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Abstract
Despite having the second largest economy at $13 trillion, China has only recently surpassed the World Bank's definition of the 'middle-income range' which is a gross national income per capita between $1,000 to $12,000 (constant 2011 international $). This is a noteworthy accomplishment since many other developing nations have fallen victim to economic stagnation within this range leading to the term "middle-income trap". This paper will argue that one of the ways in which China escaped the middle-income trap and will continue to grow its economic influence is through the support of blockchain technology. Research and development, early technological adoption and business climate all play a role in explaining how the Chinese public and private sector have used blockchain technology to encourage economic growth. While there are many questions and misconceptions about blockchain technology and its place in China, this paper seeks only to answer a select few.

Keywords
China, middle-income trap, blockchain technology, economic growth

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Despite having the second largest economy at $13 trillion, China has only recently surpassed the World Bank's definition of the 'middle-income range' which is a gross national income per capita between $1,000 to $12,000 (constant 2011 international $). This is a noteworthy accomplishment since many other developing nations have fallen victim to economic stagnation within this range leading to the term "middle-income trap". This paper will argue that one of the ways in which China escaped the middle-income trap and will continue to grow its economic influence is through the support of blockchain technology. Research and development, early technological adoption and business climate all play a role in explaining how the Chinese public and private sector have used blockchain technology to encourage economic growth. While there are many questions and misconceptions about blockchain technology and its place in China, this paper seeks only to answer a select few.

1. – Introduction

"The first generation of the digital revolution brought us the Internet of information. The second generation — powered by blockchain technology — is bringing us the Internet of value: a new platform to reshape the world of business and transform the old order of human affairs for the better" said influential author Don Tapscott (Guarda 2016). As outlandish as that claim may sound, with a total cryptocurrency market capitalization of $270,638,328,602 as of August 2018 and a 24hr trade volume of $14,378,130,110, Mr. Tapscott might be right (Cryptocurrency 2018). There are already over 1700 cryptocurrencies and 12372 digital markets and these statistics don't even fully capture the extent to which blockchain technology has and will continue to change the world. This paper seeks to shed light on the development of blockchain

technology in China and its long run economic impact on the nation but first, a brief overview of the technology itself.

Blockchain technology is a digital database structure with the potential to revolutionize the processes and capabilities of countless industries. This innovative technology has immense value for a wide array of applications because it can increase speed, transparency, and immutability of transactions while minimizing costs. Blockchain technology is most famous for being the underpinning of decentralized cryptocurrencies such as Bitcoin and Ethereum which have become an increasingly hot topic for their ability to operate outside of the oversight of third-party entities, increasing individual sovereignty and network trust. However, this type of digital database has also shown promise in a myriad of other industries, including traditional financial activities, supply chain management, energy efficiency, social impact initiatives and digital identities. For any industry or activity that could be improved by having an immutable record of transactions with the potential for a high level of transparency, blockchain technology is a powerful mechanism for future growth and development.

1.1 – Nodes, Ledgers and Consensus

While blockchains differ greatly depending on their purpose, there are some commonalities that give them their unifying backbone. A mastery of its mechanisms is not necessary to enjoy the benefits (just as with driving a car or using the internet) but having a basic understanding of blockchain will be useful in recognizing promising investment opportunities, corporate implementation strategies, and furthering the global adoption of this technology. At its most fundamental level, there are three crucial components of any blockchain: nodes, ledgers and consensus.

Nodes are the individual network users who communicate with others to maintain an agreed upon chain of data. In the popular context of cryptocurrencies, nodes are the users that buy, sell, trade, and sometimes mine the digital assets "constructed to function as a medium of exchange, premised on the technology of cryptography" (Chohan 2017).

Ledgers are the fluid copies of the network transactional history that nodes possess, and the ledgers are kept in the form of distributed chained blocks. Blocks are simply data structures that utilize cryptography to minimize digital size while increasing trustworthiness and transparency. Block structure varies but most blocks contain metadata, a pointer to the last chained block as well as a summary of the stored transactional history.

Consensus is an agreed upon processing system that allows nodes to assess and agree upon which newly created blocks are valid and worthy of being chained to personal ledgers. When all nodes agree, they are in a state of consensus and all records are final. As with block structure, the way in which networks achieve consensus varies but dividing blockchains into the subcategories of public chain, private chain, or a hybrid of the two does help to shed light on the topic.

1.2 – Public, Private and Consortium Blockchains

Public blockchains are the branch of blockchains that most people have heard about since this type includes the electronic cash system Bitcoin as well as the open-source operating system Ethereum. These networks have open membership, the potential for anonymity, no central authority and a consensus mechanism that all nodes can partake in. The two most popular consensus mechanisms for this branch of blockchain networks are Proof-of-Work (PoW) and Proof-of-Stake (PoS), a proposed alternative to PoW and its real-world shortcomings.

Private blockchains are another type of blockchain that have been gaining exposure as more firms and institutions speak of their potential. This centralized style has selective membership, known network users, a central block-creating process, and the ability to manipulate outsider visibility. This concept is in direct contrast with those who have turned to blockchain technology as way to avoid third party oversight but does still retain the cryptographic auditability function (Buterin 2015).

Consortium chains are a hybrid of the two previously mentioned blockchain styles, and this type brings together selective membership, visibility restriction capabilities, and node-driven consensus mechanisms. All three types of blockchains have their specific advantages and a mix of all three should be expected to be seen in the future as wider array of blockchain applications come into fruition.

1.3 – Blockchain and China

Blockchain technology has revealed itself to be highly disruptive digital database structure with the potential to redefine how information is stored, shared and protected in a plethora of applications. Through a combination of research and development, early technological adoption and business climate, China has positioned itself at the forefront of global blockchain application and innovation. Further supportive policy decisions will aid China in transitioning towards being a technological innovator which should help maintain strong economic growth (Zilibotti 2017). Using both neoclassical macroeconomic theory regarding long run growth and a modern macroeconomic theory relating a nation's growth rate to its proximity to the technological frontier, I will explain why policy decisions related to blockchain technology will help the nation maintain economic growth.

2. – Literature Review

After China's economic opening under Deng Xiaoping in 1978, the world's most populous nation has experienced unprecedented economic growth skyrocketing it to being the second largest economy in the world. Despite annual GDP per capita growth over 8% during the past few decades and 660 million people being lifted out poverty, Chinese income inequality has grown at an alarming rate, peaking with a Gini coefficient of 0.491 in 2008 (UNDP China 2016).

Increased FDI inflow, selective privatization, and the development of globally competitive production facilities for industrial inputs have been effective policy choices for China's historically impressive growth but this model has started to reveal its shortcomings. Using international evidence, three statistics related to China's economic status are red flags for the nation's future growth. As explained in Eichengreen, Barry, and others' 2012 paper "When Fast-Growing Economies Slow Down: International Evidence and Implications for China", a rapid-growing catch-up economy is likely to slow down if its "per capita incomes reach around US$ 17,000 in year-2005 constant international prices, … [or] the share of employment in manufacturing is 23 percent… [or] when income per capita in the late-developing country reaches 57 percent of that in the country that defines the technological frontier". All three of these indicators are true for China so for it to continue its strong economic growth despite these foreboding characteristics the government will have to change its approach towards economic growth. The high rate of growth generated from massive capital stock investments in the previous decades is no longer translating into the same increases in national output. This is a critical juncture for the Chinese economy with the choice of either transitioning towards more productive industries and becoming a technological innovator or following suit with many other emerging economies and fall victim to the middle-income trap.

There have been many studies that have investigated China's long-run economic growth trajectory and most agree on the necessity for China to turn to technology creation over adoption for strong continued growth. In his 2017 paper "Growing and Slowing Down like China", Fabrizio Zilibotti concluded that China's "high-growth trajectory then hinges on the transition from investment-driven to innovation-driven growth" as it approaches economic convergence with "developed" nations. Ha and others reached a similar conclusion in their 2009 paper "Optimal Structure of Technology Adoption and Creation: Basic versus Development Research in Relation to the Distance from the Technological Frontier" that as a nation's "distance to the technological frontier narrows, the growth effect of basic R&D increases [and] that the quality of tertiary education has a significant positive effect on the productivity of R&D".

This concept brought to light the positive relationship between innovation-driven growth and improvements to human capital stock. Luckstead and others explored this topic and concluded in their 2014 paper "China's catch-up to the US economy: decomposing TFP through investment-specific technology and human capital" that human capital "plays a central role in the decomposition of [Chinese] TFP" which goes hand in hand with Hongbin Li and other's conclusion in their 2017 paper "Human Capital and China's Future Growth" that there is "a clear positive correlation between income and education level of the sample countries for all five years of data". Shujie Yao and others empirically explored the results of Chinese policy on technological progress and human capital accumulation. One of the conclusions in their 2006 paper "Building a strong nation, how does China perform in science and technology" is that despite China's split approach of promoting domestic technology and attracting FDI and outside technology, "there is lack of evidence to prove that China has become one of the world's front runners in knowledge creation and innovations".

With all this in mind, if China aims to make blockchain technology the future of domestic technological innovation, policies to encourage research and innovation are critical. “As a late comer of industrialization, China is not able to create all the new technologies that are required to modernize its economy” (Yao 2006) which has explained its propensity for technological imitation. However, the literature agrees that this approach will not suffice for the sort of high level of economic growth that China aims to maintain. To continue to elude the infamous middle-income trap and achieve ‘developed’ nation status, China will need to lead the way on some technological fronts.

3. – Theory

3.1 – Total Factor Productivity

While there are many ways to interpret Chinese Communist Party’s (CCP) policies on blockchain technology. This paper will use the neoclassical Cobb-Douglas production function to consider China’s long-run economic growth by assessing the recent policy developments as changes to total factor productivity. Specifically, how supportive Chinese policies on blockchain technology have positioned China to continue to enjoy its trend of strong economic growth into the 21st century. It will be argued that recent Chinese policies related to blockchain technology have created great business and research conditions for innovation, increasing the technological growth rate which would put the Chinese economy on a more explosive economic trajectory.

The Cobb-Douglas production function defines an economy’s economic output (Y) as a function of labor (N), capital (K) and total factor productivity (A) as seen below:

$$Y = f(A,N,K) \qquad Y_t = A_t \cdot N_t \alpha \cdot K_t I - \square^{1} \qquad (1)$$

[1] $|\square| < 1$ & $\square$ and $1-\alpha$ are output elasticities dependent on the economy’s state of technology

Manipulating this equation, two conclusions can be drawn. The first is that the balanced growth rate of output is proportional to the sum of the growth rate of labor and the growth rate of technology [$g_Y \sim g_A + g_N$]. The second conclusion is that balanced growth path for output per worker is proportional to the growth rate of technology [$g_y \sim g_A$] (see Technical Appendix). The undeniable role that the growth rate of technology plays in both total output and output per capita growth is critical to this paper's claim that recent Chinese policies supporting blockchain technology growth will be major factors in China's high growth in the future.

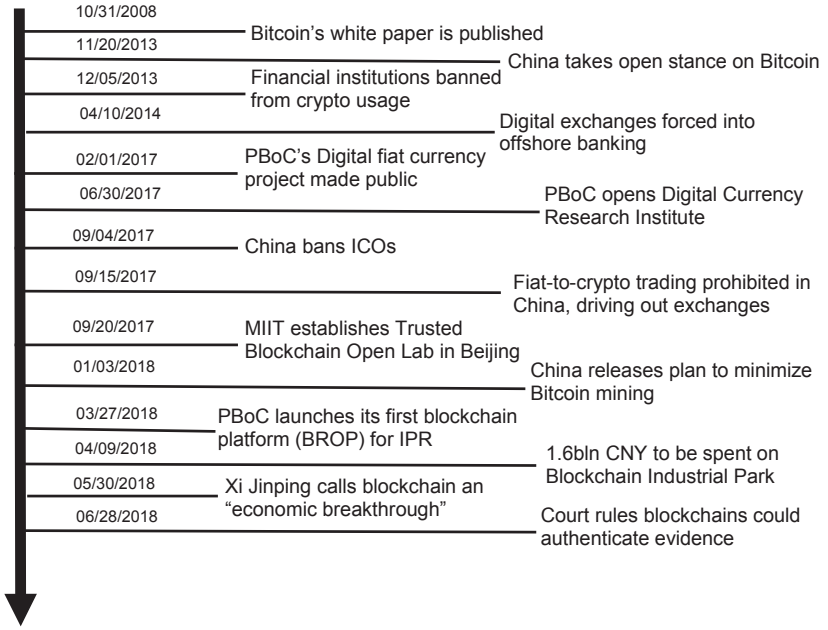
Total factor productivity (TFP) is commonly defined as the contributions to output that are outside of labor and capital inputs (Comin 2006). Considering the relatively expansive and open-ended nature of TFP, it is often considered the greatest contributor to economic growth. Three of the most academically discussed components of TFP are human capital, technology, and institutions which includes government policies.

3.2 – Innovation-led Growth vs. Investment-led Growth

In line with the theory developed in Acemoglu, Aghion, and Zilibotti (2006) (AAZ), this paper will cite policies and developments where China has opted for innovation-led growth over investment-led growth. Considering China's relative proximity to the technological frontier, aiming for this form of growth should lead to even greater long-run economic growth rates. Zilibotti et al. said, "when the economy is far from the technology frontier, the main growth engines are physical capital investments, the imitation of more productive foreign technologies, and the reallocation of resources from less to more productive activities" (Zilibotti 2017). However, once this economy has nearly capitalized on all the benefits capital accumulation, a new approach is necessary for continued growth. When "the economy has come closer to the

technology frontier, it must switch on a new engine: innovation" (Zilibotti 2017). Failing to make progress towards innovation-led growth might explain why "many developing economies get thrown off their high-growth trajectories as they approach 25%–30% of the world technology frontier" (Zilibotti 2017). Providing the environment for innovative firms and ideas to flourish has the capability of sustaining a nation's growth to a degree that capital accumulation alone cannot.

4. – Policy Timeline [2]



(See Timeline Works Cited)

4.1 –Anti-Crypto Legislation

[2] PBoC: People's Bank of China | ICO: Initial coin offering

Despite China's support and adoption of blockchain technology, the CCP has not been as supportive of decentralized cryptocurrencies. China was one of the first nations to develop an affinity for Bitcoin and much of this was not with CCP's best interests in mind. As both a tool for speculation and circumventing strict capital controls, many Chinese citizens found Bitcoin as an appealing investment. After taking a relatively benign stance on Bitcoin a month prior, the Chinese Communist Party's first major restriction on the cryptocurrency came in December of 2013 and forbid financial institutions from trading the currency on the premise of its overly speculative nature. In April of 2014, the Party's next restrictive policy was driving crypto-to-crypto digital exchanges out of China by not allowing such companies to operate through the central banks.

After this price and trade-volume deflating legislation was enacted, China entered a period of minimal government intervention regarding blockchain technology and high digital asset demand despite the uncertain business climate. The business geography of the blockchain industry in China was primarily fintech companies in Beijing and Shanghai, mining operations in western provinces such as Xinjiang and Sichuan, and high-tech manufacturing occurring in Shenzhen.

2017 was an explosive year for the blockchain ecosystem. Not only were governments starting to give greater recognition to the technology's potential, but funding, adoption, and interest were reaching new peaks thanks to the popularization of initial coin offerings (ICOs). Initial coin offerings are much like initial public offerings of companies in the traditional finance space but specific to cryptocurrencies. To combat incidences of fraud, nefarious fundraising and financial manipulation, China banned initial coin offerings on September 4th, 2017. This decision was quickly followed up with a ban on fiat-to-crypto trading in China which further drove out

domestic digital exchanges. These two policies are the most famous Chinese policies about blockchain technology but as the Timeline and Argument of this paper will explain, that does not tell the full story.

5. – Argument

5.1 – Research and Development

One approach the CCP has taken towards advancing the development of blockchain technology in China is through investing in specialized research in higher education institutions. In 1998, Project 985 was put into action. This government-funded project set out to establish "world-class universities" that would help push China into becoming a nation capable of producing new talent with the human capital to rival any other nation (China Education 2018). Of the 39 higher education institutions that received government funding under Project 985, 28 have newly established academic features associated with blockchain technology (Table 1).

Three nonacademic examples of China taking a more aggressive approach towards R&D include the People's Bank of China opening the Digital Currency Research Institute in June of 2017, the Ministry of Industry and Information Technology (MIIT) establishing the Trusted Blockchain Open Lab in September of 2017, and the announcement of the Blockchain Industrial Park in Hangzhou and its 1.6 billion yuan in funding from both the private and public sector (Timeline). Yao Qian, director-general of the PBoC's Digital Currency Research Institute said, "Conducting deep research on blockchain is the right thing for China to do to develop financial technology" (Xueqing 2018) a high value service industry that both the private and public sector seek to strengthen. Funding of this magnitude is a clear example of China making strides toward innovation-led growth.

5.2 – Early Technological Adoption

Despite the CCP's distaste for decentralized cryptocurrencies, China has been on the cutting edge of blockchain adoption for all variations of blockchains. A notable Chinese public blockchain is NEO, a community-driven blockchain project that "utilizes blockchain technology and digital identity to digitize assets and automate the management of digital assets using smart contracts" (NEO 2014). The NEO community's goal is to combine digital assets, digital identities, and smart contracts to create a smart economy. By not attempting to be a competitive currency in the Chinese economy, NEO has been able to live relatively harmoniously within China in ways that most other public blockchains have not.

The public sector's approach to blockchain technology has been through the implementation of private chains. The "Big Four State-owned banks – Bank of China, China Construction Bank, Industrial and Commercial Bank of China and Agricultural Bank of China- also use the technology on their projects, including poverty relief, international trade, home renting platform, e-commerce chain" (Zhang 2018). For example, the Bank of China is implementing a blockchain-based system to better manage the local poverty reduction fund in Tibet since the province has an unemployment rate four times greater than the national average (Wu 2018). This would not be achievable without the transparency and distributed nature of blockchain technology.

The People's Bank of China has made it clear that private chains are not the only form of blockchains that they see value in going forward. One of the most interesting announcements made by the PboC was in February 2017 when they announced their project to create a digital fiat currency utilizing "the core features of cryptocurrency and the existing monetary system" (Zhao PBoC 2018). Another example of the PBoC displaying its commitment to blockchain adoption was when the Hangzhou Blockchain Research Institute presented its Blockchain

Registry Open Platform (BROP) at the Global Financial Science and Technology Summit on March 2018. “The BROP is an open platform for developing independent intellectual property rights based on blockchain, according to its white paper (in Chinese). The platform will work with partners to make credible records of user identity, certificate data, and digital credentials for enterprise users. It plans to provide verifiable and supervised ownership registries and information on public services” (Borak 2018).

An interesting example of a consortium chain in China is MATRIX, the sole blockchain and AI solutions provider for the Party’s One Belt One Road Initiative. MATRIX offers all types of blockchain solutions, not just consortium chains, and has a promising future since “The national government [has] put aside trillions to pour into belt and road projects and [has] recently invested $2.1 billion in an AI research park in Beijing”(cryptweeter 2018).

Perhaps the most progressive decision regarding blockchain adoption in China was a judicial decision made in June 2018. A court in China’s Hangzhou city ruled that evidence authenticated with blockchain technology can be presented in legal disputes. This court set both a national and global precedent by stating that, “the usage of a third-party blockchain platform that is reliable without conflict of interests provides the legal ground for proving the intellectual infringement” (Blockchain 2018). The acceptance, acknowledgement and usage of blockchain technology by the China’s government are promising signs of China aiming to position itself at the technological frontier.

5.3 – Business Climate

Another component of total factor productivity that China has been manipulating for its economic benefit are its institutions. Institutions include government policies, rules, and regulations. While there have been many disheartening institutional decisions made by the

Chinese government regarding blockchain applications including the ICO and fiat-to-crypto bans in September of 2017, the technology itself has seen tremendous government support.

In a more general sense, business conditions for blockchain startups were improved when after an inspection by the State Council, "25 provincial regions, 82 cities and 116 counties will be entitled to 24 incentive measures for their achievements in major policies in 2017, including supply-side reform and optimization of business environment" (China 2018). The official also noted that the 2018 innovation-led growth plans were mainly focused on "Beijing, Tianjin and Hebei province… advancing the incubation of cutting-edge technologies" (FTZs 2018).

After President Xi Jinping gave a rousing speech saying both that "a new generation of industrial revolution is substantially reshaping the global economic structure" and that "artificial intelligence, internet of things and blockchain [are] constantly making application breakthroughs" (Zhao Xi 2018) it was clear that the CCP wanted the world to know about its attitudes towards the next generation of technology. This powerful statement also was accompanied by the State Council's ordering of the "Guangdong Free-trade Zone to accelerate blockchain development and application" (Zhao Xi 2018) which further clarified the CCP's intentions for the technology.

Chinese blockchain industry growth has been astounding with the number of new blockchain companies in 2016 tripling those from 2015, "40% of all Chinese Blockchain startups [beginning] in 2017" and "68 equity financing initiatives for blockchain startups in the first quarter of 2018" alone (Zhao IT 2018). Policies of this nature have clearly done a tremendous job at providing funding, talent, and viable business opportunities for those seeking to expand the understanding and application of blockchain technology.

Patents are another tangible measure of human capital growth and innovation-friendly institutions. “More than half the world’s 406 blockchain-related patents in 2017 came from China” (Patent 2018) and this trend of dominance is growing. “China filed 225 and 59 patents in 2017 and 2016 respectively, while the US filed 91 and 21 in 2017 and 2016 and Australia took third place with 13 and 19 blockchain-related patents applications” (Patent 2018). In 2017, four of the ten global leaders in blockchain patent filings: Alibaba, Bubi Technologies, Hangzhou Fuzamei Technologies and Hangzhou Yunphant Network are Chinese firms (Table 2). Despite all that has occurred regarding cryptocurrency regulation, the policies surround research, adoption, and innovation have transformed China into the leading pioneer.

6. – Conclusion

The Chinese Communist Party’s approach towards blockchain technology has been confused thanks to a few restrictive regulations in past decade. The reality of the matter is that the Party is carrying a variety of plans to augment the implementation and development of blockchain technology within China.

Educational policies like Project 985 transformed Chinese higher education institutions into academic juggernauts, many of which have blockchain affiliated academic resources in the form of research institutes and key laboratories. Roughly half the world’s blockchain patents in 2017 came from China, demonstrating the nation’s edge in blockchain innovation. The establishment of the Digital Currency Research Institute in Beijing and the Blockchain Industrial Park in Hangzhou are two more examples of how the public and private sector are also contributing towards improving human capital related to blockchain technology.

The rate of technological progress is also increasing thanks to the government’s early adoption of the technology. All the major state-owned banks have implemented blockchain

technology to some degree. Additionally, the acknowledgement of blockchain-based data being viable evidence in court means that the theoretical benefits of blockchain adoption are being realized in a tangible manner.

China's attempt to transition away from secondary industries like textiles and electronics manufacturing is directly in line with the AAZ theory that long run economic growth is best sustained by innovation-led growth over basic investment-led growth as a nation approaches the technological frontier. Blockchain technology has already shown its tremendous potential in the world of financial technologies, a high-value service-based industry that also assist in China's transition towards tertiary service industries. Beyond that, blockchain technology will elevate the economy because of its ability to improve efficiency levels for a plethora of other industries from supply chain to healthcare.

The significance of China's push towards blockchain adoption and innovation also connects to underlying economic challenges that China is facing today. In the financial realm, blockchain technology will improve transparency, efficiency and accessibility so the many millions of people in western China who are unbanked are likely to be given a whole new range of financial opportunities. State-owned banks are already working on poverty-relief efforts that incorporate the technology. With the capability to economically empower individuals who have been left behind by the traditional financial systems, this technology could not only strengthen China's economy in the major cities along the east coast but also be a tool to lift people out of poverty in the interior of China.

Research and development, early technological adoption and business climate relating to blockchain technology are all critical ways in which China is encouraging economic growth through blockchain technology.

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9. – Technical Appendix

The Cobb-Douglas production function $Y = F(A, N, K)$ or $Y_t = A_t \cdot N_t \alpha \cdot K_t 1 - \alpha$ decomposes an economy's production (Y) as a function of labor (N), capital (K) and total factor productivity (A). α and 1-α are output elasticities. A critical assumption of this equation is that labor and capital display constant returns to scale together but diminishing returns to scale individually. With the assumptions in place, factors are in perfect competition and therefore receive only their marginal products:

Marginal product of capital: $dY/dK = MPK$ | Marginal product of labor: $dY/dN = MPN$

A complete differentiation of the production function: $dY = F_A dA + F_N dN + F_K dK$

F_i is the partial derivative of factor i or the marginal product of that factor. This means it can also be written as $dY = F_A dA + MPN dN + MPK dK$

By dividing through by Y and converting factor changes into rates of growth the same equation can be expressed as: $dY/Y = (F_A A/Y)(dA/A)+(MPN*N/Y)(dN/N)+(MPK*K/Y)(dK/K)$ To simplify notation, growth rates can be denoted as $g_i = di/i$ representing percentage change of a given factor. $g_Y = (F_A A/Y)g_A + (MPN*N/Y)g_N + (MPK*K/Y)g_K$

(MPN*N/Y) and (MPK*K/Y) represent the share of income that goes to capital and labor respectively since factors receive their share based on their marginal product due to constant returns to scale and therefore perfect competition. This equation can further be simplified by replacing these two terms with α and 1- α. These terms can also be referred to output elasticities. $(F_A A/Y)$, the share of income dedicated to total factor productivity, is not as concrete of an output elasticity since total factor productivity is a multi-faceted variable. In this paper the growth rate of total factor productivity and the share of income given to total factor productivity

are analogous enough to represent with the singular term g_A. The now simplified equation can be expressed as: $g_Y = g_A + \alpha g_N + (1- \alpha)g_K$

The two conclusions made in the theory section of this paper refer to the composition of variables on a balanced growth path, a macroeconomic condition that the Chinese economy has been trending towards. On a balanced growth path an economy's output and capital level grow in unison. With this in mind, g_Y and g_K can represented by the same term.

$$g_Y = g_A + \alpha g_N + (1- \alpha)g_K$$
[Substitute g_Y in for g_K]
$$g_Y = g_A + \alpha g_N + (1- \alpha)g_Y$$
$$\alpha g_Y = g_A + \alpha g_N$$
$$g_Y = (1/\alpha)g_A + g_N$$

$$g_Y - g_N = (1/\alpha)g_A$$
[Use division property of logarithms to combine g_y and g_N]
$$g_{(Y/N)} = (1/\alpha)g_A$$
$$g_y = (1/\alpha)g_A$$

The growth rates of output, capital, and labor can follow the properties of logarithms since the diminishing returns to either input individually creates an output growth path that would be comparable in shape that of that logarithmic function. Based on this model, total output's balanced growth path would also grow at a faster rate now that China has implemented policies that will increase the growth rate of technology. Output per capita, a popular proxy for standard of living, is an economic variable that's long run trajectory is often discussed. If the employment to population ratio is constant over time then output per capita would have a balanced growth path that mirrors output per worker. The employment to population ratio has been consistent over the last decade with a range of 0.88 of a percentage point. So as with the balanced growth path of output per worker, output per capita would grow at a faster rate now that China has implemented policies to accelerate the growth rate of technology.

10. – Appendix A

Table 1 – Blockchain-related Assets at Higher Education Institutions

Institution	Key Feature
Beijing Institute of Technology	Beijing Laboratory of Intelligent Information Technology
Beijing Normal University	Zhongguancun International Incubator
Beihang University	Key Laboratory of National Defense Science and Technology for Trusted Network Computing Technology
Central South University	Information Security and Big Data Research Institute
Chongqing University	Institute of Intelligent Computation and Information Security
Dalian University of Technology	Provincial Research Center for Internet of Things
Fudan University	National Demonstrative Experimental Computer Science Center
Harbin Institute of Technology	Research Center of Computer Network and Information Security Technology
Jilin University	Institute of Computer Science and Technology
Lanzhou University	MOE Engineering Research Center of Open Source Software and Real Time System
Nanjing University	Internet of Things Engineering (IOFTE) Center
Nankai University	Institute of Big Data Technology Research
Northeastern University	Key Laboratory of Big Data Management and Analytics
Peking University	Member university for affordable education DAO
Renmin University of China	Research Center of Data Warehouse and Business Intelligence
Shandong University	Key Laboratory of Cryptologic Technology and Information
Shanghai Jiaotong University	MOE Engineering Research Center of Network and Information Security
South China University of Technology	Guangdong Province Information Security Technology Engineering Research Center

Southeast University	Research Center of Future Network
Sun Yat-sen University	Information and Communication Technology Research Center
Tianjin University	Key Laboratory of Advanced Network Technology and Application
Tongji University	X Lab
Tsinghua University	Financial Technologies Lab
University of Electronic Science and Technology of China	IBM Mainframe Laboratory
University of Science and Technology of China	National High Performance Computing Center
Xiamen University	IoT and IT R&D Center
Zhejiang University	Zhejiang University Blockchain Research Center
East China Normal University	Shanghai Key Laboratory for Trustworthy Computing

Table 2 - 2017 Leaders in Blockchain Patent Filings

Rank	Name	Filings
1	Bank of America	45
2	EITC Holdings	42
3	CoinPlug	39
4	Alibaba	36
5	IBM	34
6	NChain Holdings	33
7	Bubi Technologies	30
8	Mastercard International	21
9	Hangzhou Fuzamei Technologies	19
10	Hangzhou Yunphant Network	18