to the dynamic nature of this issue, we can infer that Zimbabwe's manufacturing sector has been stuck in an infrastructure-based poverty trap.

These findings are supported by a 2011 Africa Development Bank report. The report states that the past few decades of coordination failures and infrastructure depreciation in Zimbabwe have caused a steady increase in costs for maintenance programs. In its action plan for Zimbabwe's infrastructure system, the ADB places emphasis on "priorities for rehabilitation" of *existing* infrastructure before investing in new infrastructure projects (ADB 2011).



These findings are also consistent with the following observed trends on Zimbabwe's declining and power and transportation systems.





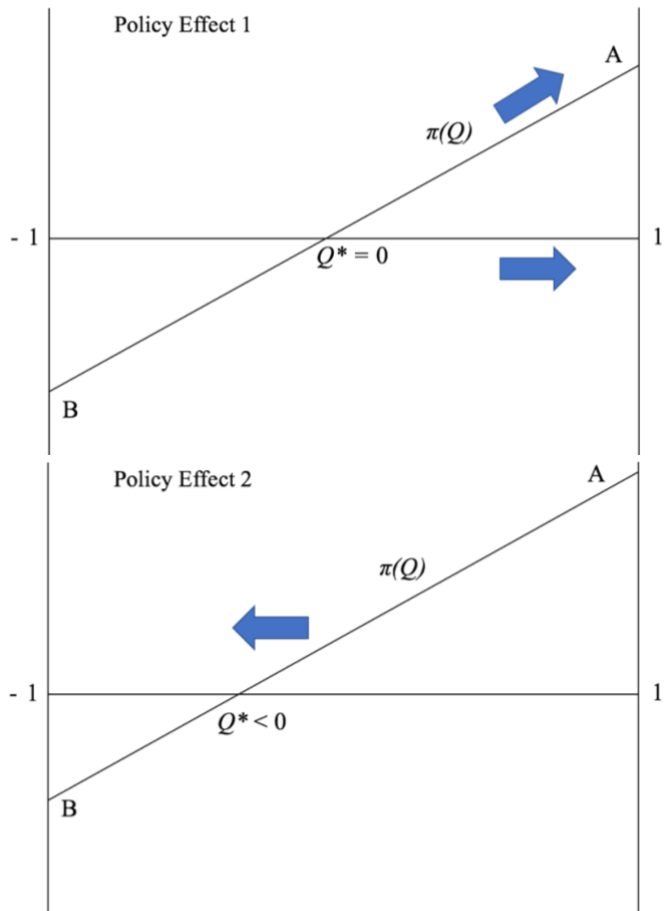
## 10. Two Policy Requirements for a Big Push

Relevant infrastructure, like highways, railroads, and power systems will depreciate over time unless properly maintained. This has been true for Zimbabwe, due to coordination failures and the previously mentioned crises since the 1990s. Unreliable and low-quality infrastructure limits manufacturing firms' efficiency and scale of operation, and makes domestic manufacturing unattractive for FDI, among other negative consequences for development. If Zimbabwe were to maintain its existing infrastructure at the minimum level to offset depreciation, then the model would locate around point  $Q^*$ . If Zimbabwe were to actively expand and modernize its infrastructure, this would allow for domestic manufacturing to grow, and push the model towards equilibrium (A).

Industrial policy should simultaneously create two effects to make Zimbabwean infrastructure and manufacturing better off.

1) Endogenous Effects: Actively improve transportation and power infrastructure so that  $Q' > Q^*$  and the model slides towards the good equilibrium. This will increase infrastructure capacity, which will consequently raise manufacturing profits.

2) Exogenous Effects: Minimize the amount of investment needed to push  $Q' > Q^*$ , by making  $Q^*$  as low as possible. A smaller  $Q^*$  will lessen the burden of maintenance costs on the Zimbabwean government, thus lowering the threshold for manufacturing firms to escape the bad equilibrium. This is especially important given Zimbabwe's growing rehabilitation costs and ongoing recovery from the series crises in the 1990s: its infrastructure spending needs were 45.7% of its GDP as of 2009 (Pushak and Briceño-Garmendia 2011).



Optimistic economic policy solutions involve increased private and foreign investment in infrastructure. Combining public, private, domestic and foreign investment could address both of the above effects. Perhaps the Zimbabwean government can put a more concerted effort towards creating build-operate-transfer public-private-partnerships with domestic and foreign infrastructure construction firms.

To make this possible, potential investors must be convinced of long-run returns to investment. Studies have estimated that each percentage increase in power outages reduces long-run GDP per capita by 2.86% in Africa (Anderson and Dalgaard 2013). More country-level studies must be done in Zimbabwe, and any optimistic findings should be publicized to potential investors.

In the past decade, the Zimbabwean government has directed more attention to its growing infrastructure problems and their negative impacts on manufacturing. In April 2018, president Emmerson Mnangagwa reached out to China to discuss “areas for economic collaboration between Zimbabwe and China

including infrastructure, mining and transport” (Crabtree, 2018). Other politicians have spoken to domestic and international media about their intentions to improve coordination in infrastructure rehabilitation programs (Kazunga, 2018).

These initiatives may improve the international community’s expectations for Zimbabwe’s manufacturing sector, and encourage foreign and private investment in infrastructure. However, they have yet to be executed on a national scale. Until then, Zimbabwe’s infrastructure quality will remain trapped below  $Q^* = 0$ , and its manufacturing sector will continue to produce below optimal capacity.

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# Analyzing Healthcare in China: Resource Expenditure, Provision, and Optimization

Athena Eden Zander

## Abstract

*China has recently undergone extensive healthcare reform programs and policy changes. Currently, Chinese government policy implementation still struggles to efficiently meet and deliver upon healthcare demands. The purpose of this paper is to examine the relationship between government expenditure and individual wealth on the allocation of healthcare resources. Using China Statistical Yearbook data from 2014, a single time frame and cross-area ( $N=30$ ) comparison, regression analyses are conducted upon multiple models to operationalize the relationship between expenditure and resource provision. The models include combinations of government spending and per capita gross regional product regressed with dependent variables: beds, doctors, technical personnel, and nurses. As the relationships vary based on resources, the null hypothesis is supported, general government expenditure and healthcare expenditure do not have positive linear relationships with all dependent variables. The results of expenditure on beds are inconclusive. However, both doctors and technical personnel are extremely statistically significant related to Gross Regional Product (GRP) ( $p<0.000001$ ) while nurses were most affected by the combination of government expenditure and GRP with statistically significant results ( $p<0.000001$ ). The complex relationships between healthcare expenditure and healthcare resources supports the interpretation of inefficiency and the need for further reform or changes in the space.*

## 1. Introduction

This paper endeavors to investigate resource expenditure and allocation across all areas (地区) of China by operationalizing the relationship between government funding, individual wealth, and healthcare resources. The history of Chinese healthcare reforms, especially in the last century, has led to questions of resource delivery efficiency.

Initially, a Literature Review will be conducted to introduce key studies on the topic. The first study introduces the concept of resource disparity. In the following paper Zhang expands upon the idea of disparity and inequality. Shi's systems-model based paper includes similar variables to this paper, including resources and personnel variables. The final two studies discuss development, a relevant theme for this study. While some sources in the section discuss a rural-urban disparity in resource provision, this paper focuses on the resources themselves in order to drive deep into the data about resource delivery inefficiency.

The driving research questions are: To what extent does government funding relate to healthcare? Does government spending make a difference in the

provision of health resources? In other cases, does individual wealth have a larger impact? To answer these questions and discuss their implications, theoretical discussions from the literature review must be compared and expanded upon in the Theory section. A brief but thorough the Background discussion on Chinese healthcare policy decisions and reforms provides the necessary framework for understanding the current situation.

Within the Methodology section, the data is presented and summarized in a descriptive statistics table, followed by univariate and bivariate distribution histograms to further demonstrate the variables' relationships. Correlation tables and subsequent discussions, including the decision to log variables, are included to ensure clarity and transparency.

The Results of the study are analyzed and explained for thorough comprehension. In regressing government expenditure (general and healthcare-specific) and Gross Regional Product (GRP) per capita on healthcare resources, such as beds of institutions and personnel, we discover that the relationships are different. While there is no significant finding on the relationship between personnel types and beds of institutions, it is most directly related to health government expenditure. Licensed doctors and technical personnel have a significant relationship with GRP per capita, and registered nurses have a significant relationship with general government expenditure and GRP. The subsequent Discussion about the implications of the results shed light on the importance of the study for the future of Chinese policy, economy, and healthcare.

## **2. Literature Review**

The following papers were reviewed and analyzed to understand research previously conducted on modern Chinese healthcare—specifically the complex relationship between government expenditure and resource provision, along with optimization.

- 1) “Explaining Urban-Rural Health Disparities in China” by Fang et al.,

includes a time-spatial comparison of “patterns of health status and health care utilization.” The researchers obtained their data from the *China Health and Nutrition Survey* from 1997-2006. Their sample pool included nearly 40,000 urban and rural respondents. Notably, the measures chosen, including “health status,” were respondent-reported. The regression analysis results were clear: “self-reported health status of urban residents is consistently worse than their rural counterparts (OR = 0.76;  $P < 0.01$ ).” The paper concludes that “Urban residents appear to fare worse than rural residents in terms of overall health status and health care utilization in China.”

- a) The Fang paper differs from this paper in that it is based upon self-reports

as opposed to capital allocation and resources available. The aforementioned paper focuses on healthcare utilization, however, utilization of healthcare is endogenous. This paper works to analyze measures of healthcare availability, not personal characteristics or other

influencing factors. A further discussion about cultural beliefs is found in the Theory section.

2) Zhang Xiaobo's "Spatial Inequality in Education and Health Care in China"

published by *China Economic Review* in 2005 discusses the importance of inequality beyond income, "in other dimensions of human development." In a long-run time-spatial comparison of inequality, Zhang discusses the impacts of fiscal, urban, and rural reforms across China, taking data from Chinese state databases and the World Bank. Variables include per capita expenditure, beds in hospitals, and healthcare providers. He concludes, "in the era of market reforms, the old foundations of education and healthcare provision have eroded." Further, "many local governments, in particular those in poor regions with insufficient revenues have largely withdrawn from their role in investing in human development." This "erosion" and "withdrawal" may lead to human capital degradation and "social instability."

a) Zhang's paper discusses important aspects of inequality by measuring

differences between and within areas of China. For this paper, collecting these statistics proved challenging, so a comparison of expenditure on resources was chosen as the model of research. This paper and Zhang use similar variables: per capita expenditure, beds, and healthcare personnel. The results allow for human capital discussions.

3) Shi's "Health Care in China: a Rural-Urban Comparison After the Socioeconomic

Reforms" examines Chinese healthcare by spatial comparison. The author explains that his paper uses a "systems model" where the inputs are resources—professionals and institutions. Shi observes expected results, "health care spending, resource allocation, and distribution of facilities and professionals varies widely between rural and urban areas." While "differences in health outcomes are apparent," unlike the Fang study, Shi found that "urban residents have a better health status."

a) Shi's paper is similar to this one in his choice of resources. However, his

study uses these resources as inputs while this paper analyzes resources as outputs, with government spending as inputs. Further, this paper focuses heavily on the distribution of these resources on a quantitative level, while Shi's is predominantly theoretical.

4) "Urban–Rural Disparity in Utilization of Preventive Care Services in China"

written by Liu et al, aimed to analyze "how much of the urban–rural disparity was attributable to each determinant of utilization in preventive care services." The data was drawn from *China Health and Nutrition Survey* in 2011 with an N=12,976. The results were "household income was the most important factor accounting for 26.6% of urban–rural disparities in utilization of preventive care services." In regards to urban-rural disparity, the "percentage of rural residents utilizing

preventive care service was 5.1% while urban residents were at 9.3%.” The authors conclude that “despite government interventions to increase access utilization [...] rural residents are still underutilizing preventive health services.” This underutilization is a problem for China.

a) This 2011 study has results similar to Shi’s. The disparity between rural

and urban residents’ healthcare utilization is very apparent. Here, the authors used household income as an indicative factor, whereas this paper uses per capita gross regional product to measure individual wealth. Liu’s study also uses education to measure development as this paper does.

5) A joint 2003 study conducted by Harvard School of Public Health and the

Chinese Ministry of Health’s Center for Health Statistics and Information, “Medical Expenditure and Rural Impoverishment in China” examines the impact of medical spending on poverty rates in China. Using data from *China National Health Services Survey*, the survey concluded that “medical spending raised the number of rural households below the poverty line by 44.3%.” This is a significant finding and is supported by data from over 50,000 households.

a) This study investigates and displays a reverse causality of variables.

Whereas the Harvard study describes the relationship of medical spending on income, this paper compares income on healthcare (and its resources). Certainly, the 2003 study provides compelling results especially because the outcomes are very clear, healthcare and spending are inextricably intertwined.

### 3. Theory

As Zhang’s study explains, healthcare provision is one metric to measure human capital development. When financed by government expenditure, resource building can help display regional development. Health and healthcare is a metric of such development, as discussed explicitly in studies 2 and 4. Specifically, government expenditure has a relationship with the amount of healthcare resources available, as supported by studies 1-5.

Quantifying healthcare via rate of care or quality can prove challenging. Ronald M. Anderson’s “Revisiting the Behavioral Model and Access to Medical Care: Does It Matter?” analyzes “health beliefs” as “attitudes, values, and knowledge that people have about health and health services that might influence their subsequent perceptions [...] and use of health services.” Beliefs absolutely influence behavior; it is challenging to quantify a concept that is often qualitatively represented, but data analysis can assist in understanding quality care and health. Instead of quantifying the care experience, which can be endogenous, certain data points and resources available have been selected to quantify health.

To compare, describe, and analyze trends in healthcare it is key to specify an area and time of study. We have chosen to quantify the differences in healthcare resources available across all areas of China, based on the most updated data, in



the year 2014. This paper works to discover: to what extent does government funding relate to healthcare resource provision? Does government spending make a difference in the provision of health resources? Where there is not a connection, does individual wealth influence resource provision and optimization?

The driving theory is as follows: Government spending in China's socialist-market economy often relates to rural and urban development and predicts why differences in resource allocation exists. The aim is to find a connection between government spending and healthcare resource availability.

#### 4. Background

China's relationship with healthcare has certainly changed over time. From ancient herbal medicines to "barefoot doctors" during Communist times, to the advent of government insurance schemes and intersection of the public-private space within the context of healthcare, China has experienced drastic changes in the healthcare space.

The Great Leap Forward witnessed health issues, including famine and other tragedies. Still, metrics displayed a high level of country-wide health improvements, and "[between] 1952-1982 infant mortality rate decreased significantly and life expectancy increased" (Ramesh). The wealth of resources is typical of a centrally planned economy, and it is accepted that these levels have not fully returned, as mentioned in the Literature Review, specifically studies 3 and 4.

It is important then, to understand the current state of healthcare. Reforms have "played a leading role in China's fundamental pivot toward emphasizing social development." For example, "from 2000 to 2010, government investment as a proportion of healthcare expenses rose from 16% to 29%, while individual expenses fell from 60% to 36%" (Ling). This reduction of individual cost implies that policy reform rhetoric about emphasizing public goods delivery was supported by capital.

Healthcare resources available can be measured through various variables to quantify healthcare and quality in a few ways. Government spending, the primary cause, can be operationalized and measured via comparing the variable of government spending and government spending specifically for healthcare. The independent variables—government expenditure, health government expenditure, and gross regional product (GRP), relate to the dependent variables, healthcare resources—beds and personnel.

We hypothesize that health government expenditure has the strongest relationship with all healthcare resources. An increase in government spending results in a positive linear increase in resources available. The null hypothesis is healthcare spending does not have a significant positive effect on healthcare provision. An alternative null hypothesis is GRP has the strongest relationship with healthcare resource availability.

## 5. Methodology

The hypothesis will be studied and operationalized; the N=30 data set size implicates the need for regression analysis models to be run on each dependent variable. Due to the studies cited in the Literature Review, particularly study 2, and other background research, hospital beds and healthcare personnel are selected as dependent variables. Data was collected from *China Statistical Yearbook* 2016, though the variables had complete data sets from 2014, so these numbers were used.

There are four dependent variables—Beds of Medical Institutions (医疗卫生机构床位数), Total Medical Technical Personnel (卫生技术人员), Total Licensed Doctors (执业医师), and Total Registered Nurses (注册护士)—all of which are standardized “per 1,000 Population.” The two independent variables are General Public Budget Expenditure (地方一般公共预算支出), and Expenditure for Medical and Health Care, and Family Planning (医疗卫生与计划生育支出). This paper will refer to the former as “general government expenditure” and the latter variable as “health government expenditure” for simplification. Per Capita Gross Regional Product (人均地区生产总值) is the third independent variable. Gross Regional Product (GRP) is a measure of regional wealth. When normalized per capita, using *China Statistical Yearbook* population data, GRP roughly estimates individual wealth. The control is educational achievement, quantified by Average Number of Students per 100,000 Population to Achieve Higher Education (每十万人口平均在校学生数) to add descriptive information to the areas. The aim in choosing this control variable, referred to as “Higher Education Level,” is to account for “development.” Beijing, China’s capital, serves as the indicator variable to control for any effects that the capital would have. The “Capital” variable takes on “1” if Beijing is present. As discussed in *Cities and Stability: Urbanization, Redistribution, and Regime Survival in China*, capitals typically have symbolic importance that often translates to disproportionate allocations of resources to the capital and surrounding areas, so this disproportionate result is corrected for.

Variables are separated into spatial categories “地区- Area.” There are 30 areas in all: municipalities, such as Beijing and Shanghai, provinces, such as Jiangsu, and autonomous regions, such as Inner Mongolia and Tibet. All monetary amounts are measured by “单位: 亿元,” units of 100 million yuan.

## 1. Summary Table of Descriptive Statistics

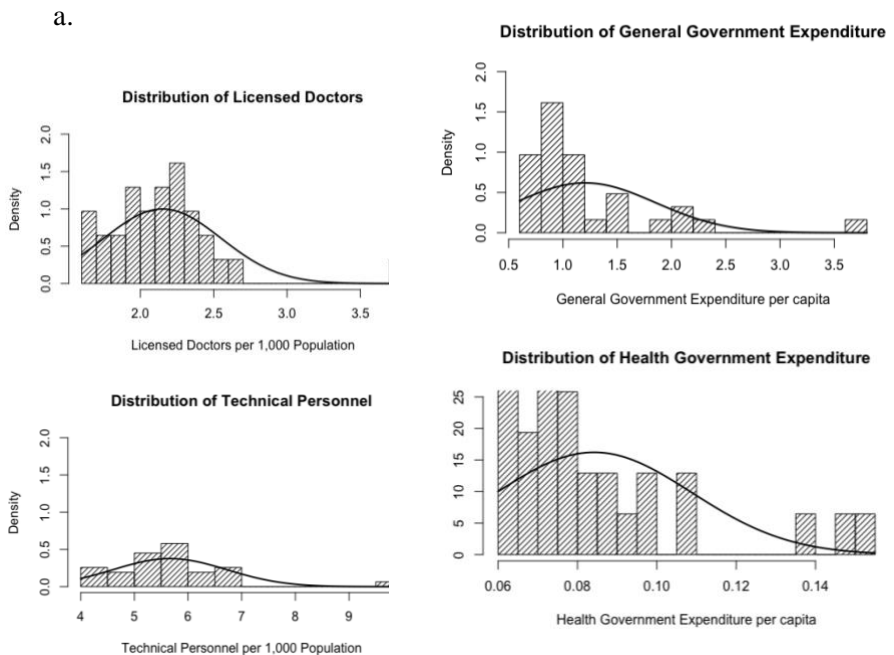
Variable	Min	Max	Mean	Standard Deviation	N
Beds of Medical Institutions	3.750	6.220	4.857	0.6202	30
Medical Technical Personnel	4.050	9.910	5.662	1.0424361	30
Medical Technical Personnel (log)	1.399	2.294	1.719	0.1687045	30
Licensed Doctors	1.600	3.720	2.151	0.39320318	30
Licensed Doctors (log)	0.4700	1.314	0.7513	0.1691524	30
Nurses	0.850	4.110	2.219	0.50926729	30
General Gov. Expenditure	0.6334	3.728	1.2048	0.63453623	30
General Gov. Expenditure (log)	0.457	2.294	1.719	0.4149466	30
Health Gov. Expenditure	0.0605	0.154	0.0842	0.024201	30
Health Gov. Expenditure (log)	2.414	2.805	2.508	0.2526959	30
Gross Regional Product	26433	105231	50743	21721.5015	30
Gross Regional Product (log)	10.18	11.06	10.75	0.3952396	30
Higher Level Education Achieved	318	10724	4395	842.391925	30
Capital	0	1	(N/A)	(N/A)	30

## 2. Selected Univariate Distributions (Appendix contains further distributions and logs)

Dependent Variable: Note that the distributions appear similar (long right tail)

Independent Variables

b.



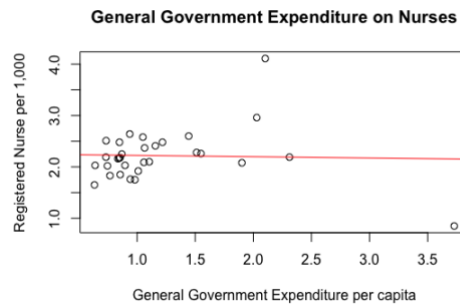


Both distributions of Government Expenditure have long right tails and skewed distributions. This is corrected for by transforming the abnormally distributed variables through logging. (See [Appendix](#) for Graphs)

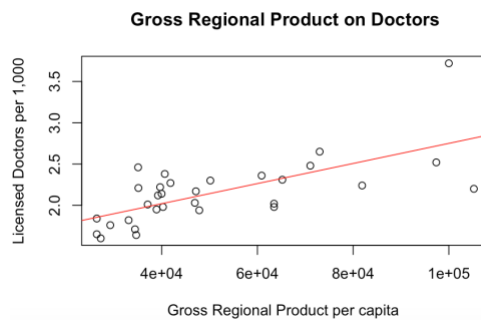
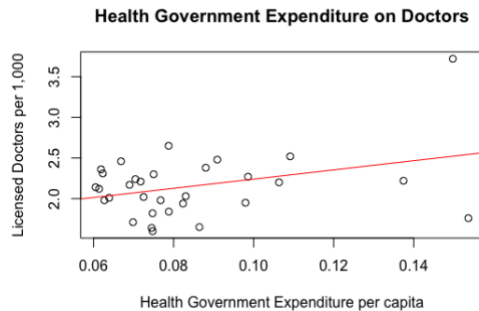
### 3. Bivariate Distributions ([Appendix](#) contains all distributions)

The bivariate distribution histograms displayed in this section demonstrate the various patterns of correlation between variables.

#### a. General Government Expenditure on Nurses



#### b. Health Government Expenditure vs. GRP on Doctors



As displayed, there are no clearly observable positive linear relationships, indicated by the nearly flat line of best fit. While the difference in slopes between health government expenditure versus GRP on doctors is clear, it is still not acceptable to say that a linear bivariate regression is enough to be sure of the most accurate model, thus multiple regressions must be conducted. Of note, in most cases the capital, Beijing, exists as an outlier, supporting the decision to use capital as an indicator variable.

#### 4. A Note on Correlations:

General government expenditure and health government expenditure are categorically similar, as supported by the correlation table. The two types of government spending do not appear together in models; the high (nearly +1) correlation would not assist in demonstrating the relationship between government expenditure and resources available.

	General Government Expenditure (per capita)	Health Government Expenditure (per capita)
General Government Expenditure (per capita)	1.00000000	0.9152299
Health Government Expenditure (per capita)	0.9152299	1.00000000

Alternatively, as demonstrated by the following correlation table, per capita GRP and education are not correlated. While we initially believed that since the variables are two measures of development, and thus would be correlated, they are in fact not so they can appear together in models as they predict different variables.

	Gross Regional Product (per capita)	Education Level Achieved (per 100,000)
Per Capita GRP	1.00000000	-0.02723425
Education Level Achieved	-0.02723425	1.00000000

Correlation is not causation, which is why the regression analyses aid in assessing the most important factors impacting the dependent variables.

#### 6. Results

To understand the relationships between the variables, regressions were run on a variety of multivariate models. The following tables present the regressions run on each dependent variable, displaying the different combinations of models. In all, model six “M6” represents the final model for each dependent variable.

# The Economics Review

1.

Linear Regression of Beds per 1,000 people, by Area-level unit, in 2014

	M1	M2	M3	M4	M5	M6
General Government Expenditure (log), per capita	0.870	0.830	-	-	-	-
Health Government Expenditure (log), per capita	-	-	0.2562	-	0.230	0.135
GRP (log), per capita	-	0.874	-	0.945	0.656	-
Higher Education Achieved per 10,000	0.871	0.783	0.3491	0.859	0.316	0.236
Capital (1=yes, 0=no)	0	0	0	0	0	1
Intercept	4.930***	4.360	3.199*	4.663	3.672	2.251
Model P Value	0.9713	0.9938	0.5108	0.9821	0.6761	0.4794
Adjusted R-squared	-0.0692	-0.1078	-0.02123	-0.07005	-0.05108	-0.01536
N	30	30	30	30	30	30

Significance codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

M6 has only one independent variable: health government expenditure (log). This regression displays the strongest relationship with the dependent variable, beds per 1,000. Still, the p value of 0.4794, is not significant. Further, the negative adjusted  $R^2$  means that there is a lack of positive relationship, it is in fact slightly negative.

2.

Linear Regression of Medical Doctors per 1,000 people, by Area-level unit, in 2014

	M1	M2	M3	M4	M5	M6
General Government Expenditure (log), per capita	0.062	0.85383	-	-	-	-
Health Government Expenditure (log), per capita	-	-	0.0957	-	0.61573	-
GRP (log), per capita	-	8.99e-05 ***	-	1.08e-05 ***	4.58e-05 ***	9.19e-05 ***
Higher Education Achieved per 10,000	0.283	0.71314	0.4338	0.411278	0.85282	0.70228
Capital (1=yes, 0=no)	0	0	0	0	0	1
Intercept	6.570e-01***	-2.43**	4.594e-01*	-2.480**	-2.224**	-1.826**
Model P Value	0.1527	0.0002089***	0.2186	4.746e-05***	0.000188***	2.258e-06***
Adjusted R-squared	0.06318	0.455	0.03883	0.4738	0.4595	0.6135
N	30	30	30	30	30	30

Significance codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Both licensed doctors and technical personnel had the same model. Here, “doctors” is displayed and “technical personnel” is in the [Appendix](#). Model Five (M6) shows the strongest relationship, GRP (log) on the dependent variable. Model four has the variable GRP (log) and the added indicator variable, capital, makes the regression even more significant, from  $p=4.746e-05$  to  $p=2.258e-06$ . This model also has the largest adjusted  $R^2$  value, meaning that a large majority of the dependent variable, licensed doctors, is determined by GRP.

3.

Linear Regression of Registered Nurses per 1,000 people, by Area-level unit, in 2014

	M1	M2	M3	M4	M5	M6
General Government Expenditure (log), per capita	0.481	0.21369	-	-	-	0.0291*
Health Government Expenditure (log), per capita	-	-	0.17043	-	0.706022	-
GRP (log), per capita	-	7.64e-05 ***	-	0.000101 ***	0.000328***	8.28e-05 ***
Higher Education Achieved per 10,000	0.707	0.21820	0.40384	0.673220	0.995383	0.1115
Capital (1=yes, 0=no)	0	0	0	0	0	1
Intercept	2.111***	-2.969**	3.919**	-6.888**	-6.249*	-1.682**
Model P Value	0.0007996	0.0007996	0.3757	0.000446	0.001588	1.088e-06***
Adjusted R-squared	-0.05058	0.3959	0.0009282	0.3825	0.4421	0.6644
N	30	30	30	30	30	30

Significance codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

The final dependent variable, registered nurses differs from the other personnel variables in that the regression of best fit involves the independent variables general government expenditure and GRP. The p value increases from  $p=0.001588$  to  $p=1.088e-06$  with the addition of the indicator. The adjusted  $R^2$  value means that a large amount of the result of nurses is dependent upon general government expenditure and GRP.

## 7. Discussion

The study includes several interesting results, which indicate that the relationship between government spending, individual wealth, and healthcare resources is a complex one. The null hypothesis is supported, an increase in health spending does not lead to a proportional linear increase in healthcare resources. The research question was about the relationship between public spending (measured by government expenditure) and/or individual wealth (measured by per capita GRP) on healthcare resources. Beds was the only variable with a model including health government spending. Two of the personnel dependent variables, doctors and technicians, were strongly related to only GRP. The Results section of this paper show that GRP, or “individual wealth,” is positively related to some personnel. However, the other personnel dependent variable, nurses, is dependent upon general government expenditure and GRP.

Firstly, the dependent variable beds of medical institutions is most strongly correlated with health government expenditure. However, the p value is not significant. Additionally, the slightly negative  $R^2$  indicates that other factors would better predict bed provision. The regression model results do not support a clear relationship.



Beds is dissimilar to all of the personnel variables. The two personnel models (licensed doctors and technical personnel) have a model of best fit that displays a strong statistically significant relationship with the independent variable GRP per capita. They share the same model but have slightly different significance values: Technical Personnel per 1,000 with  $p=4.644e-06$ ; and licensed doctors with  $p=2.258e-06$ .

In contrast, the other human capital resource, registered nurses, has the strongest relationship with general government expenditure and GRP. When health spending and GRP are regressed on nurses,  $p=0.001588$ , a comparatively less significant value, to general government and GRP (capital = 0) regressed on nurses:  $p=0.0007996$ . The addition of the indicator variable allows the model to become even more significant,  $p=1.088e-06$ .

The results of nurses' relationship with expenditure may differ because of skill differences, payment structures, availability, or other factors. Another potential mechanism leading to the regression result could be that in some urban areas, health institutions are without licensed doctors and are mostly staffed by nurses (Kalisch). This could mean that the budget support is coming directly from general government expenditure as opposed to health government expenditure.

These results do not support the hypothesis that government (general or healthcare) expenditure is consistently positively related with healthcare resources. However, the results could mean that these variables are not the best measures of government spending. Alternatively, the lack of patterned results could mean that government spending is generally not the best indicator of healthcare resources.

Many factors influence healthcare provision. Individual perspectives or beliefs on healthcare affect visits to healthcare institutions and could appear to lower individual relative demand. The lower demand for such resources may then result in a lower amount supplied, which is why there is such a broad distribution. We saw this in the beginning of the Data section, where the resources available had an abnormal distribution. This distribution, though corrected for by logging variables, could still have an effect on the expenditure to provide such resources. Other potential influencing variables could include individual city or rural institutional differences, lack of availability of skilled labor, and more. The tiered-leadership structure of the Chinese government allows for much discretion. Province-level, let alone township-level, leaders have a significant level of individual judgement, allowing them to choose which capital projects to invest more time, energy, and resources into. Though human capital development is important in the long term, the promise of individual gain from the positive result of a more visually-observable short-term project can be more incentivizing to many. As a result, there are systematically "weak public health functions" (*World Bank*) and less expenditure may be funneled towards healthcare resource allocation and optimization.

This paper's results could help inform a manager or policy maker's decisions on funding mechanisms supporting different healthcare personnel. Alternatively, it could help a hospital institutional planner predict the number of personnel they can expect to hire based on funding and GRP regionally. As the

private sphere increasingly develops in China, the government's inability to efficiently allocate resources could potentially lead to a market solution opportunity for private companies. Further, as demographics shift in future decades, there will be a change in the dynamics of demand and healthcare services, and this challenge to meet healthcare demand will increase.

## 8. Conclusion

The political economy of Chinese polity and reforms greatly impacts the experiences of Chinese people across the country. By studying all areas of China and modelling the relationships between funding and resource allocation, this paper presents the findings that healthcare resources have different relationships with funding. While it would logically make sense that government resource spending has a strong relationship with the resources available, this is not consistently the case. This gap between spending and resources is one that calls for further research. Especially as the Chinese market becomes increasingly less state-planned and the introduction of insurance impacts the country's healthcare, there are opportunities for private companies to potentially help fill the gap between capital and resources.

As China's healthcare sector continuously undergoes reform initiatives and change from within the government, the story of healthcare resources and quality may change. Ideally, allocation of resources will become more efficient through some combination of government work and individual expenditure. State accountability solutions and programs must be sourced. Undoubtedly, a degree of individual wealth is absolutely impactful upon resources and essential to understanding the current state of healthcare in China.

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- Liu Y, Rao K, Hu S. "Towards Establishing a Health Protection System for Rural China." *Beijing: Asian Development Bank*, 2003, pp. 17-21.

## Appendix:

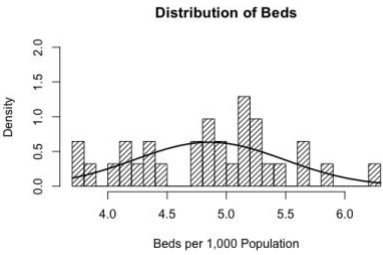
### Methodology

Notably, data comparison is challenging. For example, in 1996 the topic of "Health" itself was lumped into the group: "Sports, Public Health, Social

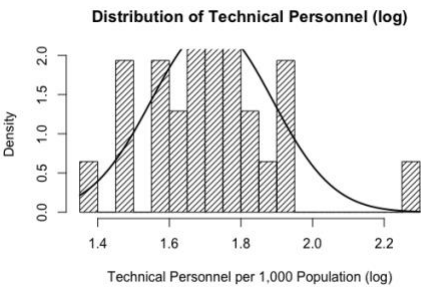
Welfare and Others.” Clearly, even twenty years ago, health was not of top concern for government officials and policy-makers. Luckily, by 2014 health received its own category: “Public Health and Social Services.”

Data:  
Univariate Distributions

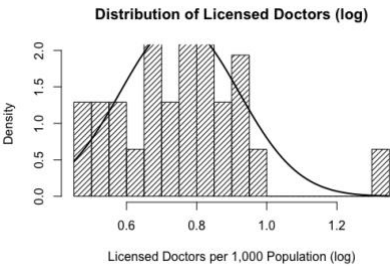
a.



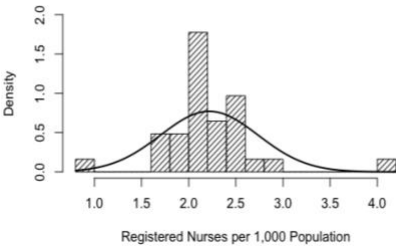
b.



c.



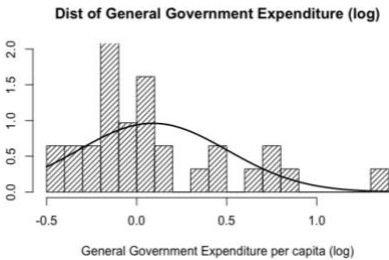
**Distribution of Registered Nurses per 1,000 Population**



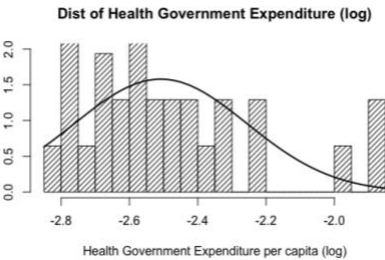
d.

Independent Variables

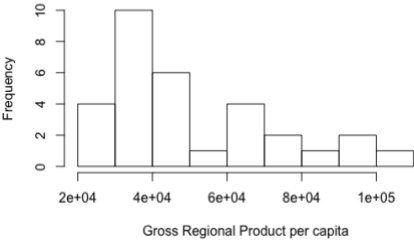
e.



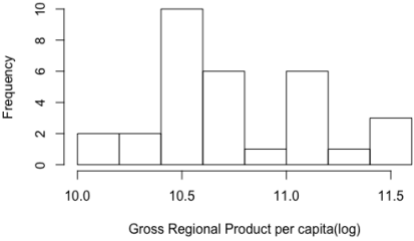
f.



Distribution of Gross Regional Product per capita

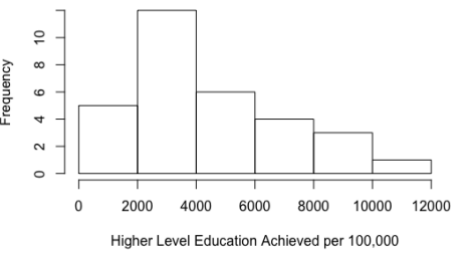


Distribution of Gross Regional Product per capita (log)

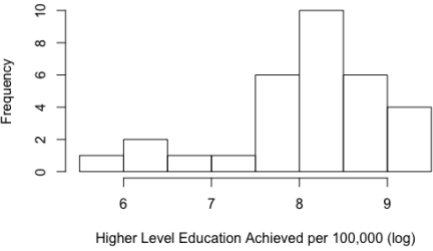


Control Variable

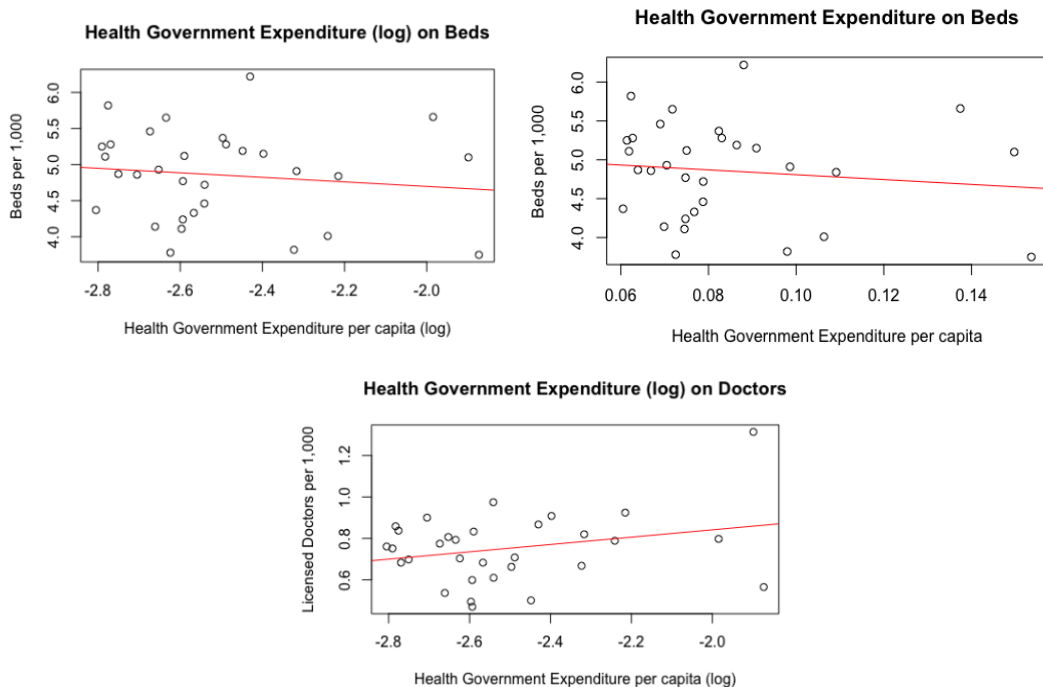
Distribution of Higher Level Education Achieved



Distribution of Higher Level Education Achieved (log)



## Bivariate Distributions:



## Regression of Technical Personnel:

Linear Regression of Technical Personnel per 1,000 people, by Area-level unit, in 2014

	M1	M2	M3	M4	M5	M6
General Government Expenditure (log), per capita	0.200	0.591	-	-	-	-
Health Government Expenditure (log), per capita	-	-	0.115	-	0.711967	-
GRP (log), per capita	-	9.62e-05***	-	3.5e-05***	0.000424***	0.000312***
Higher Education Achieved per 10,000	0.624	0.284	0.513	0.2905	0.815187	0.515215
Capital (1=yes, 0=no)	0	0	0	0	0	1
Intercept	1.671***	-1.490*	2.369***	-1.342*	-1.029	-6.514e-01
Model P Value	0.3464	0.0004777**	0.226	0.0001319***	0.00125**	4.644e-06***
Adjusted R-squared	0.006703	0.4194	0.03657	0.434	0.3876	0.5918
N	30	30	30	30	30	30

Significance codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

As mentioned in the paper, Technical Personnel and Licensed Doctors share the same regression model. However, the p value is slightly less significant for Technical Personnel at  $p = 4.644e-06$ .

# Ideology vs Pragmatism: What is Driving Sino-Latin American Trade?

Pablo Saud & Ezra Cohen

## Abstract

*Latin America has historically been under U.S. economic and political influence. However, China's economic boom has challenged the United States' grip on the region. Since its admission into the World Trade Organization in 2001, China grew its trade volume with Latin America by 1500%—it has eclipsed the U.S. as the biggest trade partner for Argentina, Peru, and others in the region. What is driving the increased trade between China and Latin America? Is China interested in gaining a geopolitical foothold in the United States' backyard? Or is it simply looking for economic opportunities? After running linear regression models on 18 different Latin American countries in the year 2015, we found that ideological convergence with China was not predictive of higher trade volume. Instead, we found that the quality of a country's infrastructure is more likely to predict trade volume with China, as well as whether or not the country recognizes the People's Republic of China over the Republic of China (Taiwan). Those wary of a power struggle in Latin America between the U.S. and China need not worry; Latin America's scant geopolitical relevance relative to other regions of the world means that there is little influence to be won in the region. As a result, China's presence in Latin America has focused on expanding its own economic opportunities and confirming its own political legitimacy in a region that contained 12 out of the 22 countries in the world who still maintained diplomatic ties with Taiwan in 2015. Although future conflicts in the region might illicit different responses from Beijing, as it stands China appears to have a pragmatic rather than ideological approach to trade with Latin America.*

## 1. Introduction

Separated by the length of the Pacific Ocean along with profoundly different cultures and languages, the People's Republic of China and Latin America appear to be worlds apart. From Beijing to Buenos Aires, or Shanghai to Santiago, there hardly appears to be any link between one of the world's fastest growing economies and a region with a legacy of economic stagnation and unfulfilled potential. However, Sino-Latin American relations – particularly economic relations – have blossomed in the 21<sup>st</sup> century. Since China's admission into the World Trade Organization in 2001, trade volume with Latin America has increased nearly 1500% (Fig. 1). China is now the top trade partner for several of Latin America's biggest economies, including Argentina, Brazil, and Peru, thus affirming its position as one of the region's most influential actors.

*Figure 1: Sino-Latin American Trade Volume, 1994-2015*



This may come as a surprise to many observers, particularly those in the United States. Latin America has historically been under direct U.S. influence; the Monroe Doctrine (1823) is emblematic of the U.S. stronghold in the region, as it threatened European powers not to interfere with Western Hemispheric affairs. Since then, the United States has had an active role in shaping Latin American development, engaging in activities from propping up dictatorships to establishing regional free trade agreements and bilateral investment treaties. China's spectacular rise in Latin America has raised red flags all over U.S. academic and political circles, prompting fears that U.S. national security interests may be compromised. Indeed, former Secretary of State Rex Tillerson recently accused China of using economic statecraft to pull the region into its orbit (Calamur, 2018). Meanwhile, Beijing officially maintains that China's exchanges with the region are solely based on principles of win-win economic cooperation and non-intervention in state affairs. What, then, should causal observers make of China's rise in Latin America?

In this paper, we explore whether China's surge in Latin America is fueled by ideology or pragmatism. To do this, we look at which countries China is choosing to trade with (or choosing to ignore). Does China have a higher trade volume with countries that share its views on foreign policy, as measured by affinity on United Nations General Assembly votes? Or is it instead trading more with countries who have better infrastructure and a higher percentage of natural resource exports, indicating its desire for raw material acquisition rather than geopolitical influence? Does China reward Latin American countries that have officially cut ties with the Republic of China in Taiwan through trade?

First, we will give a brief overview of recent literature regarding Sino-Latin American relations: scholars' beliefs that China desires geopolitical influence in the region, the reality of Sino-Latin American ideological closeness, and arguments that China's rising presence is largely because of economic reasons rather than ideological ones. Next, we will describe our data and methodology: we



are running a linear regression with 18 countries using data from 2015, examining the effects of four different variables on each country's trade volume with China (political affinity on United Nations General Assembly votes, recognition of Taiwan, quality of infrastructure, and the share of merchandising exports dedicated to extractive resources). Contrary to our hypothesis, the results showed that in 2015, China did not have higher trade volume with countries that were more ideologically aligned with it; rather, it placed a higher importance on infrastructure quality and whether a country recognized Taiwan.

We concluded that China's trading habits in Latin America are indifferent toward ideological alliances as there is little geopolitical influence to be won in the region. At the moment, China is content to approach Latin America with economic pragmatism rather than ideological motivations, unless a conflict like the Venezuelan refugee crisis breaks out that allows it to exert its influence over the United States. Instead, the PRC is currently more preoccupied with getting Latin America, home to over half of all countries in the world who still hold diplomatic relations with Taiwan, fully onboard with the "One China" policy.

## 2. Related Literature

### 2.1. Theory of Hegemonic War: Relevant in Latin America?

China's meteoric rise in Latin America, a region that has historically been under U.S. influence, has provoked fears of a new "Hegemonic War" between the two superpowers, a concept that derives from Hegemonic Stability Theory. HST states that there must be one dominant hegemonic power in the international system to ensure international economic and political stability (Kindleberger, 1981). Political economist Robert Gilpin explained the process by which a new hegemon overtakes its predecessor in his paper "The Theory of Hegemonic War." By analyzing Thucydides' account of the Peloponnesian War between Athens and Sparta, Gilpin notes that hegemonic wars—triggered by changes in political, strategic, and economic affairs—threaten to transform the structure of the international system (Gilpin, 1988).

Rex Tillerson's comments reflect the view that a new hegemonic war between the U.S. and China may be on the horizon. China, like Athens prior to the Peloponnesian War, has experienced a massive boom in population and has consequently expanded its international reach to meet its economic needs. Meanwhile the U.S., its incumbent hegemon similar to Sparta, has become bogged down due to an imbalanced preoccupation with domestic affairs. Gilpin illustrates the theory of Hegemonic War as follows:

(1) The *thesis* is the hegemonic state, which organizes the international system in terms of its political, economic, and strategic interests.

(2) The *antithesis* or contradiction in the system is the growing power of the challenging state, whose expansion and efforts to transform the international system bring it into conflict with the hegemonic state.

(3) The *synthesis* is the new international system that results from the inevitable clash between the dominant state and the rising challenger (Gilpin, 1988).

If China is the *antithesis* to the U.S. thesis, then Gilpin's theory suggests that a hegemonic war is imminent. To understand if fears of a hegemonic war are reasonable, it is first necessary to get a solid grasp of the relational dynamics between China, Latin America, and the U.S.

## **2.2. China's Official Stance Toward Latin America: All Countries Are Equal (but some are more equal than others)**

The PRC published its second-ever policy paper on Latin America and the Caribbean in 2016, where it stressed its vision of win-win cooperation and complementary development with the region. The policy paper emphasizes China's non-interventionist view towards Latin America, promising to respect the right of Latin American and Caribbean countries to choose their own paths of development without targeting nor excluding any third parties. However, further examination reveals some underlying Chinese motives in Latin America. Amid the harmonious rhetoric of the paper that promises mutual benefits, there are a few caveats.

The first of these caveats involves China's exhaustive push of the "One China" principle. For decades, the PRC has expressed its desire for the international community to officially cut diplomatic ties with Taiwan and recognize its legitimacy over the ROC. So far, most countries have subscribed to the PRC's view of "one country with two different systems." But as of 2016, 12 of the 22 states that still held diplomatic ties with Taiwan were found in Latin America.

The remarkable number of Latin American states that still refuse the PRC's decades-long demands for legitimacy has not gone unnoticed in Beijing, as confirmed in the policy paper:

The 'One China' principle is an important political foundation for China... The Chinese government appreciates that the vast majority of Latin American and Caribbean countries abide by the one China principle... China is ready to establish and develop state-to-state relations with Latin American and Caribbean countries on the basis of the 'One China' principle. By deliberately expressing its gratitude towards countries that abide by the "One China" principle, the PRC implies it may favor those nations when it comes to establishing economic, political, and social relationships in Latin America.

The second caveat revolves around collaboration in international political affairs. The policy paper states that the PRC will make efforts to deepen exchanges between the two sides in the United Nations and other international organizations. This also implies that China may favor Latin American countries that are more aligned with its own international affairs.

While the policy paper regularly reiterates China's pursuit of mutually beneficial relationships, without targeting or excluding any third parties and

promising to maintain respect for each individual nation's developmental goals, several Freudian slips regarding the recognition of Taiwan and cooperation in the United Nations indicate that China may be more willing to establish reciprocal relationships with some states over others.

### **2.3. China and Latin America's Ideological Union**

The ambiguity of China's stated goals and actual ambitions in Latin America has led scholars to believe that, in addition to seeking complementary development, China also has a strategic interest in obtaining geopolitical influence. Taeheok Lee of Busan University of Foreign Studies claims that a strong feeling of ideological alignment between the two regions has culminated in China actively "shaping" Latin America (Taeheok, 2016).

In his 2016 paper *Within and/or Beyond Perception and Ideology: The U.S., China, and Their Relationship towards Latin America*, Lee explores the pivotal role of ideology in making of foreign policy. By this view, the United States' historically negative perception of Hispanic culture affects U.S. foreign policy toward Latin America to this day (Schoultz, 1998). On the other hand, China has formed a linking ideology with Latin America, promoting third-world solidarity and anti-U.S. imperialism. Lee believes this has enabled China to amass more influence than the United States has in the region.

To show the extent of China's rise and the United States' fall of influence, Lee observes the Latin American responses to two major events involving both powers: the 1989 Tiananmen Square protests and the September 11<sup>th</sup> attacks on the World Trade Center. While most of the international community immediately denounced the Chinese government's response to the Tiananmen protests, Latin American countries were actually sympathetic and supportive towards the PRC, thus re-emphasizing their solidarity (Li, 1991). Meanwhile, the United States' shift in focus to the Middle East after the September 11<sup>th</sup> attacks drew a very hostile reaction from Latin America that, according to Lee, felt disappointment that the Bush era did not explicitly deliver toward Latin America. Additionally, Lee states the "pink tide" that swept through the region in the early 21<sup>st</sup> century, when leftist governments emerged in a number of powerful Latin American countries, further confirms the fall in American influence and rise in Chinese ideological convergence. According to Lee, this has granted China a 'cognitive impact,' that allows it to shape Latin American regional development (Taeheok, 2016).

### **2.4. Ideological Divergence Between China and Latin America**

In "*The Geopolitics of China's Rise in Latin America*", Ted Piccone challenges the belief that China and Latin America are deeply ideologically intertwined. He concedes that China and Latin America have a strong ideological alignment when it comes to non-interventionism and notions of independence but diverge on a variety of issues as a consequence of the heterogeneity of foreign policies in the region. Perhaps the best example of this can be seen in stances on human rights. Piccone observes that China has taken a strong stand against singling out individual countries at the United Nations for criticism of their human rights

record (Piccone, 2016); a few Latin American countries with dodgy human rights records of their own, like Cuba and Venezuela, align with China on this view, but several others like Argentina, Mexico, and Chile instead align with the United States and favor active condemnation of human rights abuses.

Piccone finds that member states of the Bolivarian Alliance for the Peoples of Our America (ALBA) – including Bolivia, Cuba, Ecuador, Nicaragua, and Venezuela – are particularly more inclined to vote alongside China, while countries that are geographically closer and more integrated with the U.S. tend to vote alongside their northern neighbor. These findings cast doubt on claims that Latin America and China are strongly linked by a common ideology.

Furthermore, Piccone questions the reach of China's influence in Latin America, highlighting its significant lack of soft power in the region. There are less than 40 Confucius Institutes in Latin America, a region with a population exceeding 600 million people, and only 100 of the 20,000 foreign recipients of Chinese government scholarships in 2010 were from Latin America. More importantly, however, the perception of Latin American people towards China as measured by social media outlets is surprisingly negative. Piccone cites a Pew Research Center study that found the following perceptions toward China in the region:

Negative views of China are widespread, mainly regarding the poor quality of Chinese goods, unfair business practices, incompatible language and culture, unsustainable development policies harmful to the environment, and fears of Chinese economic and demographic domination in international relations (Pew Research Center, 2013).

These negative views towards China further dampen claims of growing Chinese ideological alliance with the region.

Piccone argues that China's rise forces Beijing to exert greater leverage on Latin American states in the future, but that this has not come at the expense of United States influence in the region. China may have the potential to shape Latin American development, as Lee claims, but its ideological stronghold in the region is not as strong as some scholars suggest.

## **2.5. Patience is Key: China's Favorable Financing to Latin America**

Piccone and other scholars indicate that China's influence in the region is more based on economics than on ideology. To quote an anonymous South American diplomat at the Inter-American Dialogue, "given the choice between the onerous conditions of the neoliberal Washington consensus and the no-strings attached largesse of the Chinese, elevating relations with Beijing was a no-brainer" (Piccone, 2016). Stephen Kaplan elaborates on this view in his paper *The Rise of Patient Capital: The Political Economy of Chinese Global Financing*, explaining the characteristics and benefits of the Chinese financing model in Latin America over the traditional Western financing model.

Kaplan refers to Chinese financing as "patient capital," characterized by a long-term investment horizon and high-risk tolerance. This stands in stark contrast to the conventional Western short-term horizon "portfolio investment" that has

plagued Latin America with credit shocks and economic destabilization for decades (Kaplan, 2018). The pattern of portfolio investment is as follows: Western financiers invest in developing Latin American countries, closely monitoring the performance of assets relative to annual or quarterly benchmarks. If and when these assets underperform, the financiers are quick to pull their investments and sell the assets. A massive capital flight ensues, leaving cash-starved countries to implement austerity measures to retain capital within the country. Thus, the debtor government's long-term plans for economic development are scrapped in favor of short-term damage control measures.

On the other hand, the "patient capital" offered by China is more conducive to helping Latin American countries meet their long-term economic development goals. This type of capital, dominated by state-to-state finance and development banks, is willing to incur more uncertainty today in the hopes of achieving higher returns in the future. As a result, Latin American governments are able to incrementally correct policy errors without facing destabilization or having to worry about their country's macroeconomic performance. Kaplan argues that Latin American governments' newly-found fiscal policy autonomy as a result of Chinese financing gives them higher fiscal maneuverability (Kaplan, 2018).

It is therefore no surprise that Latin America has been accepting Chinese trade and investment with open arms. Its non-interventionist nature has provided a welcomed break from the traditional Western model that seems to constantly instigate boom-bust cycles. Kaplan's findings suggest that the Chinese presence in Latin America is not so much focused on geopolitical influence, but rather is an example of mutually beneficial state-to-state trade that is rendering the conventional model of Western financing obsolete. More importantly, it points to the possibility that Latin American countries are shifting their attentions to China not because of its rising ideological influence in the region, but because China actually offers them a much more attractive and economically sound financing model.

### **3. Methodology**

#### **3.1. Hypothesis**

Amid the contradictory perspectives on China's interests in Latin America, we pose the following questions: is China adopting an ideological or pragmatic approach to trade with Latin America? Are there real Chinese geopolitical ambitions in the region, or is China more interested in acquiring raw resources to feed its population? Essentially, is geopolitics or economics the driving factor behind the increased volume of Sino-Latin American trade?

We believe that China has strategic interests in obtaining geopolitical influence in Latin America. Therefore, we predict that in 2015, China had a higher trade volume with Latin American countries that were more ideologically aligned with it. Alternatively, it is possible that in 2015 China preferred to trade with countries that abided by the "One China" principle and punished those who still held diplomatic ties with Taiwan by trading less with them. We control for natural predictors of trade, including natural resource exports and better infrastructure,

which lowers trade costs and makes trade logistics smoother. To evaluate these questions, we translated them into testable hypotheses:

H<sub>1</sub>: Higher ideological alignment with China (as measured by *political affinity* score with China on 2015 UNGA votes) will lead to higher trade volume with China (as measured by adding the total value of imports and the total value of exports).

H<sub>2</sub>: Refusal to adhere to the “One China” principle (as measured by *recognition of Taiwan* over the PRC) will lead to lower trade volume with China.

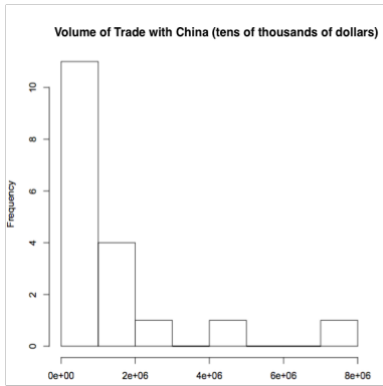
### **3.2. Description of Data**

There is no single established definition of “Latin America;” it is generally referred to as a region that includes North and Central America, South America, and the islands of the Caribbean. For the purposes of this study, former Spanish and Portuguese colonized countries were analyzed. Data was collected from 18 different countries belonging to North, Central, and South America, and only for the 2015 year. The specific countries analyzed were: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and Venezuela. Cuba was excluded from the dataset due to the limited availability of reliable statistics. Moreover, Caribbean countries whose GDP was too low to produce meaningful results in terms of trade volume with China, and those who did not possess much were excluded. Finally, Puerto Rico was excluded because of its status as a United States territory. A more comprehensive study would analyze all countries and territories in Latin America to better observe the influence of China in the region and would observe growth over time rather than just one a single year snapshot of data.

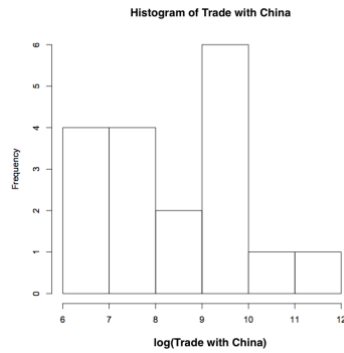
### **3.3. Dependent Variable: Trade Volume**

The data for trade volume was obtained from the *National Bureau of Statistics of China’s Statistical Yearbook of 2016*. The bilateral trade volume, in tens of thousands of dollars, was calculated by adding China’s total value of imports from Latin American to the total value of exports to the region. Financial flows and FDI between countries were not included in our dependent variable. Perhaps measuring FDI would have given a more holistic view of economic exchange between Latin American countries and China, but this is beyond the scope of this paper. Initially, the trade volume with China was exponentially distributed (Fig. 2). The natural logarithm of bilateral trade results in a normal distribution (Fig. 3).

*Figure 2: Trade Volume*



*Figure 3: Natural log of Trade Volume*



### 3.4. Independent Variable: Political Affinity and Recognition of Taiwan

Political affinity scores in UNGA votes in 2015 were used to measure the ideological convergence between China and each Latin American country (Voeten, 2012). This “score” measures how similarly two countries vote on General Assembly resolutions. A higher score translates to higher political affinity, indicating an ideological convergence on foreign policy issues. The average voting affinity of Latin American countries with China was 0.734 out of 1, with a standard deviation of 0.067, indicating a high political affinity (comparatively, the average political affinity score with the United States was 0.283). To compensate for the exponential distribution, the natural logarithm of the score of each country was taken to measure the variable’s linear increase in the rate of change (Fig. 4 & 5).

*Figure 4: Political Affinity with China*

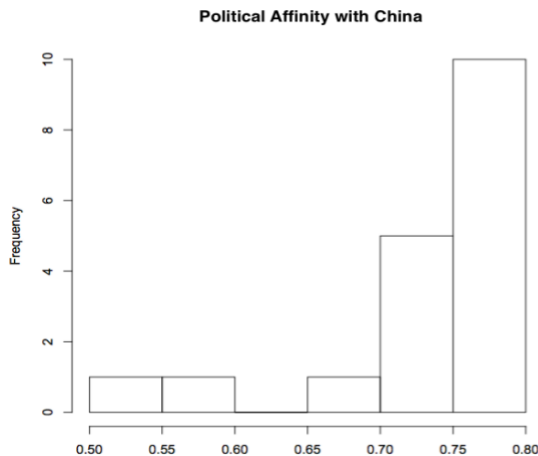
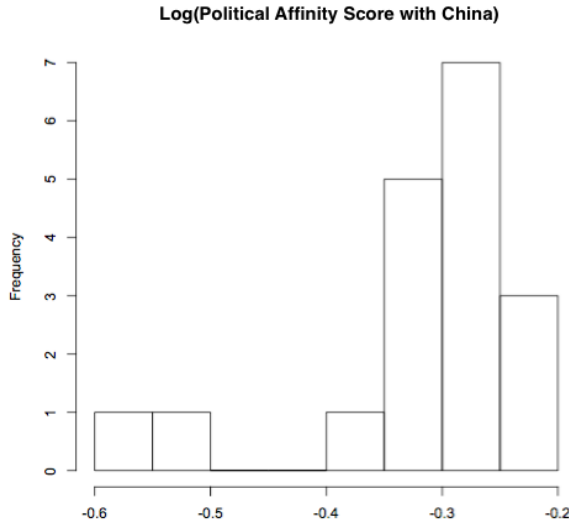


Figure 5: Natural log of Political Affinity



Recognition of Taiwan may be an alternative explanation for higher trade volume with some countries over others. If political affinity in the UNGA is not a significant predictor of trade volume, then recognition of Taiwan could be. In other words, China may be punishing countries who maintain diplomatic ties with Taiwan by trading less with them; trade could be used as leverage for China to enforce its “One China” policy around the world. Data regarding recognition of Taiwan was obtained from The Ministry of Foreign Affairs of Taiwan (Diplomatic Allies - Ministry of Foreign Affairs, Republic of China (Taiwan)). and the variable was coded as follows: countries who entertain full diplomatic relations with Taiwan are given a score of 0, and countries who do not are given a score of 1. Of the 18 countries in the dataset, 11 have switched their alliance from Taiwan to the PRC while the other 7 still engage in diplomatic relations with Taiwan. Since the data is from 2015, Panama (2017) and the Dominican Republic (2018) are considered to still entertain full diplomatic ties with the ROC in Taiwan. A full description of the variables used can be found in Figure 6.

### 3.5. Control Variables: Resource Exports and Infrastructure Level

The independent variable *Resource Exports* is calculated by adding each country’s share of merchandise exports coming from fuel exports (like oil and coal) to the share of merchandise exports coming from ores and metals exports in 2015. All data comes from the World Bank’s *Databank* (The World Bank, 2016). We hypothesize that China will trade more with countries that already have resource exportation as a large share of their GDP, meaning they are abundant in the resources concerned. China’s need for resources would fuel the trade volume between it and Latin America countries who possess fuel and ores.



The variable *Infrastructure Level* controls for trade as a consequence of infrastructure quality and depth. Extensive infrastructure networks allow for cheaper transportation costs and are more conducive to trade. Therefore, trade will be higher between China and another country if the infrastructure level is higher. The Logistics Performance Index provided by the World Bank takes into account customs performance, infrastructure quality, and timeliness of shipments, making it a reliable and satisfactory variable to measure trade facility. The LPI is a score of infrastructure quality out of 5 points. The world average in 2016 was 2.88, whereas the average for Latin American countries was 2.76. One of the main shortcomings of this data is that it comes from the 2016 LPI report (there is no 2015 LPI report), but the proximity is close enough for the purposes of this paper.

*Figure 6: Table of Descriptive Statistics*

Descriptive Statistics for Chinese Trade with Latin American countries (2015)					
	Minimum	Median	Mean	Maximum	Standard Deviation
Dependent Variable					
Trade with China (tens of thousands of USD)	70,098	425,049	1,207,228	7,150,159	1,830,896
Log(Trade with China)	6.552	8.354	8.472	11.177	1.435
Independent Variables					
UNGA Voting Affinity	0.549	0.763	0.734	0.792	0.067
Resources as a percentage of exports	0.537	10.542	26.320	98.104	30.026
Infrastructure quality	2.250	2.680	2.759	3.340	0.309

### 3.6. Research Design

We are running a linear regression with 18 countries, examining the effects of four different variables on each country's trade volume with China: foreign policy convergence, resource exports, infrastructure level, and recognition of Taiwan. We believe the linear regression is the best way to analyze the causal relationship between the independent and dependent variables.

## 4. Results

### 4.1. Bi-variate Distribution of Variables

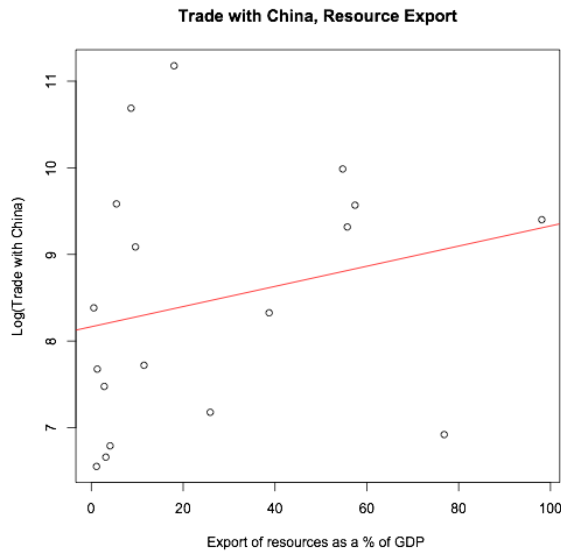
Figure 7 shows the relationship of political affinity to trade volume. The hypothesis was that there would be positive relationship between the two variables: the higher the political affinity in UN votes, the higher trade volume will be with China. However, the data points are heavily skewed (due to most countries in Latin

America voting similarly to China at the General Assembly) and have large residuals.

*Figure 7: Trade Volume and Political Affinity Scatterplot*

Figure 8 shows the causal relationship between a country’s share of exports dedicated to resource exports and its volume of trade with China. This relationship is not particularly strong. A country’s share of exports dedicated to resources is not an accurate predictor for trade with China. There are several countries in the dataset that have a high trade volume with China but do not necessarily have a high share of exports dedicated to resources. For example, countries with industrial strengths or important export-oriented agricultural sectors like Argentina, Uruguay, and Mexico, are some of China’s biggest trade partners but have less than 10% of their exports coming from resources.

*Figure 8: Resource Exports (as a share of Merchandise Exports) and Trade*



*Volume Scatterplot*

Figure 9 is a scatterplot showing the relationship between infrastructure level and trade volume with China. Here, the relationship is stronger, implying that a better infrastructure level predicts higher trade volume. Venezuela, who has the second lowest LPI of the sample, still has a high trade volume with China mainly due to deep political and ideological ties with China.

Figure 9: Infrastructure Level and Trade Volume Scatterplot

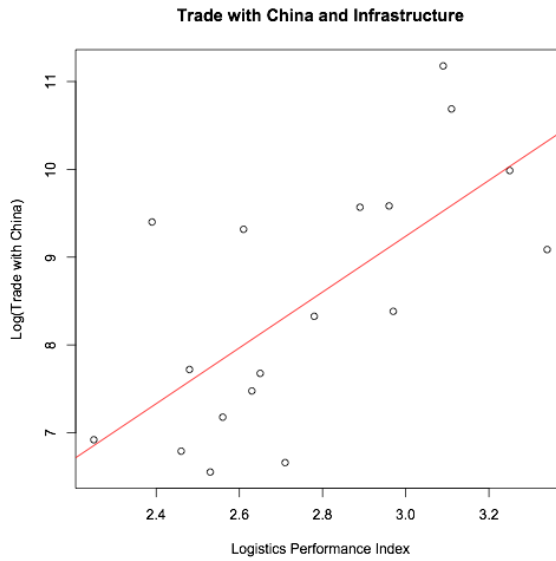


Figure 10: Diplomatic Ties with Taiwan and Trade in China

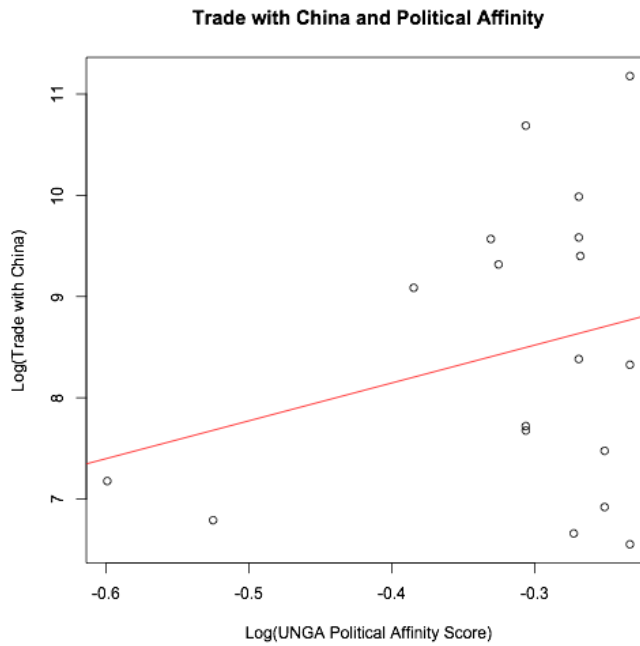
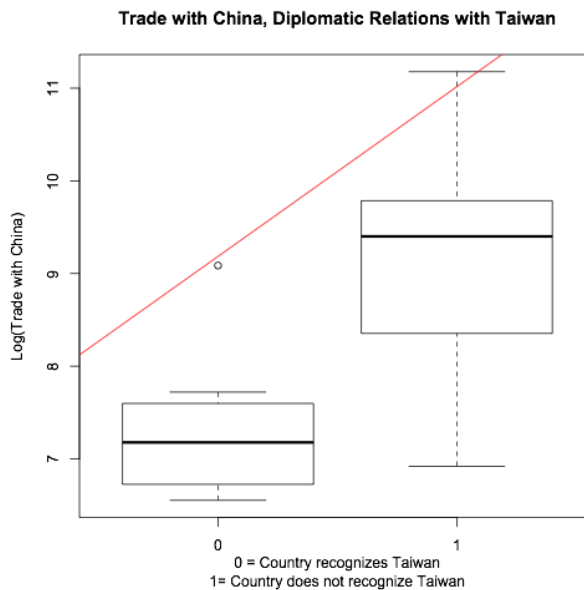


Figure 10 shows the relationship between diplomatic ties with Taiwan and trade with China. It is evident that China trades more with countries that do not recognize Taiwan. This reflects China's eagerness to enforce the "One China" policy, seeking to delegitimize Taiwan on the world stage. One outlier is

*Figure 11: Recognition of Taiwan and Trade Volume Box Plot*



Panama, who had diplomatic relations with Taiwan in 2015, but still had significant trade with the PRC. It is important to note that in 2017 Panama cut its ties with Taiwan and developed diplomatic relations with China. In June 2018, they will both start talks to negotiate a free-trade agreement.

## 4.2. Regression Models and Table

### *Model 1: Political Affinity and Trade Volume*

Firstly, we measured the main independent variable, political affinity, against trade volume to see if there was any relationship between the two variables. The results were inconclusive. The r-squared value was very low (.001675) and the coefficient was not significant, so the model was not a good fit. We can infer that a country's alignment with China in UNGA votes will not lead to higher trade.

### *Model 2: Infrastructure and Trade Volume*

Next, we measured infrastructure, a control variable, against trade volume and found significant results, with a high coefficient and an adjusted r-squared higher than the other variables (.4346). We can say that China trades more with countries who have better infrastructure. One big exception is Venezuela who has deep ideological ties with China.

### *Model 3: Resource Exports and Trade Volume*

Resource exports as a percentage of merchandise exports was not a significant predictor of trade. A country's exports of fuel and ores as a percentage of its total merchandise exports is not predictive of how much it trades with China.

### *Model 4: Taiwan Recognition and Trade Volume*

To test our second hypothesis, we ran the model for a country's diplomatic relations with Taiwan. Our results found that the coefficient is significant for this variable, although less than for infrastructure level. The adjusted r-squared (.3733) showed that China was more likely to trade with a country if it did not have a diplomatic mission in Taiwan.

### *Model 5: Resource Exports, Infrastructure and Trade Volume*

To see how important our control variables were to the fit of the model, we tested how well infrastructure and resource exports were able to predict trade, and the results were of high significance, with a relatively high r-squared (.6238). Moreover, resources exports became significant once added in the model with infrastructure. Therefore, our control variables proved significant in predicting a country's volume of exports and imports with China.

### *Model 6: Political Affinity, Infrastructure, Resource Exports and Trade Volume*

When the three variables - political affinity, infrastructure, and resource exports - were tested together, only infrastructure and resource exports were significant. Moreover, adding political alignment in UNGA votes actually reduced the model's quality of fit, seen by the decreased r-squared (.6084). UN political affinity is not a good indicator of Chinese trade.

### *Model 7: Taiwan Recognition, Political Affinity, Infrastructure, Resource Exports and Trade Volume*

Next, we wanted to see how recognition of Taiwan would contribute to the model when tested along all other variables. Recognition of Taiwan lost some of its significance in predicting trade in this model, while resource exports just became insignificant. However, adding Taiwan in the model led to a significant increase in the adjusted r-squared – the highest of all our regressions (0.6754). Our control variables lost some of their significance and their coefficient decreased (by a small amount) due to the small sample size. The loss of significance is a consequence of adding another variable to a model with small-N.

These models help us deduce that, if a country does not recognize Taiwan and has a high level of infrastructure, its trade volume with China will be higher. However, if it does have diplomatic relations with Taiwan, then trade will be significantly lower. The only exception to this rule is Panama, which is a junction for many trade routes and is home to the Colón Free Trade Zone, where a lot of goods coming from China are then re-exported to Latin America. Another outlier is Venezuela, which has the second worst infrastructure rating in the observation pool, yet it is ranked sixth in trade volume with China. This is also a result of its ideological alignment with China and its oil-focused economy. The models are summarized Figure 11 below:

*Figure 11: Regression Models and Their Outcomes*

	M1	M2	M3	M4	M5	M6	M7
Log(UN Political Affinity)	5.280					1.43637	-0.435
Infrastructure		3.1783**			3.7685***	3.685483***	3.095*
Resource Exports (as a % of exports)			0.01164		0.0222**	0.021413*	0.011
Recognition of Taiwan				1.8323**			1.0097
Intercept (i.e. constant)	4.594	-0.2969	8.16522***	7.3519***	-2.5103	-1.809967	-1.175
Adjusted R-squared	0.001675	0.4346	0.0005436	0.3733	0.6238	0.6084	0.6754
N	18	18	18	18	18	18	18

## 5. Discussion

Our main hypothesis that China will have a higher trade volume with ideologically aligned Latin American countries did not hold true. There was no correlation between political affinity with China on UNGA votes and trade volume. The second hypothesis that China will have a lower trade volume with countries that maintain diplomatic ties with Taiwan was found to be true. Our control variables, infrastructure level and resource exports, also turned out to be significant in predicting trade volume.

As our results indicate, the story of Sino-Latin American relations is actually simpler than we thought. We embarked on this research with an initial skepticism of Chinese motives in Latin America, particularly because of the region's symbolic and historical value to the U.S. With the United States becoming increasingly focused on domestic affairs and seemingly abdicating its position as the unofficial world leader, we thought that China would be interested in filling in this U.S.-shaped vacuum in Latin-America, and this is why it has stepped up its trade with countries in the region. As our results suggest, however, China is not necessarily favoring countries who have a higher affinity with them in the UNGA. Rather, China is trading more with the countries that have more resources to offer and better infrastructure that facilitates trade. China also heavily favors the Latin American countries who comply with the “One China” policy. This indicates that the PRC, while not necessarily interested in gaining ideological influence in Latin America, is very keen on having the region acknowledge its legitimacy. This is reasonable given the importance of the “One China” principle to Beijing, and the fact that over half of the countries who refused to subscribe to it in 2015 were found in Latin America.

One explanation for China's indifference in exerting its ideological influence in Latin America is the region's relative insignificance in the grand scheme of global international affairs. While the region is home to several humanitarian and social issues that are of great importance to the international community, including drug trafficking and money laundering, these issues lack the urgency of those in other regions of the world, such as the refugee crisis in Syria. In short, there is little geopolitical influence to be won in Latin America today. There are no Latin American countries who currently possess nuclear weapons; there is little to no terrorism relative to other regions; there are no active conflicts following the historic ceasefire signed by the Colombian government and the Revolutionary Armed Forces of Colombia in 2016. Meanwhile, the Middle East remains a hub for all of these issues, naturally attracting more attention from both Washington and Beijing. Areas like the South China Sea and the Korean Peninsula also

have much higher potential for conflict than Latin America, so they receive more attention. This makes China's influence in Latin America, acquired through sheer economic prowess, largely dormant. Perhaps this paper would be better suited to study another region of more strategic geopolitical importance to China.

While it currently does not provide a suitable arena for a "hegemonic war," Latin America could potentially become a battleground for United States-China influence. The issue most likely to escalate into an international conflict in the region is the refugee crisis in Venezuela. According to Dany Bahar and Sebastian Strauss of the Brookings Institution, as many as 4 million Venezuelans have fled the country since 1999, most of them doing so after 2014 (Bahar & Strauss, 2018). This has caused tensions with bordering countries such as Colombia, which is currently accommodating at least 600,000 Venezuelans. Venezuela's close ideological ties with China (and strong anti-United States sentiment) has raised some eyebrows in the Western Hemisphere; already, China has used its veto power in the United Nations Security Council to protect the Maduro administration in Venezuela following accusation of human rights violations but has stopped short of offering the regime debt forgiveness or bailouts (Gedan, 2017). If the Venezuelan crisis deepens and erupts into a full-scale conflict, will China awaken its dormant influence in the region, recruiting its ideological partners in ALBA or financially strong-arming its Latin American trade partners to align with its pro-Maduro ideology rather than the anti-Maduro United States perspective?

As it stands, China is content to approach Latin America with pragmatism rather than ideology. But whether or not this stance will hold in the face of growing conflicts in the region is something to ponder. As China slowly amasses influence in the region, the United States should keep a cautious eye on its southern neighbors.

## 6. Conclusion

The Sino-Latin American trade corridor, virtually nonexistent two decades ago, is now overshadowing the historical United States presence in the region. China's favorable "patient capital" financing model is attracting more and more

Latin American suitors, as frustrated governments jump at the chance to escape the traps of traditional policy-conditioned Western financing. Ideological convergences between China and Latin America in regards to non-interventionism and sovereign equality of states further cement China's links to the region. At a surface level, one can understand the anxiety of U.S. academics and politicians who fear that rising Chinese influence in a region that has traditionally been closely patrolled by the United States jeopardizes their country's national security interests.

However, China does not currently appear to be interested in pursuing geopolitical influence in the region. Our research showed that China does not necessarily have a higher trade volume with Latin American countries that are more ideologically aligned with it. Rather, a Latin American country's quality of infrastructure and recognition of Taiwan are more predictive of trade volume with China. Favoring countries with better infrastructure suggests China prefers to trade with countries that are logistically easier to trade with. China also trades more with countries who have renounced diplomatic ties with Taiwan, demonstrating a strong interest in having its legitimacy recognized in the region home to the most Taiwan supporters. Those skeptical of China's geopolitical motives can breathe freely for the moment.

China's apparent lack of geopolitical pursuit in Latin America could be explained by the region's relative remoteness in the international arena. Whereas the Middle East and the South China Sea provide high potentials for conflicts close to home, Latin America's geographical isolation, limited terrorism and lack of nuclear weapons makes it much less important to China's geopolitical ambitions. If an issue like the Venezuelan refugee crisis were to trigger a full-scale conflict in Latin America, China may become more interested in exerting the influence it has amassed in the region. Under current conditions, however, China seems content to approach Latin America with pragmatism rather than ideology.

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