Journal of Global Business and Trade

Vol. 16 No. 1 May 2020

The Journal of Global Business and Trade
IAGBT
International Academy of Global Business and Trade

Journal of Global Business & Trade
Vol. 16 No. 1 May 2020
IAGBT

ISSN 1946-5130 (Print)
ISSN 2470-4733 (Online)

Journal of Global Business and Trade
Vol. 16 No. 1 May 2020

Published by
International Academy of Global Business and Trade
The Journal of Global Business and Trade
IAGBT
www.pfw.edu/jgbt

Journal of Global Business and Trade

ISSN 1946-5130 (Print)
ISSN 2470-4733 (Online)

About Journal

Journal of Global Business and Trade (JGBT) is the official publication of the International Academy of Global Business and Trade (IAGBT) and is published by IAGBT on a semiannual basis. JGBT is the leading peer-reviewed, scholarly journal that publishes research across the entire range of topics encompassing the domain of global business and trade.

JGBT aims to be a resource for the advancement of the theoretical foundations and the practical applications in the context of Asia-Pacific global business, trade and economy. The journal takes a broad perspective of the global economy by covering many vibrant sectors such as manufacturing, retailing, international trade, agricultural economy, tourism, and information technology, just to name a few. The journal will publish research papers, reports, and commentaries of significant interest to the community engaged in global business and trade. By being a conduit for sharing intellectual ideas and opinions among the academia and individual global industry sectors, the journal aims to bridge the gap between research and sound decision-making.

JGBT is the only business journal that highlights a diversity of perspectives through research papers, reports, and commentaries of significant interest to the international business and trade community.

JGBT enhances sound research through quick and constructive review of the manuscripts submitted.

JGBT aims to appeal to academics, government representatives, business major students, business and industry professionals, and trade organizations.

ISO abbreviation of journal title

The official title of the journal is 'Journal of Global Business and Trade' and the abbreviated title is 'J. Glob. Bus. Trade'

Year of launching (history)

Journal of Global Business and Trade was launched in 2005.

Availability of the full-text in the web

Full text is freely available from: http://www.pfw.edu/jgbt

Fund support

This journal was supported by the International Academy of Global Business and Trade.

Index in database

The articles published in this journal are indexed and/or abstracted in EBSCO, ProQuest, Exribris, and GoogleScholar.

Subscription information

All correspondences regarding membership, subscriptions and changes of address should be sent to the society addressed as below:
International Academy of Global Business and Trade, 2101 E. Coliseum Boulevard, Fort Wayne, IN 46805, U.S.A. (Tel: 1.260.481.6794, Fax: 1.260.481.6879, E-mail: myeonghwan.kim@pfw.edu, Homepage: http://www.pfw.edu/jgbt). The annual subscription fees are free of charge.

Submission

The IAGBT operates an on-line submission system. Details of how to submit online and full author instructions can be found at: http://www.pfw.edu/jgbt. Manuscripts should be submitted to the on-line submission system at http://www.jgbt.us following all prompts on the screen. Other correspondences can be sent by e-mail to the editor Myeong Hwan Kim at myeonghwan.kim@pfw.edu.

Peer review under responsibility of International Academy of Global Business and Trade.

Journal of Global Business and Trade Volume 16, Number 1

Published 30 May 2020

Publisher (Editorial office)

International Academy of Global Business and Trade founded in 2005,
2101 E. Coliseum Boulevard, Fort Wayne, IN 46805, U.S.A. (Tel: 1.260.481.6794, Fax: 1.260.481.6879,
E-mail: myeonghwan.kim@pfw.edu, Homepage: http://www.pfw.edu/jgbt).

Copyright

Editorial Staff

The Journal of Global Business and Trade (JGBT) editorial team is committed to providing subscribers with the best quality articles in a timely manner, ensuring a journal that subscribers will find stimulating and useful in their teaching and professional activities.

Journal of Global Business and Trade

Vol. 16 No. 1 May 2020

The Journal of Global Business and Trade
IAGBT
www.pfw.edu/jgbt

ISSN 1946-5130 (Print), ISSN 2470-4733 (Online)
http://dx.doi.org/10.20294/jgbt.2020.16.1.1

The Journal of Global Business and Trade

Journal of Global Business and Trade

https://www.pfw.edu/jgbt

Sukuk (an Islamic Bond) Utilization for One Belt One Road

Yoonmin Kim*

Department of Economics and Finance, Keimyung University, South Korea

Received 9 January 2020, Revised 8 April 2020, Accepted 22 May 2020

ABSTRACT

Purpose – Islamic finance is one of the most rapidly growing segments of the global financial system. This is especially so due to *Sukuk*, an Islamic bond that holds the highest influence in Sharia (Islamic law) because it meets the requirement of a financial instrument in both the conventional and Islamic financial markets. The bonds were utilized for One Belt One Road (OBOR) projects and when analyzing several leading Islamic, finance-related stock markets.
Design/Methodology/Approach – Due to the vernacular used in Sharia, a subsequent language barrier persisted whereby *Sukuk* bonds were analyzed and standardized in this paper indirectly. This author indirectly analyzed and standardized *Sukuk* bonds from several leading Islamic finance-related stock markets, such as the Indonesia Stock Exchange (IDX), The Bursa Malaysia exchange, Tadawul (the Saudi Stock Exchange), The London Stock Exchange (LSE), The Luxembourg Stock Exchange, The Irish Stock Exchange (ISE), and NASDAQ Dubai.
Findings – The findings are that *Sukuk* would be able to play a central role in supporting and advancing the financing needed for OBOR projects while also enabling the mobilization of capital for initiatives that would maintain a net positive impact socially for all countries involved.
Research Implications – The principles of Islamic finance are grounded in the timeless values of social justice and the betterment of humankind that provides a broader moral arc for ethical and equitable business practices. Given the prudent decision of Chinese leadership to significantly expand environmentally sustainable and climate-friendly infrastructure projects, there is a distinct opportunity to unlock combined synergies through the convergence of Islamic financing and funding for the OBOR.

Keywords: bond, *Ijara*, one belt one road (OBOR), sharia, *Sukuk*, *Wakala*
JEL Classifications: B26, D53, E44, E58, F21, F55, F65

Ⅰ. Introduction

Adherents of Islam constitute the world's second largest religious group. In 2019, Islam had 2 billion adherents, which is approximately 25% of the world's population. An estimate of the Islamic Finance market's current size ranges from $2 trillion U.S. to $2.4 trillion U.S., with expectations of the market size to reach $3.4 trillion U.S. by the end of 2022.

* Corresponding Author, E-mail: *ykim419@kmu.ac.kr*

Based on $2 trillion U.S., Islamic Finance assets represented 1% of the global financial market assets of $200 trillion. To put this in context, $2 trillion U.S. was about the size of the balance sheet assets of the Hong Kong and Shanghai Banking Corporation (HSBC) as of 2018. Islamic finance, in 2018, consisted of Islamic banking ($1,462 billion U.S.), *Sukuk* (Islamic bonds, $337 billion U.S.), sovereign funds ($61 billion U.S.), and *Takaful* ($34 billion U.S.).

Moreover, global *Sukuk* issuances in 2018 rose to $123.2 billion U.S., up 5.5% from the primary market *Sukuk* issuances of $116.7 billion U.S. in 2017, according to the International Islamic Financial Market (IIFM) in its Annual *Sukuk* Report 2019, recently released.

The One Belt One Road (OBOR) project is not just public construction work to develop overland and overseas routes to satisfy China's desire to build the country's infrastructure. OBOR is based on the spirit of the Silk Road. The ancient Silk Road was a series of trade and cultural transmission routes that connected the West and East by linking traders, pilgrims, soldiers, and urban dwellers from China and India to the Mediterranean Sea.

OBOR is a significant strategy shaped by the Chinese government that focuses on the connectivity and promotion of economic cooperation among countries along the Silk Road and silk belt routes. OBOR represents a third of the world's total economy, and more than half of the global population.

Ⅱ. Operational Framework of Conventional Bonds and *Sukuk*

Conventional bonds are debt instruments. A government, corporation, or other entity issuing a conventional bond essentially sells IOUs to investors. Each bond has a face value, or a par value, which is often $1,000. An investor pays that amount, or, depending on the state of the bond market at the time of purchase, may pay a premium (more than par value) or a discount (less than par value).

In order to reward investors for conventional bonds, a conventional investor receives interest payments for a bond purchase. This interest may be based on a fixed interest rate for the life of the bond, or may be adjustable. The issuer usually sends interest payments to the investor twice a year.

In order to repurchase conventional bonds at maturity, each bond is issued with a specific date of maturity, or the date when the bond's term is complete. On that date, the issuer owes the investor the initial face value of the bond. The principle is guaranteed by the issuer no matter how well the underlying investment performs. Therefore, the investor gets his principal back and, in the meantime, receives interest for letting the issuer use his money.

The operation of conventional finance involves the elements of uncertainty (*Gharar*) and gambling (*Maysir*) in the contract of finance, and usury (*Riba*) in its investment activities, which do not conform to the requirements of Islamic law (*Shariah*). *Gharar* may exist with regard to the scope of coverage, terms of the contract, and source of the claim payments. *Maysir* may arise from any speculative element present in a contract, such as an unequal exchange in the amount of money that might be based on an immoral inducement to gain without the consideration of loss. *Riba*, or excessive profit, may arise from financial interest received from the investment of funds collected from participants.

Conventional bonds are not Shariah-compliant because the rewards are based on interest. Bonds pay investors based on fixed or adjustable interest rates. Investors also earn money by purchasing bonds at less than face value and/or selling higher than face value. The market price of a bond is directly related to interest rates, and may be higher or lower than a bond's face value.

Sukuk are certificates of equal value that represent a proportional, undivided ownership right for tangible assets, a pool of predominantly tangible assets, or a business venture. These assets may be in a specific project or investment activity in accordance with Shariah rules and principles.

In order to reward investors for *Sukuk*, the future cash flows from the underlying assets are transferred

into the present cash flow. *Sukuk* may be issued for existing assets or for assets that will exist in the future. Investors who purchase *Sukuk* are rewarded with a share of profits derived from the asset, but do not earn interest payments because doing so would violate Sharia.

In order to repurchase *Sukuk* at maturity, they are also issued with specific maturity dates. When the maturity date arrives, the *Sukuk* issuer buys them back through a middleman called a Special Purpose Vehicle (SPV). However, with *Sukuk*, the initial investment is not guaranteed. The *Sukuk* holder may or may not get back the entire principal (face value) amount. This occurs because, unlike conventional bond holders, *Sukuk* holders share the risk of the underlying asset. If the project or business on which *Sukuk* are issued does not perform as well as expected, the *Sukuk* investor must bear a share of the loss.

Most Sharia scholars believe that having *Sukuk* managers, partners, or agents that promise to repurchase *Sukuk* at its face value is unlawful. Instead, *Sukuk* are generally repurchased based on the net value of the underlying assets (each share receiving its portion of that value) or at a price agreed upon at the time of the *Sukuk* purchase.

The key characteristics of *Sukuk* are considered Sharia-compliant. This ruling means that Islamic investors have the right to receive a share of profits from the *Sukuk's* underlying asset. Due to Sharia jargon and the language barrier that could occur, it is very difficult to distinguish *Sukuk* from conventional bonds directly, according to the Quran. This author indirectly analyzed and standardized *Sukuk* bonds from several leading Islamic finance-related stock markets, such as the Indonesia Stock Exchange (IDX), The Bursa Malaysia exchange, Tadawul (the Saudi Stock Exchange), The London Stock Exchange (LSE), The Luxembourg Stock Exchange, The Irish Stock Exchange (ISE), and NASDAQ Dubai.

Table 1. Contrasting *Sukuk* and a Conventional Bond

	Sukuk	**Conventional Bond**
Asset Ownership	*Sukuk* gives an investor partial ownership in the asset upon which the *Sukuk* is based.	A bond does not give an investor a share of ownership in the asset, project, business, or joint venture they support. A bond is a debt obligation from the issuer to the bond holder.
Investment Criteria	The asset on which *Sukuk* are based must be Sharia-compliant.	Generally, bonds can be used to finance any asset, project, business, or joint venture that complies with local legislation.
Issue Unit	Each *Sukuk* represents a share of the underlying asset.	Each bond represents a share of debt.
Issue Price	The face value of *Sukuk* is based on the market value of the underlying asset.	The face value of a bond price is based on the issuer's credit worthiness (including its rating).
Investment Rewards and Risks	*Sukuk* holders receive a share of profits from the underlying asset (and accept a share of any loss incurred).	Bond holders receive regularly scheduled (and often fixed rate) interest payments for the life of the bond, and their principal is guaranteed to be returned at the bond's maturity date.
Effect of Costs	*Sukuk* holders are affected by costs related to the underlying asset. Higher costs may translate to lower investor profits and vice versa.	Bond holders generally are not affected by costs related to the asset, project, business, or joint venture they support. The performance of the underlying asset does not affect investor rewards.

Ⅲ. How *Sukuk* Works in the Non-Muslim Financial Market

The issuance of *Sukuk* is not only popular in Muslim countries, it has become popular in non-Muslim countries as well. Islamic investing is growing rapidly as an alternative investment class among all investors, and both Muslims and non-Muslims note that *Sukuk* is a good practice because of its foundation in ethical business practices, social responsibility, and fiscal conservatism.

Imam and Kpodar (2013) insisted that interest rates were found to have a negative impact on banking selection among Muslims, while the quality of institutions was not found to be a significant determinant. However, non-Muslims noted a positive impact due to the benefits they derived, including a greater stability of returns, transparency, and diversification. *Sukuk* financing has demonstrably come of age as a preferred asset class of choice by institutional investors globally and by market participants in key regional blocs. *Sukuk* issuance per annum has consistently hit the 90-100 billion U.S. dollar range in recent years.

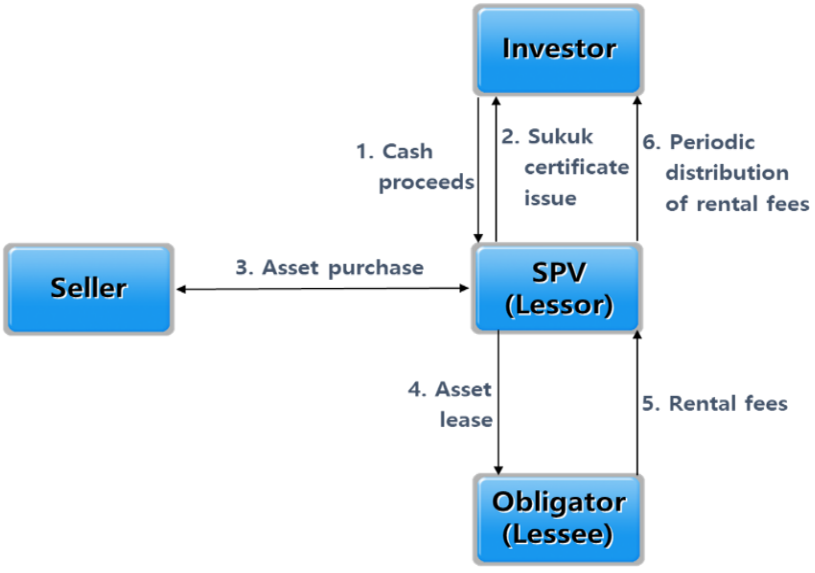
On June 25, 2014, the U.K. government confirmed that £ 200 million of *Sukuk*, maturing on July 22, 2019, had been sold to investors based in the U.K. There was a strong demand for the U.K.'s first sovereign *Sukuk* with orders totaling around £ 2.3 billion. Allocations were made to a wide range of investors, including sovereign wealth funds and central banks, as well as domestic and international financial institutions.

Investors from the major centers for Islamic finance in the Middle East, Asia, and U.K. were all represented in the final allocation. The profit rate on the *Sukuk* was set at 2.036%, and is in line with the yield on gilts of similar maturity.

The U.K.'s sovereign *Sukuk* uses the *Ijara* (lease-based Sukuk) structure, which is the most common structure for sovereign *Sukuk* that consists of rental payments on property that provides income for investors. The *Sukuk* was underpinned by three central government properties and listed on the London Stock Exchange on July 2, 2014.

The *Ijara* contract is essentially a rental or lease contract. It establishes the right to use an asset for a fee. The basic idea of *Ijara Sukuk* is that the *Sukuk* holders (investors) are the owners of the asset and are entitled to receive a return when the asset is leased.

Fig. 1. *Sukuk* Based on a *Ijara* Contract.



Ijara is a well-known *Sukuk* structure because it is simple and tradable. *Ijara Sukuk* gives the holders a fixed flow of income. Companies may opt to use *Ijara Sukuk* if they determine that doing so is less expensive than securing a bank loan to purchase an asset.

In this scenario, the Special Purpose Vehicle (SPV) receives the *Sukuk* proceeds from investors. In return, each investor gets a portion of ownership in the asset to be leased. The SPV buys the title of the asset from the same company that is going to lease the asset. In turn, the company pays a rental fee to the SPV.

The *Ijara* contract process begins when a company needs an asset but cannot afford to purchase it outright and contracts an SPV, which agrees to purchase the asset and rent it to the company for a fixed period of time.

After the contract is signed, the following figure demonstrates how *Ijara Sukuk* works.

Ⅳ. Necessity of *Sukuk* for One Belt One Road

The One Belt One Road (OBOR) initiative is a combination of a land-based Silk Road Economic Belt and a sea-based 21st Century Maritime Silk Road. It refers to the New Silk Road Economic Belt that will link China with Europe through central and western Asia, and the 21st century Maritime Silk Road connects China with Southeast Asia, Africa, and Europe. Funding for this initiative will be carried out mainly through China's own Silk Road Fund and the newly established Asian Infrastructure Investment Bank (AIIB). The OBOR initiative is taking place via the $1 trillion investment by China in their bold, innovative, and strategic OBOR project that spans more than 68 countries and 4.4 billion people which collectively comprise 40 percent of global GDP.

The five major goals of the OBOR initiative are the fostering of policy coordination, financial integration, unimpeded trade, facility connectivity, and people-to-people bonds. The initiative to jointly build the Belt and Road, embracing the trend towards a multipolar world, economic globalization, cultural diversity, and greater IT application, is designed to uphold the global free trade regime and the open world economy in the spirit of open regional cooperation. It is aimed at promoting the orderly and free flow of economic factors, a highly efficient allocation of resources, and deep integration of markets. It encourages the countries along the Belt and Road to achieve economic policy coordination and carry out a broader and more in-depth regional cooperation of higher standards, and jointly create an open, inclusive, and balanced regional economic cooperation architecture that benefits all.

Theoretically, the asset-based nature of *Sukuk* makes it ideal to be used as an infrastructure financing tool to build highway networks, ports, and other big projects involving tangible assets. The Asian Development Bank (ADB) estimated that the region needs $750 billion worth of infrastructure financing annually. The China-led AIIB is collaborating with the Jeddah-based Islamic Development Bank (IDB) to appraise the appropriateness of Islamic Finance as tool to fund different projects. China's eagerness to jump on the *Sukuk* financing bandwagon affirms the prominence *Sukuk* has gained from investors across developing countries and multilateral lenders to help finance various infrastructure projects.

Moreover, *Sukuk* can potentially attract excess liquidity to China that supports strategic infrastructure projects in the country and create OBOR strategic economic partnerships with its historical "silk road" partners across Eurasia, where 40 percent of OBOR countries are Muslim. If China wants to connect with related countries along the route, it should develop *Sukuk* and consider it a priority because *Sukuk* lays a foundation that makes China more approachable to new segments of investors.

Ⅴ. Offshore *Sukuk* Issuance in Hong Kong

Sukuk not only saves costs, it also hedges against risks from exchange rate fluctuations, and especially

corporate debts that are denominated in the dollar. Offshore *Sukuk* issuance in Hong Kong is an effective method for hedging. The proceeds would not be channeled into China, but just operate and flow abroad in a way that might promote enterprises to expand businesses along the route of the OBOR initiative.

On September 10, 2014, the Hong Kong Special Administrative Region of the People's Republic of China (the HKSAR government) confirmed that U.S. $1 billion of *Sukuk* and a 5 year tenure marked the world's first USD-denominated *Sukuk* originating from an AAA-rated government. The first USD *Sukuk* was placed at 2.005% (23 basis points over 5-year U.S. Treasuries). The *Sukuk* drew a strong demand from global investors, attracting orders exceeding U.S. $4.7 billion and recording oversubscription at 4.7 times, thus allowing financial pricing to tighten a 7 a basis points from its initial price guidance. Pricing at 23 basis points over the corresponding yield of U.S. Treasuries represents the tightest spread ever achieved on a benchmark USD issuance from an Asian government, setting an important benchmark for Hong Kong and the rest of Asia.

The deal attracted interest from a diverse group of conventional Islamic investors. The *Sukuk* was allocated to over 120 global institutional investors, with 36% of the *Sukuk* being distributed in the Middle East, 47% to Asia, 6% to Europe, and 11% to the United States. By investor type, 11% was distributed to fund managers, 56% to public banks and private banks, 30% to sovereign wealth funds, central banks, and supranational institutions, and 3% to insurance companies.

The *Sukuk* also used an *Ijara* structure, underpinned by selected units in two commercial properties in Hong Kong. The *Sukuk* was issued by a Special Purpose Vehicle, Hong Kong *Sukuk* 2014 Limited, established and wholly owned by the HKSAR Government. The *Sukuk* was settled on September 18, 2014, and listed on the Hong Kong Stock Exchange, Bursa Malaysia (Exempt Regime), and NASDAQ Dubai.

The Hong Kong Monetary Authority acted as the HKSAR Government's representative in the *Sukuk* offering under the Government Bond Program. The primary objective of the Government Bond Program was to promote the further and sustainable development of the local bond market.

HSBC and Standard Chartered Bank acted as Joint Global Coordinators, Joint Lead Managers, and Joint Bookrunners, and CIMB and the National Bank of Abu Dhabi PJSC acted as Joint Lead Managers and Joint Bookrunners for the *Sukuk* offering.

On May 28, 2015, the HKSAR government confirmed that U.S. $1 billion of *Sukuk* and a 5 year tenure marked the second USD-denominated *Sukuk*, subsequent to the inaugural issuance in September 2014. The *Sukuk* was placed at 1.894% (35 basis points over 5-year U.S. Treasuries). The *Sukuk* also saw a strong demand from global investors, attracting orders of U.S. $2 billion, which was 2 times the size of the issuance.

The deal attracted interest from a diverse group of conventional and Islamic investors. Orders were received from 49 global institutional investors with 42% of the *Sukuk* being distributed in the Middle East, 43% to Asia, and 15% to Europe. By investor type, 77% was distributed to public banks, private banks, and fund managers, and 23% to sovereign wealth funds, central banks, and supranational institutions.

The *Sukuk* used a *Wakala* structure, where one-third of assets were underpinned by selected units in an office building in Hong Kong. The *Sukuk* was issued by a Special Purpose Vehicle, Hong Kong *Sukuk* 2015 Limited, established and wholly owned by the HKSAR Government. The *Sukuk* was settled on June 3, 2015 and listed on the Hong Kong Stock Exchange, Bursa Malaysia (Exempt Regime), and NASDAQ Dubai. The *Sukuk* was assigned a credit rating of AAA by Standard and Poor and Aa1 by Moody's.

The Hong Kong Monetary Authority acted as the HKSAR Government's representative in the *Sukuk* offering under the Government Bond Program. HSBC and Standard Chartered Bank acted as Joint Global Coordinators, Joint Lead Managers, and Joint Bookrunners, and CIMB and National Bank of Abu Dhabi PJSC acted as Joint Lead Managers and Joint Bookrunners for the *Sukuk* offering.

Wakala means representing someone, and *Wakil* refers to the agent who acts on behalf of the person represented. A *Wakala* contract can facilitate many trading transactions. The relationship between the two parties involved is similar to the relationship that exists with a *Mudaraba* contract, but not exactly same. In a *Mudaraba* contract, the fund manager is given the freedom to use the funds according to his experience and knowledge. In a *Wakala* contract, the agent does not have such freedom. The agent only acts in accordance with the instructions given by the fund owner. Hence, the agent acts as the instructor's representative.

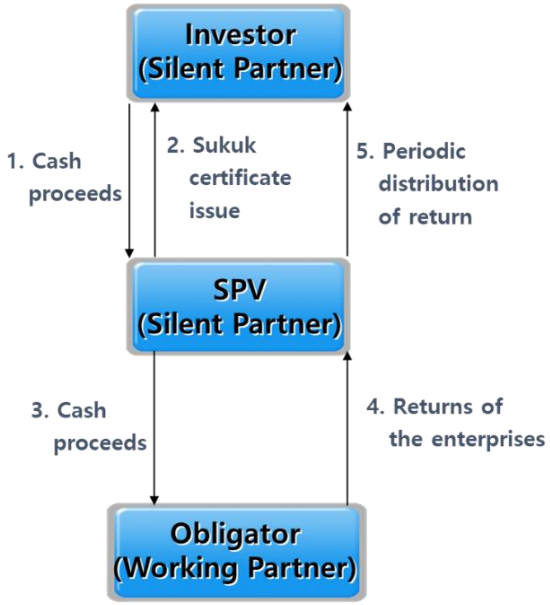
In order to understand a *Wakala* contract, we must understand *Mudaraba* structure first. A *Mudaraba* contract is based on a financial partnership wherein one party (an investor) gives money to another (a fund manager) for the purpose of investing in a business or economic activity. The investor puts up all the capital, and the fund manager provides expertise and knowledge to facilitate the activity's success. Both parties share the profits based on an agreed-upon ratio, but only the investor can lose the initial capital if the activity is not successful.

In a *Mudaraba Sukuk*, the *Sukuk* holders are not silent partners who do not participate in the management of the underlying asset, business, or project. The working partner is the *Sukuk* obligator. SPV is also a silent partner in the *Mudaraba* contract because it represents the *Sukuk* holders (investors). Investor funds are pooled by the SPV and acts on their behalf, so in essence, the SPV is owned by the *Sukuk* holders.

A *Sukuk* obligator as a working partner is generally entitled to a fee and/or share of the profit that is detailed in the initial contract with investors. The contract may refer the investor to the prospectus for information on how the originator is to be paid.

After the contract is signed, the following figure shows how a *Mudaraba Sukuk* works.

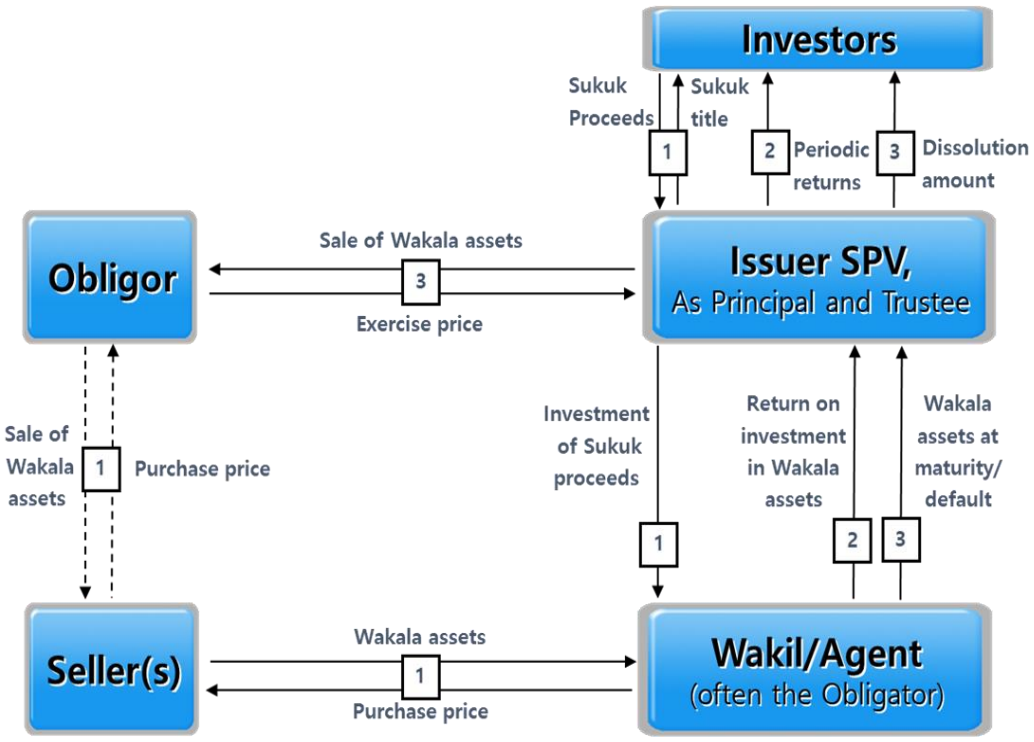
Fig. 2. *Sukuk* Based on a *Mudaraba* Contract



Wakala Sukuk is based on an investment agency contract wherein the agency invests the fund into a pool of eligible investments or assets. Commonly, the pool of investments are originally held by the obligator. The obligator, in its capacity as an agent, will manage the investment based on the agreement between the

principal (investors, via SPV) and the agent, which among others, governs the expected return (profit) and fees (that are usually performance based). A sale/purchase undertaking agreement governs the purchase undertaking by the obligor upon maturity and the relevant exercise price.

Fig. 3. *Sukuk* Based on a *Wakala* Contract



On February 21, 2017, the HKSAR government confirmed that U.S. $1 billion of *Sukuk* and a 10 year tenure of marked the third USD-denominated *Sukuk* made subsequent to the issuances in September 2014 and June 2015. The *Sukuk* was placed at 3.132% (68 basis points over 10-year U.S. Treasuries). Despite the certain global environment and the longer tenure, the *Sukuk* saw a strong demand from global investors, attracting orders of U.S. $1.72 billion, which was 1.72 times the issuance size that allowed the final pricing to be tightened by a 7 basis points from the mid-point of its initial price guidance.

The deal attracted interest from a diverse group of conventional and Islamic investors. Orders were received from over 88 global institutional investors with 57% of the *Sukuk* being distributed in Asia, 25% in the Middle East, and 18% in Europe. By investor type, 53% was distributed to public banks, 36% to fund managers, private banks, and insurance companies, and 11% to sovereign wealth funds, central banks, and supranational institutions. The 10-year tenure also attracted new investors, with over half of them never participating in any of the previous issuances.

Similar to the second *Sukuk*, the *Sukuk* used a *Wakala* structure, with one-third of the assets underpinned by selected units in commercial properties in Hong Kong, and two-thirds of assets underpinned by Sharia-compliant commodities.

The *Sukuk* was issued by a Special Purpose Vehicle (SPV), Hong Kong *Sukuk* 2017 Limited, which was established and wholly owned by the HKSAR Government. The *Sukuk* was settled on February 28, 2017, and listed on the Hong Kong Stock Exchange, Bursa Malaysia (Exempt Regime), and

NASDAQ Dubai. The *Sukuk* has been assigned a credit rating of AAA by Standard and Poor and AA+ by Fitch.

The Hong Kong Monetary Authority acted as the HKSAR Government's representative in the *Sukuk* offering under the Government Bond Program. HSBC and Standard Chartered Bank acted as the Joint Global Coordinators, Joint Lead Managers, and Joint Bookrunners, and CIMB and the National Bank of Abu Dhabi PJSC acted as the Joint Lead Managers and Joint Bookrunners for the Sukuk offering.

Ⅵ. Conclusion

Sukuk can play a central role in supporting and advancing the financing needs of OBOR projects while also enabling the mobilization of capital for initiatives that can maintain a net positive impact socially for all countries.

The principles of Islamic finance are grounded in the timeless values of social justice and the betterment of humankind that provides a broader moral arc for ethical and equitable business practices.

Given the prudent decision of Chinese leadership to significantly expand environmentally sustainable and climate-friendly infrastructure projects, there is a distinct opportunity to unlock combined synergies through the convergence of Islamic finance and funding for the OBOR. With the utilization of *Sukuk*, this author hopes that China will be able to promote the economic development and prosperity of countries along the Belt and Road through enhanced economic cooperation with a spirit of peace and cooperation, openness and inclusiveness, mutual learning, and mutual benefit.

The object of OBOR should be to traverse the world's longest economic corridor, which originates in China and includes Central Asia, Southeast Asia, South Asia, West Asia, and part of Europe, in order to link the Asia-Pacific economic circle at the seat of Eurasia and the European economic circle at its west end. OBOR must provide economic stimulus, create new job opportunities, and subjects of study for young people in all participating countries.

References

Bo, D., Ali, E. R. A. E., & Saiti, B. (2016). Sukuk issuance in China: Trends and positive expectations. *International Review of Management and Marketing, 6*(4), 1020-1025.

Godlewski, C. J., Turk-Ariss, R., & Weill, L. (2011). *Do markets perceive sukuk and conventional bonds as different financing instruments?* (BOFIT Discussion paper No. 6/2011), 3-22. Retrieved from SSRN: https://ssrn.com/abstract= 1833344 or http://dx.doi.org/10.2139/ssrn.1833344

Godlewski, C. J., Turk-Ariss, R., & Weill, L. (2013). Sukuk vs. conventional bonds: A stock market perspective. *Journal of Comparative Economics, 41*(3), 745-761.

Graceffo, A. (2017). Combined Chinese and Islamic financing in the China Pakistan Economic Corridor (CPEC). *Journal of the Punjab University Historical Society, 30*(2), 31-38.

Imam, P., & Kpodar, K. (2013). Islamic banking: how has it expanded?. *Emerging Markets Finance and Trade, 49*(6), 112-137.

IMF [International Monetary Fund] (2019). *Global financial stability report*. Washington, DC: Author.

International Islamic Financial Market. (2019). *A comprehensive study of the global Sukuk market* (Sukuk peport). Manama, Bahrain: Author, 132-138.

Miller, N. D., Challoner, J., & Atta, A. (2007). UK welcomes the Sukuk: How the UK finance bill should stimulate Islamic finance in London, much to the delight of the city's banks. *International Finance Law Review*, *2017*(May), 24-28.

Shaikh, S. A. (2015). Financing public infrastructure using sovereign Sukuk. *Journal of Islamic Banking and Finance*, *32*(1), 11-22.

Swaine, M. D. (2015). Chinese views and commentary on the 'One Belt, One Road' initiative. *China Leadership Monitor*, *47*(2), 3.

Visvizi, A., Lytras, M. D., Alhalabi, W., & Zhang, X. (2019). The new silk road leads through the Arab peninsula: Mastering global business and innovation. West Yorkshire, UK: Emerald.

Wong, M. C. S., & Bhatti, W. I. (2019). Developing international Sukuk in East Asia: Implications from Hong Kong Sukuk. *Journal of Asian Finance, Economics and Business*, *6*(4), 9-17.

ISSN 1946-5130 (Print), ISSN 2470-4733 (Online)
http://dx.doi.org/10.20294/jgbt.2020.16.1.11

The Journal of Global Business and Trade

Journal of Global Business and Trade

https://www.pfw.edu/jgbt

The Impact of Energy Saving Practices: An Estimation of Residential Electricity Consumption in the Philippines

Anna Floresca F. Firmalino*

Graduate School of International Development, Nagoya University, Japan and
Assistant Professor, University of the Philippines Los Baños, Laguna, Philippines

Received 12 January 2020, Revised 15 April 2020, Accepted 22 May 2020

ABSTRACT

Purpose – Recognizing the rise in household electricity consumption and the share of the residential sector in electricity consumption in the Philippines, this paper develops a household electricity model to analyze household electricity consumption and the factors that significantly affect related behavior among Philippine households, with an emphasis on the impact of energy-saving practices as promoted by the government and industry.
Design/Methodology/Approach – The demand for electricity in the Philippines is examined via an Ordinary Least Squares Regression of several functional forms of a residential electricity consumption model, using data from the Household Energy Consumption Surveys of 2004 and 2011.
Findings – Results show that electricity consumption is price inelastic and reacts as a normal good to income changes, with income effects stronger at lower incomes. Charcoal was found to be a complement, while fuelwood, kerosene, and liquefied petroleum gas were substitutes to electricity. Results also showed that household size, urbanity, and the capital stock of appliances directly relate to household electricity consumption.
Research Implications – From the perspective of energy policy, there seems to be a need to rethink information campaigns relating to energy-saving and reducing practices and alternatives. As the backfire phenomenon (the extreme case of the rebound effect) seems to manifest among the survey households, there seem to be misconceptions regarding the appropriate use and purpose of energy efficient electrical devices, which should be clarified to preclude greater electricity consumption and promote energy savings. If public information and awareness campaigns can be redesigned to prevent the backfire phenomenon, there is a potential to reduce the residential use of electricity.

Keywords: demand estimation, electricity consumption, energy saving
JEL Classifications: O13, Q41, Q48

Ⅰ. Introduction

The relationship between electricity consumption and development is not a straightforward proposition.

* Corresponding Author, E-mail: *affirmalino@up.edu.ph*

Most studies have claimed that, although there is a positive relationship between energy consumption and human development, especially in the short term, the phenomenon of decoupling demonstrates that development in a country can be achieved with lower total electricity use.

From key energy statistics of the Department of Energy for 2007-2017 (DOE, 2018), the Commercial, Industrial, and Residential sectors of the Philippines have been largely been using most of the electricity in the country. In fact, the Agriculture, Forestry and Fishery (AFF) and Transport sectors account for only 3% to 4% of total electricity consumption in the past ten years, although the average annual growth in consumption has been fastest in the AFF sector. Particularly, in the last three years, the Residential sector has already overtaken the Industrial sector as the largest electricity consuming sector in the Philippines. Moreover, use of electricity in the Residential sector has been growing, on average, at a rate faster than that in the Industrial sector over these ten years. This illustrates the importance of the Residential sector in the total energy use of the Philippines.

In line with arguments that commercial and industrial use of electricity seems to contribute less to development indicators, the analysis of household electricity consumption can provide insights into what may be driving the increasing demand in the Residential sector, and whether or not the use of energy efficient appliances in households may eventually contribute to national development through its impacts on electricity consumption.

Thus, this paper develops a household electricity model to analyze household electricity consumption in the Philippines, and the factors that significantly affect electricity consumption behavior among Philippine households. Emphasis is placed on the impact of energy-saving practices (such as the use of energy efficient appliances), as promoted by the government and industry.

Ⅱ. Review of Literature

Subtle differences exist between how some would differentiate energy demand from energy consumption. Although used interchangeably here, demand commonly refers to quantities that would be purchased at a given price, including both the satisfied and unsatisfied portions, and exists before the purchasing decision is made (an *ex-ante* concept), while consumption takes place once the purchasing decision is made (an *ex-post* concept) and refers to the manifestation of satisfied demand (Bhattacharyya, 2011).

Either way, one must consider that energy demand is a derived demand since energy can only be consumed through the utilization of equipment specific to the ulterior purpose for which it is demanded. Thus, energy demand is influenced by location, technology, and user, among others, although the analysis of the demand for energy is no different from any other commodity (Bhattacharyya, 2011).

A "top-down" analysis of energy demand assumes that individual components of energy demand can be linked to related or similar macroeconomic variables which are more manageable than the significant micro-data requirements of a "bottom-up" approach. Such analytical models primarily explore the role of population growth, economic growth, and relative prices on energy demand (Zweifel et al., 2017).

However, issues such as the differentiation of short- and long-term adjustments, isolation of the effects of technological change from that of changing prices, the substitutability or complementarity of energy for other production inputs, instability of estimated relationships over time, and the potential of reverse causality (say, the endogeneity of GDP to prices) have been raised in line with the former approach (Zweifel et al., 2017). Thus, this analysis will take a "bottom-up" approach to estimating energy demand, particularly the demand for electricity.

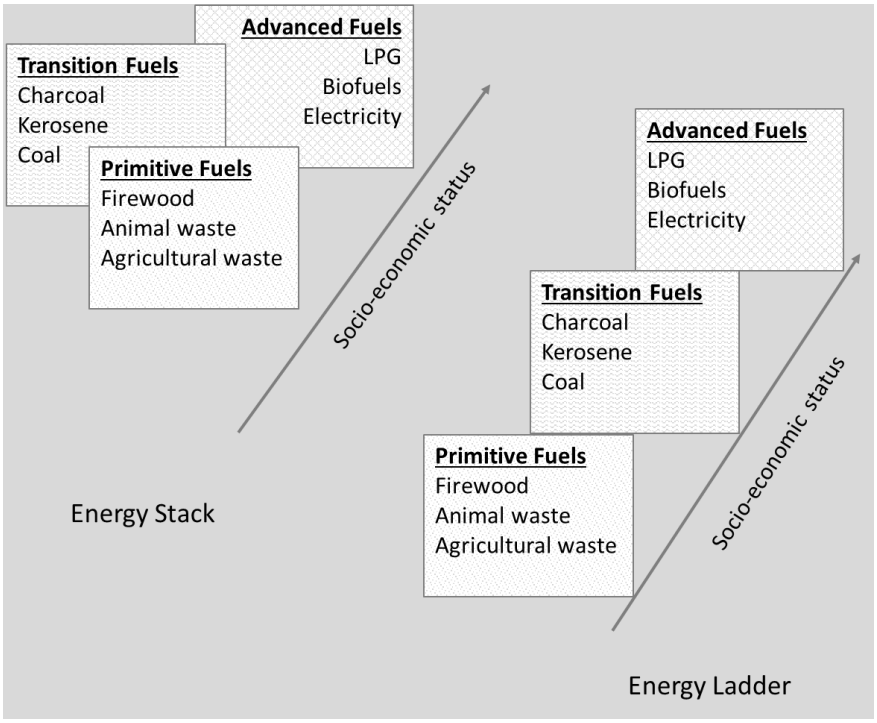
1. Household Energy Consumption Analysis

An economic perspective of energy demand may be best viewed within the context of household production (Becker, 1965), wherein the demand for energy is primarily derived from the need to power consumer durables. Thus, utility is not directly derived from the consumption of energy, but rather from the consumption of commodities or services that use energy as an input (Linderhof, 2001).

Earlier studies of energy demand in the residential sector indicate that two main models have been used to explain household behavior in energy allocation. These are the energy ladder model and the energy stack model. Figure 1, adapted from Schlag & Zuzarte (2008), illustrates the differences in the main arguments of these models.

Traditionally used as the basis for economic studies of household energy consumption, the energy ladder model assumes that the fuel choices of households follow their socioeconomic status, where, as households become more affluent, they tend toward cleaner and more advanced forms of energy. The weakness of the model is that it presumes perfect substitutability of fuels, where households do not mix fuels in total consumption (Schlag & Zuzarte, 2008). For instance, Bye (1992) observed that fuel-oil and electricity could be separable in the estimation of Engel elasticities, which are both influenced by the stock of electricity using durables.

Fig. 1. The Energy Ladder and Energy Stack Models

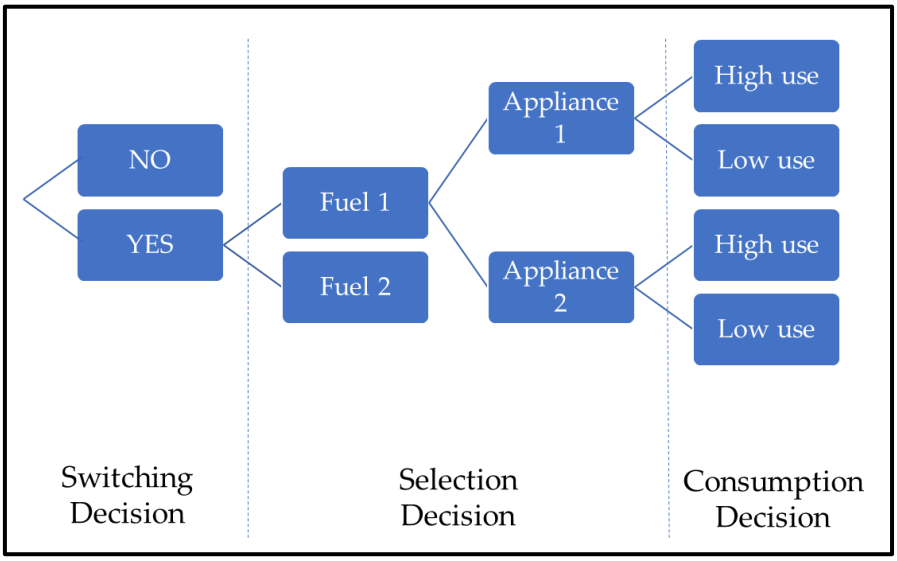


Source: Adapted from Schlag and Zuzarte (2008).

Since empirical data has shown that perfect fuel substitution does not normally occur, many researchers have now used the energy stack model, proposed by Masera et al. (2000, as cited in Schlag & Zuzarte, 2008), as a logical foundation. The model proposes the contemporaneous use of different fuels by households, wherein modern fuels are slowly integrated into energy use patterns as socioeconomic positions change. Observations of fuel switching patterns suggest that social, economic, and technological barriers may prevent a linear progression towards cleaner fuels, particularly focusing on electricity (Schlag & Zuzarte, 2008).

Whichever model is followed, monetary exchanges are required when commercial energy is to be used. As such, the decision to switch to commercial energies involves three stages: switching, selection, and, consumption. The following figure illustrates this three-stage decision-making process.

Fig. 2. Three-stage Decision-making Process of Energy Demand



Source: Adapted from Bhattacharyya (2011).

As the figure shows, the decision-making process starts with the household deciding to buy or not buy commercial energy. The switching decision is largely determined by: the amount and regularity of money income; alternative uses of income; and willingness to spend on commercial energies relative to competing needs. The process ends with the final stage, wherein the household decides on the usage pattern or utilization level of each appliance (Bhattacharyya, 2011).

In between, the household has to decide what appliances will utilize the energy bought, where the decision to purchase or not purchase the energy consuming appliance is made, depending on the available fuel. This second stage has a deciding influence on demand since the purchase of an appliance introduces strong path dependence in energy demand, i.e., it limits options thereby influencing the demand path, such that there would be lagged reaction to external changes (Bhattacharyya, 2011).

Moreover, it must be noted that the consideration of this process implies that technology will matter as the availability of more technical options allows for greater substitution possibilities (Bhattacharyya, 2011).

2. Micro-level Analyses of Electricity Consumption

With the varying tendencies in energy consumption behavior, studies have considered different factors and methodological specifications in estimating energy use. Related studies, however, seem to follow the assumptions of the energy stack model, where the use of various forms of energy is allowed, while mostly focusing on estimating electricity use in terms of usage patterns or the utilization level decision. The relative scarcity of household level analyses relative to macro-level investigations is most likely due to the unavailability of micro-data required for the former. The following discussion intends to provide a quick review of the available literature on individual or household energy consumption to contextualize the model to be used for this analysis.

Disparities in household energy use among rural and urban populations and between high- and low-income groups usually arise due to differences in economic development, living standards, climate, or cultural practices, among others. By analyzing case studies in various countries, Dzioubinski & Chipman (1999) observed that household electricity consumption

has grown with the availability of fuel and access to electricity supply together with the penetration rates, sizes, and efficiency of appliances, while prices have been seen to dampen demand.

Linderhof (2001) estimated energy use in relation to characteristics of energy-using appliances and utilized the predicted value of energy use as instrumental variables to estimate the hedonic price of energy-using appliances. As the predicted value of energy use is endogenous, a Two-Stage Least Squares (2SLS) rather than an Ordinary Least Squares estimation was used to obtain consistent estimation results. Results showed that electricity use was significantly affected by the selected characteristics of refrigerators, freezers, washing machines, and dishwashers, while it had significant negative effects on the purchase prices of only refrigerators and dishwashers. On the other hand, the study found that prices of energy-efficient appliances increased significantly with less energy use, although subsidies and energy taxes had a positive impact on the penetration rate of those types of technologies.

Household electricity price elasticities were estimated by Reiss and White (2002) to provide a model that could evaluate the effects of alternative tariff designs on residential electricity use. Using a generalized method of moments procedure, they found that marginal price effects were significant and varied for appliances providing space heating, cooling, and water heating services while income effects were negligible, probably owing to the conditionality on household appliance stocks. Further analysis of these elasticities showed that a five-tier electricity tariff scheme would be more regressive than a two-tier tariff system, which is still less regressive than a revenue-equivalent traditional uniform rate increase.

A two-step estimation was undertaken for Canadian household data by Guertin, Kumbhakar, & Duraiappah in 2003. A deterministic frontier analysis to calculate the efficiency of water heaters and furnaces and then energy service demand was estimated via double log regression. The analyses found that low-income households were more responsive to price and income changes as compared to high-income households, while all households were found to be more responsive to price changes over income changes. In addition, energy consumption levels for various uses in the household were found to increase with household size, number and use of appliances, floor area, and number of sky windows.

For the Peshawar District in Pakistan, Rehman, Tariq & Khan (2010) studied the determinants of household demand for electricity. Using a Multinomial Logistic Model categorizing households based on monthly electricity consumption, they found that income, education, and number of rooms positively affected electricity expenditure levels of households, while the price of electricity had an inverse impact. Weather was also found to be significant.

Using unpublished household survey data from New Zealand, Polkinghorne (2011) modeled household energy expenditure against seasonal, demographic, geographic, and housing variables using Seemingly Unrelated Regressions. Implications of the results related to residential energy expenditures included the revealed energy efficiency of high-density living, the relevance of size and composition of the household, and the significance of the impact of seasonality.

Distinguishing demand for electricity from the demand for energy for heating, Gram-Hanssen (2011) tried to analyze the relationships of user practices and energy efficiency to household energy demand in Denmark. Correlation analyses showed that the number, use, and type of appliances significantly affected whether a household would be considered a high-, medium-, or low-energy user. Regression analyses showed that the number of inhabitants, household income, and the size of the home significantly explained electricity consumption, while

demographic factors such as education and age of household members contributed minimally to explaining variations in consumption levels. These results implied that user practices rather than energy efficiency were better predictors of household electricity demand.

Using a residential electricity demand model following Alberini and Filippini (2011, as cited in Guo, Khanna, & Shang, 2016), household electricity consumption in China was found to be significantly affected by income, prices of electricity and gasoline, household size, home area, educational attainment, urbanization, heating degree days, and cooling degree days. These results were generated in different specifications of double-log Ordinary Least Squares regressions with robust standard errors (Guo, Khanna & Shang, 2016).

In the Philippines, although not particular to the estimation of electricity consumption, Dacuycuy and Dacuycuy (2018) modelled energy choices by households surveyed in the 2011 Household Energy Consumption Survey (HECS). With a main concern of how energy price shocks and heat index deviation affected the probability of a household choosing a given energy portfolio, they found that energy switching (mostly in high-income households) and energy stacking (mostly in low-income rural households) were strategies adopted by Philippine households, and that price shocks had substantial effects, especially when considering households that considered electricity an energy anchor or primary energy source.

Given the foregoing literature and the limited micro-level application to the Philippines, this study emphasizes the case of Philippine households, highlighting the impact of policy- and practice-driven promotion of energy-saving measures.

Ⅲ. Framework and Methodology

In Becker's Revised Theory of Choice of time allocation (1965), households were assumed to combine time and market goods via "production functions" to produce basic commodities that maximize utility functions (p. 495). As such, the consumption of electricity within a household is dervied from electricity being an input to both household consumption and production.

However, analysis of electricity demand within such a framework may have limited empirical applicability (Linderhoff, 2011). Thus, analyses of electricity demand have directly substituted energy consumption into the household utility functions.

Generally following Alberini and Filippini (2011), energy services can be considered the output of the production function of the composite energy commodity (ES), and is determined by the amount of electricity (*E*) and other energy (*F*) purchased, and the quantity of the capital stock of appliances (*CS*):

$$ES = ES\,(E, F, CS) \tag{1}$$

The household then maximizes the utility (Equation 2) from energy services (*ES*) and aggregate non-energy consumption (*C*), influenced by household characteristics (**Z**) and seasonal (i.e., climate and weather) variables (**S**), subject to a budget constraint (Equation 3) considering money income (*Y*) and the price of the composite energy commodity (P_{ES}):

$$U = U\,(ES\,(E, F, CS), C;\ \mathbf{Z, S}) \tag{2}$$

$$Y - P_{ES} \cdot ES - C = 0 \tag{3}$$

where the price of aggregate non-energy consumption is assumed to be one.

Although solving the optimization problem will yield various demand functions for the components of the energy commodity as well as aggregate non-energy consumption, the concern here is restricted to the demand for electricity:

$$E^* = E^*\,(P_E, P_F, P_{CS}, Y;\ \mathbf{Z, S}) \tag{4}$$

Consistent with demand, the own-price of electricity is expected to maintain an inverse relation to electricity consumption. Prices of the capital stock of appliances are presumed to also inversely affect

electricity consumption, considering the complementarity of electricity and appliances as posited by the three-stage decision-making process of energy demand. However, in the absence of reliable appliance prices, it can be assumed that electricity consumption would then be directly proportional to the quantity of electrical appliances.

On the other hand, in line with the energy stack model which does not presume perfect substitutability among different forms of fuels, prices of related energy sources may either have positive or negative relationships with electricity consumption, depending on the general socioeconomic status of households. As households may mix fuels in their total energy consumption, integration of modern energy sources, specifically electricity, may occur alongside the use of other energy sources, or may be substituted for less advanced forms of energy as socioeconomic statuses improve.

Even though presented here as influencing factors as opposed to determinants, household characteristics and seasonal variables have previously been found to significantly alter electricity consumption behaviors as they affect household tastes and preferences. For instance, previous analyses showed that electricity consumption increased with household size, the "life stage" of the household that may be depicted by the age of the household head, home ownership, and dwelling size. In addition, some studies have shown that electricity consumption was higher on hotter days, mainly arising from air conditioning, while others posit that colder (and usually darker) days increased electricity consumption more due to heating and lighting concerns. Moreover, policies related to energy use have also been shown to affect electricity consumption (see, for instance, Alberini & Filippini, 2011; Gram-Hanssen, 2011; Guo, Khanna, & Shang, 2016; Polkinghorne, 2011).

For the microeconometric estimation of household electricity consumption in the Philippines, a residential electricity model incorporating considerations of various econometric models that have been reviewed, and considering data availability, was used to analyze the factors that might significantly affect household electricity consumption. The general model is described as follows:

$$ec_i = \propto + \beta pe_i + \boldsymbol{\mu}\mathbf{y_i} + \boldsymbol{\gamma}\mathbf{p_i} + \boldsymbol{\theta}\mathbf{h_i} + \boldsymbol{\rho}\mathbf{x_i} + \boldsymbol{\omega}\mathbf{r_i} + \tau t_i \quad (5)$$

where the dependent variable (ec_i) is the average monthly household electricity consumption measured in kilowatt-hours (kWh) of household *i*. There will be six general categories of independent variables.

The own-price of electricity (pe_i) is measured as the average price in Philippine pesos (PHP) per kilowatt-hour (kWh) paid by households (average monthly electric bill/average monthly electricity consumption). Total monthly household income (**y**) is a vector of four income ranges, with under PHP 10,000 per month as the base.

The vector of other fuel prices (**p**) will include the prices of the common fuels used by the survey households, including liquified petroleum gas (LPG), kerosene, fuelwood/firewood, and charcoal, but not including fuels used for transport and non-energy uses. For households that do not use alternative fuels, the average fuel price for households within the same region are used.

The vector of household characteristics (**h**) will encompass the size of the household (as demonstrated by the number of household members), the household's capital stock of appliances (measured by the number of units of each type of appliance to account for different uses of energy), and urbanity of the household.

The vector of policy variables (**x**) will comprise the household characteristics that may possibly influence the energy consumption of households. These possible policy-controlled variables will consider the household's practice of consumption-reducing measures, natural gas awareness, willingness to install natural gas, and the awareness of government labelling programs for electrical appliances.

The definition and measurement of the variables, including seasonality, are shown in Table 1.

Table 1. Definitions and Measurements of Independent Variables for Regression Analysis

Variable	Definition	Measurement
pe_i	Price of Electricity	PHP per kWh
y_i	Average Monthly Household Income	1 if the household earns an income within the specified range, 0 otherwise Base category = under PHP 10,000 *i* =1: PHP 10,000 – PHP 29,999 *i* =2: PHP 30,000 – PHP 59,999 *i* =3: PHP 60,000 – PHP 99,999 *i* =4: PHP 100,000 and over
p^C_i	Price of Charcoal	PHP per kilogram
p^F_i	Price of Fuelwood	PHP per kilogram
p^K_i	Price of Kerosene	PHP per liter
p^L_i	Price of LPG	PHP per kilogram
h^N_i	Household Size	Number of household members
h^{Aa}_i	Number of Electrical Appliances	Number of units of category *a* Electrical appliances include: (1) recreation devices: television sets, listening devices, and gaming devices; (2) food preparation devices: microwave oven, rice cooker, and electric stove/oven; (3) refrigeration devices: refrigerator and freezer; (4) lighting devices: incandescent lamp and fluorescent lamp; (5) space cooling devices: electric/exhaust fan and air conditioner; (6) water heating devices: water heater and thermos/airpot; (7) laundry devices: washing machine and electric iron; and (8) computing devices: desktop and laptop
h^U_i	Urbanity	1, if urban; 0, otherwise
x^{Mm}_i	Consumption-reducing Practices	Interaction between use of an appliance (1 if the appliance is used, 0 otherwise) and practice of related energy consumption-reducing measure, where practice of energy consumption-reducing measures is given by: 1, if majority of related energy consumption-reducing measures are practiced; 0, otherwise Areas *m* include: (1) lighting; (2) cooking; (3) refrigeration; (4) ironing; (5) space cooling; and (6) machine washing
x^G_i	Natural Gas Awareness	1, if aware of availability of natural gas as fuel; 0, otherwise
x^W_i	Willingness to install Natural Gas	1, if willing to install natural gas in the home; 0, otherwise
x^A_i	Program Awareness	1, if aware of labeling programs; 0, otherwise
r^l_i	Location (Region)	1, if Region *l*; 0, otherwise (*l* = 16, base: NCR)
t_i	Year of survey (Time)	1, if surveyed in 2011; 0, if in 2004

Although the model would like to account for seasonality to consider the impacts of differences in climate or weather, data limitations allow only for differentiation by the location (region, **r**) of the households and the year (time, t_i) for which the household was surveyed.

Although several functional forms of an Ordinary Least Squares (OLS) regression may be assumed, Xiao et al. (2007, as cited in Alberini and Filippini, 2011) have shown that a log-linear model is superior to a linear model in residential energy demand. The double logarithmic form, however, has an advantage in the estimation of ad hoc energy demand models by providing the ability to directly interpret coefficients as elasticities (Alberini and Filippini, 2011). Thus, different specifications are used here to compare the estimating ability of the different functional forms.

The most recent editions of the Household Energy Consumption Survey (HECS) by the Philippine Statistics Authority (PSA) are used for the estimation. These datasets involve surveys done in 2004 (with 21,960 observations) and 2011 (with 20,591 observations). Due to the unbalanced sets and an inability to match households between surveys, a pooled sample of all households surveyed in the two years is used for the regression analysis.

However, with a focus on determinants of the consumption level of residential electricity, particularly preferences and practices that can be influenced by government intervention, only households using electricity as a source of energy are included in the final sample. This also allows for the logarithmic transformation of the dependent variable for alternative functional forms of the estimating equation. Thus, the number of households included from the 2004 survey is 16,557, and 16,642 for the 2011 survey, leading to a final sample size of 33,199.

Ⅳ. Results and Discussion

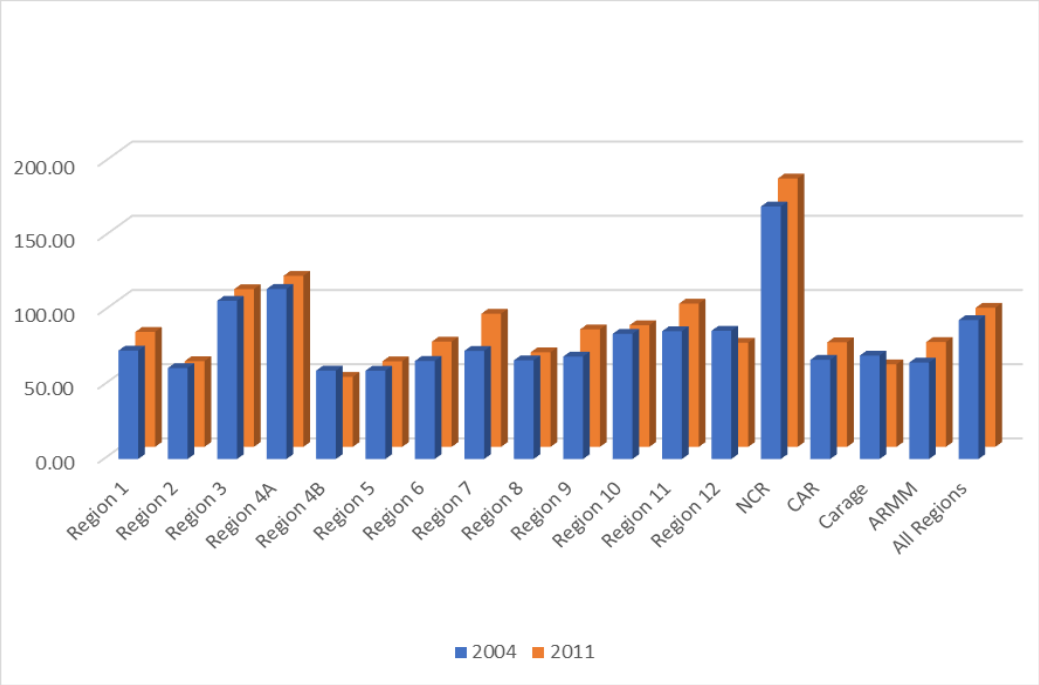
For the surveys in general, although only 3,093 households in 2004 and 2,920 households in 2011 indicated that they had not used electricity, an additional 10.5% and 5.0% of the households who respectively participated the 2004 and 2011 editions of the Household Energy Consumption Survey (HECS) did not indicate any electricity consumption. This implies that only 75.4% in 2004 and 80.8% in 2011 of household respondents to the HECS actually used electricity at home and are subject of the analysis that follows.

1. Electricity Consumption and Household Characteristics

Based on an examination of the socioeconomic characteristics of the household respondents for the 2004 and 2011 HECS, households surveyed in 2004 generally had more household members and were more urbanized than those surveyed in 2011. Based on the previously discussed relationships with energy consumption, it could be assumed that observations for electricity consumption would be generally higher in 2004 than in 2011, considering the larger household sizes and more urban households participating in the 2004 survey. Thus, Figure 3 illustrates the regional averages of electricity consumption per household for each of the surveys.

As the figure shows, average electricity consumption seemed to be generally higher in 2011 than in 2004. However, it should be noted that, for all regions, there was a very small difference in average household electricity consumption between 2004 and 2011, which were respectively at 93.62 kilowatt-hours (kWh) and 93.71 kWh. In addition, although there are large positive differences in electricity consumption in 2004 compared to 2011 for the NCR, Central Visayas (Region 7), Western Mindanao (Region 9), and Southern Mindanao (Region 11), there were also large negative differences in observed electricity consumption for Caraga, Mimaropa (Region 4B), and Central Mindanao (Region 12). Although these differences are being considered, they should not be interpreted as a demonstration of growth in electricity consumption since the households surveyed in 2004 may not necessarily be the same as those surveyed in 2011.

Fig. 3. Average Monthly Household Electricity Consumption, in kWh, by Region, 2004 and 2011



Sources: Basic Data from HECS (2004) and HECS (2011).

More important to note from the figure are the differences among regions. For instance, the NCR, Calabarzon (Region 4A), and Central Luzon (Region 3) regions are consistently the regions with the highest electricity consumption. In fact, households in the second top electricity-consuming region (Region 4A) only consume about two-thirds the electricity consumed monthly on average by households in the NCR, while the combined average monthly electricity consumption of households in the three least consuming regions in both survey years just about equal the average consumption of households in the NCR.

Although the rankings of regions by average monthly household electricity consumption is generally consistent in the two survey years, it can also be observed that there are relatively large disparities in the rankings of some regions. For Western Visayas (Region 6), Western Mindanao (Region 9), and ARMM, the rankings in terms of average electricity consumption went up from 2004 to 2011, while the rankings for Eastern Visayas (Region 8) and Central Mindanao (Region 12) went down by a large magnitude. It will be interesting to see later in the analysis whether these movements in the rankings are a function of time, or of other variables.

2. Prices of Energy Sources

Primary among variables that may affect electricity consumption levels, the price of electricity needs to be considered. Although certain areas may impose electricity prices based on a tiered system, the average prices of electricity, as shown in Table 2, only consider average price per kWh of electricity as depicted by the quotient of the monthly electricity bill paid (in Philippine pesos, Php) and the monthly electricity consumption. In addition, the average annual growth rate (AAGR) of average regional prices indicated in Table 2 considers a straightforward average of prices over the seven years in between the survey years.

Table 2. Average Price by Kilowatt-Hour of Electricity Paid by Households in the HECS, 2004 and 2011, by Region

Region	2004 Prices	2011 Prices	*AAGR*	Region	2004 Prices	2011 Prices	*AAGR*
Ilocos	5.18	9.73	*12.53*	Western Mindanao	4.13	6.64	*8.67*
Cagayan Valley	5.05	9.25	*11.89*	Northern Mindanao	4.12	7.73	*12.54*
Central Luzon	5.23	9.45	*11.51*	Southern Mindanao	3.83	6.60	*10.34*
CALABARZON	5.14	9.12	*11.06*	Central Mindanao	3.60	6.47	*11.38*
MIMAROPA	5.64	9.68	*10.23*	NCR	5.92	10.47	*11.00*
Bicol	5.60	9.66	*10.33*	CAR	5.40	9.73	*11.47*
Western Visayas	5.62	9.29	*9.34*	Caraga	4.44	7.55	*10.00*
Central Visayas	5.76	9.04	*8.13*	ARMM	4.32	6.96	*8.74*
Eastern Visayas	5.54	8.62	*7.93*	All Regions	5.14	8.90	*10.45*

Table 3. Average Prices of Various Energy Sources Used by Households in the HECS, per Kilogram (for Charcoal, Fuelwood, and LPG) or Liter (for Kerosene), 2004 and 2011, by Region.

Region	Charcoal			Fuelwood			Kerosene			LPG		
	2004	2011	AAGR	2004	2011	AAGR	2004	2011	AAGR	2004	2011	AAGR
Ilocos	10.94	11.45	0.66	4.37	7.44	10.04	32.06	91.83	26.63	33.87	65.36	13.28
Cagayan Valley	9.03	10.63	2.52	3.27	5.57	10.06	32.69	67.29	15.12	34.00	69.90	15.08
Central Luzon	9.48	12.03	3.84	4.32	7.24	9.67	31.67	106.14	33.60	32.68	63.26	13.36
CALABARZON	9.12	15.08	9.33	4.19	6.99	9.55	33.13	105.42	31.17	32.64	63.54	13.53
MIMAROPA	9.25	11.21	3.03	5.11	7.18	5.78	39.39	117.20	28.22	36.23	76.02	15.69
Bicol	9.57	12.15	3.86	2.94	5.05	10.28	36.58	166.22	50.62	34.93	70.48	14.54
Western Visayas	8.28	11.02	4.73	3.93	6.68	10.01	29.73	113.71	40.36	35.66	74.06	15.39
Central Visayas	9.85	12.65	4.06	3.05	4.78	8.10	30.47	119.23	41.61	37.20	76.55	15.11
Eastern Visayas	11.59	17.68	7.51	3.57	7.09	14.12	33.15	146.76	48.96	36.71	76.92	15.65
Western Mindanao	10.48	11.88	1.91	2.15	5.13	19.89	34.13	67.77	14.08	36.80	74.54	14.65
Northern Mindanao	10.60	14.81	5.67	3.11	4.84	7.93	34.92	154.41	48.88	36.49	76.31	15.59
Southern Mindanao	10.59	12.56	2.65	3.05	6.39	15.63	42.81	146.27	34.52	36.18	76.86	16.06
Central Mindanao	8.41	10.69	3.86	3.36	5.88	10.70	33.98	156.73	51.61	35.34	75.33	16.17
NCR	12.92	11.62	(1.44)	6.64	8.71	4.47	25.68	72.10	25.82	34.76	63.53	11.82
CAR	10.00	13.68	5.26	2.90	5.88	14.66	26.94	86.12	31.39	35.22	68.17	13.37
Caraga	9.02	10.95	3.06	2.37	5.47	18.74	35.80	64.64	11.51	39.22	78.77	14.41
ARMM	11.74	24.52	15.56	3.12	3.75	2.86	31.00	167.78	63.03	35.46	77.70	17.02
All Regions	10.24	13.12	4.03	4.03	6.47	8.67	32.20	111.94	35.38	34.94	70.39	14.50

As the table shows, average electricity prices are consistently higher across all regions in 2011 than in 2004. In fact, the reported average prices increased by more than 70% in the seven years between surveys. The fastest increase can be observed in the Northern Mindanao region, where there was a noted decrease in average electricity consumption, while the slowest growth can be observed in the Eastern Visayas region, where a consumption decrease of about the same magnitude was also noted. Despite these increases in prices, it should be recalled that it was previously shown that there was a general increase in average monthly electricity consumption in general over all regions. Thus, for econometric estimation, real prices (base year: 2000) are used.

Among the factors that may be causing this result that seemingly contradicts the established relationship of demand to own price, prices of other energy sources may provide some insight into what may be causing the rise in consumption of electricity in spite of the increase in its price. Table 3 presents prices for charcoal, fuelwood, kerosene, and LPG, which households commonly use as an alternative, or alongside electricity, as an energy source.

From the table, it can be observed that the prices of charcoal and fuelwood seemed to increase at a slower rate than electricity prices, while those for kerosene and LPG increased at rates higher than for of for electricity. In terms of levels, the average prices were highest for both 2004 and 2011 on average in Luzon for fuelwood and in Mindanao for kerosene. For charcoal, average prices were highest in 2004 in Luzon, while they were highest in 2011 in Mindanao. For LPG, average prices in 2004 were highest in Visayas and in Mindanao in 2011. Thus, the econometric estimations make use of real prices (base year: 2000).

3. Capital Stock of Appliances

The previously discussed trends in prices only make sense in terms of the purposes for which the energy is used. As previously mentioned, particularly for electricity, the demand for energy is a derived demand. Thus, it is important to consider a household's capital stock, that is, the stock of appliances that use electricity.

Based on the survey results, the average number of lighting devices (bulbs or lamps) and recreational devices (listening devices, television sets, and video playing/recording devices) used by households were about four lighting devices per household in the 2004 HECS, while each household in the HECS 2011 used more than four lighting devices on average. For recreational devices, on average, both surveys showed that each household respondent had at least one listening device (radio, cassette recorder, or stereo), one television set, and one video playing/recording device (CD/DVD player and the like).

It is also interesting to note that average numbers of listening devices and video playing/recording devices was lower for the 2011 HECS compared to the 2004 HECS, while the average number of television sets was higher for 2011 than for 2004. This may reflect the impact of the additional features provided by modern television set designs such that households may no longer be using other recreational devices alongside television sets that may be able to serve the same purpose.

Since almost all households indicated that they used lighting devices and about 90% of households indicated the use of recreational devices, these would seem to be the most significant items in the capital stock of households. However, it is still necessary to consider the impact of other household appliances on electricity consumption.

An examination of the data shows that space cooling devices have the greatest presence in the households surveyed in both HECS editions, with just over 70% of households in 2004 and 2011 reporting that they had either electric fans and/or air conditioning units. These were followed by laundry devices (such as washing machines and electric irons) and refrigeration devices (refrigerators and freezers), reported by more than 50% and 40% of the households, respectively. For both surveys, penetration of electric cooking devices and water heating devices were low, respectively at 11% and 2.5% in 2004 and 21% and 4.8% in 2011.

Moreover, it is interesting to note the large difference between households in 2004 and 2011 that reported using computing devices (desktop and laptop computers). Only about 10% of households in 2004 reported the use of computing devices in the home, while about 66% of households in 2011 reported computer usage.

4. Energy Consumption-saving Practices and Awareness

With a large percentage of households reporting the use of different electrical appliances, the practice of energy consumption-reducing or saving measures can help economize theconsumption of electricity in households. Moreover, awareness campaigns by the government are expected to further this goal.

In the HECS, for both 2004 and 2011, respondents were asked about several practices that promote a more efficient use of electricity specific to the use of lights/lamps, electric stoves/ovens, refrigerators, electric irons, electric fans and air conditioning units, and washing machines, as well as their awareness of related government initiatives. Figure 4 presents the percentages of households who reported that they practiced consumption-reducing measures.

Fig. 4. Percentage of Households Practicing Energy Consumption-reducing Measures, by Activity and Region, 2004 and 2011

Sources: Basic Data from HECS (2004) and HECS (2011).

As the figure shows, except for ironing-related practices, more households in 2011 than in 2004 practiced energy consumption-reducing measures. Particularly, in the case of space cooling-related measures, a large difference between 2004 households and 2011 households can be observed, with only about 5% of the former practicing energy-saving measures compared to about 53% for the latter. In addition, although more than 60% of the households in 2004 indicated that they practiced energy-saving in relation to the use of lighting devices, almost 91% of the households in 2011 reported practicing related measures.

In terms of awareness, about 12% of all households surveyed in 2004 were aware of the potentials of natural gas as an alternative energy source, and only about 7% of all households would be willing to have natural gas pipelines installed in their homes. Moreover, just a little over 12% of all households in the 2004 survey were aware of the government labeling program, which required energy information to be included in the packaging of electrical devices. These percentages were much lower than those for the 2011 households, where about 20% were aware of the potential of natural gas, as about 11% were willing to have natural gas pipelines installed, and almost 30% had knowledge of the energy labeling program of the government.

5. Estimation Results

Given these observations, an econometric analysis could provide further insights on how certain factors affect the level of electricity consumption among households. Thus, regression of a residential electricity consumption model was run, for which several functional forms (linear, linear-log, log-linear, and log-log) of the estimating equation were tested in an Ordinary Least Squares (OLS) regression. The dependent variable for the analysis was monthly household electricity consumption in kilowatt-hours. Table 4 presents the estimated coefficients (with standard errors) for the four forms of the residential electricity consumption model.

The results for the various functional forms of the estimating equation indicate that the semi-log specifications are superior to the linear specification, with higher coefficients of determination and more significant independent variables. Along the same lines, aside from providing the advantage of direct interpretation of the coefficients as elasticities, the log-log form presents the highest coefficient of determination and the most significant independent variables among the specifications.

Thus, although the results for all models are presented in Table 4, discussion of the predicted relationships focuses on the estimates of the log-log specification. However, it should be noted that the tests of the F-statistics demonstrate that the model as provided in all functional forms significantly depicts the determinants of residential electricity consumption.

Coefficients for the own-price and income variables are as expected. Although the significance of coefficients may vary, the relationships remain consistent across specifications. As the log-log specification estimates show, demand for electricity in households is inelastic, as consumption inversely responds to changes in electricity prices, and it demonstrates the characteristics of a normal good, where consumption of electricity increases with income. In terms of alternative energy commodities, charcoal appears to be a complement for electricity based on the estimated cross-price elasticity, while fuelwood, kerosene, and LPG seem to be substitutes for electricity. As such, these results demonstrate the possible presence of energy switching, as well as of energy stacking, within the households surveyed.

It is interesting to note that the coefficients for the different income categories seem to decrease as income increases. To provide a possible explanation for this occurrence, average electricity consumption and number of household members were computed for the different income categories. Table 5 provides the results of these tabulations.

Table 4. Estimation Results (Dependent: Monthly Household Electricity Consumption)

Independent Variables	Linear		Linear-Log		Log-Linear		Log-Log	
	Coeff.	Robust S.E.	Coeff.	Robust S.E.	Coeff.	Robust S.E.	Coeff.	Robust S.E.
Price of Electricity	-282.1828***	61.0260	-3894.9620***	814.1553	-0.0996***	0.0070	-0.6265***	0.0515
Income								
10,000 to 29,999	17.3808	28.1748	29.6773	27.0811	0.2080***	0.0091	0.2082***	0.0090
30,000 to 59,999	170.4118*	90.7837	195.6974**	83.7707	0.2311***	0.0179	0.2312***	0.0174
60,000 to 99,999	274.4685	207.6911	356.6828*	200.8443	0.1843***	0.0396	0.1862***	0.0389
100,000 and over	155.4930***	59.2433	182.8317***	69.5906	0.1403**	0.0596	0.1401**	0.0592
Prices of Alternative Fuels								
Charcoal	-1.4009	2.3413	-28.6853	39.5149	-0.0026***	0.0009	-0.0352***	0.0098
Fuelwood	4.0352	8.1621	-25.4223	28.9976	0.0055***	0.0019	0.0484***	0.0063
Kerosene	0.0477	0.1207	30.6633	26.7214	-0.0001	0.0001	0.0194*	0.0105
LPG	-1.9410	7.1755	1388.8020***	381.4836	-0.0008	0.0015	0.1445***	0.0537
Number of HH Members	5.6254	5.4388	8.5346	5.3749	0.0358***	0.0017	0.0365***	0.0017
Urbanity	-14.7426	31.8899	-91.1605**	39.2174	0.2637***	0.0087	0.2533***	0.0088
Capital Stock of Appliances								
Cooking Devices								
Electric Stoves/Ovens	-200.5704**	97.8128	-175.1073	111.4173	0.0450	0.0637	0.0495	0.0636
Rice Cookers	-54.0268***	17.7947	-95.3256***	25.0209	0.0971***	0.0102	0.0942***	0.0102
Microwave Ovens	-30.5540	31.1062	-24.4729	33.2769	-0.1316***	0.0271	-0.1294***	0.0269
Water Heaters	-20.5296	17.9038	-57.9787**	26.9738	0.0480**	0.0219	0.0442**	0.0218
Recreational Devices								
Listening Devices	-38.5721	27.8003	-41.8851	26.7406	0.0176**	0.0074	0.0184**	0.0074
Television Sets	13.7472	22.4700	30.0893	22.4466	0.2618***	0.0145	0.2622***	0.0145
Video Devices	-13.6799	21.2662	-21.8431	20.3535	0.0244***	0.0069	0.0241***	0.0068
Refrigerator	-15.5462	48.2113	-41.1703	41.9362	0.5748***	0.0184	0.5719***	0.0182
Space Cooling Devices								
Air Conditioning unit	122.7650***	24.0736	125.9373***	23.1005	0.1819***	0.0157	0.1809***	0.0156
Electric/Exhaust Fan	4.5793	8.6589	30.2837***	10.0345	0.1031***	0.0052	0.1036***	0.0052
Laundry Devices								
Electric Iron	-52.4185	46.3927	-48.1654	44.6233	0.1828***	0.0140	0.1833***	0.0140
Washing Machine	123.6945	105.7504	132.3698	100.1803	0.2323***	0.0232	0.2304***	0.0226
Computer	59.0401***	20.5419	74.4946***	20.5127	0.1205***	0.0132	0.1215***	0.0132
Lighting Devices	2.4088	2.7205	0.4180	2.8884	0.0231***	0.0029	0.0230***	0.0029

Energy Consumption-Saving Practices								
Lighting	-73.6022	45.7338	-97.5608**	44.0206	0.0241**	0.0107	0.0237**	0.0106
Cooking	481.7707	376.0428	420.1626	360.7707	-0.0261	0.0866	-0.0368	0.0854
Refrigeration	50.8148	53.0357	97.5933**	44.5237	0.0929***	0.0189	0.0968***	0.0187
Ironing	-7.7452	36.2330	-9.4454	35.8682	-0.0206	0.0133	-0.0215	0.0133
Space Cooling	82.3277***	26.2385	118.8611***	30.3573	0.2239***	0.0112	0.2247***	0.0111
Washing	-82.9618	98.3329	-81.9535	92.9106	-0.1043***	0.0229	-0.1034***	0.0224
Natural Gas Awareness	1.7068	43.7118	-10.1383	43.6369	0.0329**	0.0147	0.0310**	0.0146
Willingness to Install NG	-34.9657	40.4252	-35.2706	41.7734	0.0092	0.0178	0.0094	0.0178
Program Awareness	7.7517	22.5385	31.4676	23.7224	0.0419***	0.0096	0.0417***	0.0096
Region								
Region 1	69.9084	109.1315	-205.5321*	121.5476	-0.2655***	0.0201	-0.2771***	0.0196
Region 2	-176.4373***	59.9287	-503.5924***	111.0657	-0.4089***	0.0211	-0.4200***	0.0215
Region 3	-265.2201***	61.4021	-544.0366***	114.4745	-0.1920***	0.0163	-0.1989***	0.0169
Region 4A	-192.4546***	54.7785	-477.7768***	106.3033	-0.1993***	0.0145	-0.2107***	0.0151
Region 4B	52.9908	105.8631	-217.3103*	111.0759	-0.4464***	0.0273	-0.4887***	0.0271
Region 5	-178.6676***	51.7367	-498.0753***	108.2516	-0.3759***	0.0207	-0.3922***	0.0215
Region 6	-156.9000***	56.5423	-537.7145***	119.1613	-0.3656***	0.0202	-0.3950***	0.0210
Region 7	-178.6464***	64.7012	-556.1730***	121.8780	-0.3743***	0.0210	-0.3877***	0.0214
Region 8	-231.3785***	72.8808	-721.0848***	155.6452	-0.4053***	0.0232	-0.4372***	0.0238
Region 9	-559.5321***	131.4575	-1783.5930***	375.9818	-0.3754***	0.0287	-0.4405***	0.0344
Region 10	-492.5733***	142.2206	-1738.7600***	378.6763	-0.4839***	0.0264	-0.5616***	0.0320
Region 11	-632.4834***	144.2138	-1983.6810***	416.8434	-0.2876***	0.0247	-0.3787***	0.0325
Region 12	-746.4261***	162.1454	-2381.5830***	496.1533	-0.3452***	0.0262	-0.4703***	0.0369
CAR	-232.4568***	55.4748	-539.9335***	113.7954	-0.3867***	0.0235	-0.3776***	0.0241
Caraga	410.2405	312.9318	-842.6996**	382.6483	0.1618***	0.0402	0.0670*	0.0375
ARMM	-668.5632***	158.7553	-2090.8110***	439.1631	-0.5622***	0.0277	-0.6356***	0.0348
Year of Survey	248.5610**	105.5355	310.1285***	112.6722	-0.0693***	0.0258	-0.1327***	0.0251
Constant	1626.5950***	363.8444	1683.9780**	720.7126	3.3677***	0.0551	3.3128***	0.1600
Number of Obs	33,199		33,199		33,199		33,199	
F (51, 33147)	32.53		12.03		1158.34		1177.00	
Prob > F	0.0000		0.0000		0.0000		0.0000	
R-squared	0.0173		0.1042		0.6608		0.6664	
Root MSE	2218.4		2118.1		0.65422		0.64878	

Note: ***significant at 1%, **significant at 5%, *significant at 10%.

Table 5. Average Electricity Consumption and Number of Household Members of Respondents of the HECS by Income Category, 2004 and 2011.

Income Category	Income Range	Average Electricity Consumption (in kWh)	Average Number of Household Members
Y0 (base)	Under PHP 10,000	79.67	4.64
Y1	PHP 10,000 – PHP 29,999	140.10	5.15
Y2	PHP 30,000 – PHP 59,999	326.15	5.48
Y3	PHP 60,000 – PHP 99,999	511.58	5.67
Y4	PHP 100,000 and over	443.09	5.48

As Table 5 shows, the average electricity consumption of Y1 households is more than 75% greater than Y0 households, while Y2 households use more than twice the electricity used by Y1 households and three times that of Y0 households. The incremental increase in the electricity consumption of Y3 households is relatively smaller at about 57% more than Y2 households. Moreover, although using more than four times the electricity used by Y0 households, electricity consumption of Y4 households is less than that of Y3 households on average.

One factor that may be driving these results, and thus the larger coefficients for the lower income categories in the regression, is the relatively larger incremental differences in the averages for household membership in the lower income categories. On the other hand, the larger jumps in consumption values for the lower income households may also be a result of these households using less expensive but also less efficient appliances, such that the impact on electricity consumption of moving up one income category is larger at lower income levels.

Returning our attention to Table 4, with regard to capital stock, except for electric stoves/ovens and microwave ovens, the use of any type of appliance significantly increases household electricity consumption, with the largest percentage increases in consumption being from the use of refrigerators, television sets, and washing machines. Interestingly, the effect of using microwave ovens is to decrease electricity consumption, a tendency that may be a result of the lower energy consumption of more compact microwave ovens compared to larger electric ovens.

Related to the stock of appliances, the impact of practicing laundry-related energy consumption-saving or reducing measures were shown to be consistent with expectations. As the results showed, households that practiced these measures had lower electricity consumption.

On the other hand, households that practiced lighting, refrigeration, and space cooling-related measures seemed to have higher electricity consumption. Although this may seem inconsistent with the expected relationship, this could be a demonstration of the backfire phenomenon, an extreme case of the rebound effect where an improvement in energy efficiency causes an increased utilization of products due to lower operating costs, which in turn wipes out any energy savings from the efficiency gains (Nadel, 2012). This same phenomenon may also be driving the positive relationship of electricity consumption to the awareness of natural gas as an alternative energy source as well as to the awareness of government labeling programs that indicate product efficiency and energy use.

Finally, for seasonality variables, regional dummies relate as significant, and NCR households were generally seen to have higher monthly electricity consumption than households in other regions. On the other hand, there seems to be a slight difference in electricity consumption behavior between the two survey years with levels in 2011 statistically lower than in 2004. It should be noted that, although the inclusion of this set of variables was meant to account for differences in climate conditions across regions and across time, this set of variables may reflect the impacts of other factors arising from the differences in location or time period.

V. Implications

As household electricity consumption and the share of the residential sector in electricity consumption have been on the rise in the Philippines, the demand for electricity in the residential sector of the Philippines was examined with data from the 2004 and 2011 Household Energy Consumption Surveys. Several functional forms of the residential electricity consumption model were estimated.

Results show that electricity consumption is price inelastic and reacts as a normal good to income changes, although the impact of income changes on electricity consumption are stronger at lower incomes. In addition, there appears to be both energy switching and energy stacking among households in the Philippines as charcoal is seen as a complement, and fuelwood seems to be a substitute for electricity. Moreover, the results also show that household size, urbanity, and the capital stock of appliances do indeed directly relate to household electricity consumption.

From the perspective of energy policy, it seems that there is a need to rethink the information campaigns of the government in relation to energy-saving/reducing practices and alternatives. As the backfire phenomenon (the extreme case of the rebound effect) seems to manifest among the survey households, there seems to be misconceptions regarding the appropriate use and purpose of energy efficient electrical devices which should be clarified to preclude greater electricity consumption and promote energy savings.

If public information and awareness campaigns can be redesigned to prevent a backfire in electricity consumption, there is a potential to reduce the residential use of electricity. An estimate of the possible impacts of this intention could then be subject to the valuation of environmental impacts which can be done in the future.

References

Alberini, A., & Filippini, M. (2011). Response of residential electricity demand to price: The effect of measurement error. *Energy Economics, 33*, 889-895.

Becker, G. S. (1965). A theory of the allocation of time. *The Economic Journal, 75*(299), 493-517.

Bhattacharya, S. C. (2011). *Energy economics concepts, issues, markets and governance*. London: Springer-Verlag London Limited.

Bye, B. (1992). *Modelling consumers' energy demand* (Discussion paper No. 68). Oslo, Norway: Central Bureau of Statistics. Retrieved from https://www.ssb.no/ a/publikasjoner/pdf/DP/dp_068.pdf

Dacuycuy, C. B., & Dacuycuy, L. B. (2018). *Urban and rural households' energy use: Sets, shocks, and strategies in the Philippines* (Discussion paper series No. 2018-01). Manila: Philippine Institute for Development Studies.

Department of Energy [DOE]. (2018). *Key energy statistics*. Retrieved from https://www.doe. gov.ph/sites/default/files/pdf/energy_statistics/2017_key_energy_statistics.pdf

Dzioubinski, O., & Chipman, R. (1999). *Trends in consumption and production: Household energy consumption* (Discussion Paper, No. 6), New York, NY: United Nations Department of Economic and Social Affairs [DESA]. Retrieved from https://sustainabledevelopment.un.org/content/documents/esa99dp6.pdf

Gram-Hanssen, K. (2011). *Households' energy use which is the more important: Efficient technologies or user practices?* Paper presented at the World Renewable Energy Congress on 8-13 May 2011 at Linkoping, Sweden. Retrieved from http://www.ep.liu.se/ecp/057/vol3/032/ecp57vol3_032.pdf

Guertin, C., Kumbhakar, S. C., & Duraiappah, A. K. (2003). *Determining demand for energy services: Investigating income-driven behaviours*. Manitoba, Canada: International Institute for Sustainable Development (IISD). Retrieved from http://www.iisd.org/sites/default/files/publications/energydetermingdemand.pdf

Guo, J., Khanna, N. Z., & Shang, X. (2016). *Electricity demand in Chinese households: Findings from china residential energy consumption survey*. ACEEE Summer Study on Energy Efficiency in Buildings. Retrieved from https://aceee.org/files/proceedings/2016/data/papers/976.pdf

Linderhof, V. G. M. (2001). *Household demand for energy, water, and the collection of waste: A microeconometric analysis*. IJssel, Holland: Labyrint. Retrieved from https://www.researchgate.net/profile/Vincent_Linderhof/publication/200586333_Household_demand_for_energy_water_and_the_collection_of_waste_a_microeconometric_analysis/links/0912f5087bf26e4c9d000000/Household-demand-for-energy-water-and-the-collection-of-waste-a-microeconometric-analysis.pdf

Nadel, S. (2012). *The rebound effect: Large or small?* (ACEEE white paper). Washington, DC: American Council for an Energy-Efficient Economy.

Polkinghorne, J. D. (2011). *Factors affecting household demand for* energy (Unpublished dissertation). Auckland, New Zealand: University of Auckland. Retrieved from http://www.greaterauckland.org.nz/wp-content/uploads/2014/09/JP-Dissertation-14.01.11.pdf

Rehman, K. N. U., Tariq, M., & Khan, J. (2010). *Determinants of household's demand for electricity in district Peshawar* (MPRA paper No. 56007). Retrieved from https://mpra.ub.uni-muenchen.de/56007/1/MPRA_paper_56007.pdf

Reiss, P. C., & White, M. W. (2002). *Household electricity demand, revisited*. Stanford, CA: Graduate School of Business, Stanford University and NBER. Retrieved from https://web.stanford.edu/~preiss/demand.pdf

Schlag, N., & Zuzarte, F. (2008). *Market barriers to clean cooking fuels in Sub-Saharan Africa: A review of literature* (SEI working paper No. 8). Sweden: Stockholm Environment Institute. Retrieved from https://pdfs.semanticscholar.org/6965/b960ed89e9d4b2514f7658c78b2aadbc73f2.pdf

Zweifel, P., Praktiknjo, A., & Erdmann, G. (2017). *Energy economics theory and applications*. Germany: Springer International.

ISSN 1946-5130 (Print), ISSN 2470-4733 (Online)
http://dx.doi.org/10.20294/jgbt.2020.16.1.31

The Journal of Global Business and Trade

Journal of Global Business and Trade

https://www.pfw.edu/jgbt

Factors Affecting Entrepreneurial Intention and Behavior among the Indigenous Farming Community in Mountain Province, Philippines

Hanna A. Canillo[a], Jeanette Angeline B. Madamba[b*], James Roldan S. Reyes[c], Normito R. Zapata, Jr.[d] and Agnes T. Banzon[e]

[abde]*Department of Agribusiness Management and Entrepreneurship, College of Economics and Management, University of the Philippines Los Baños, Philippines*
[c]*Institute of Statistics, College of Arts and Sciences, University of the Philippines Los Baños, Philippines*

Received 24 January 2020, Revised 20 April 2020, Accepted 24 May 2020

ABSTRACT

Purpose – With the shift of the Philippine economy towards an agribusiness-driven sector from mere production-oriented farming, indigenous people have been encouraged to engage in entrepreneurship as it is seen as a means to improve their socio-economic status and their community. This study attempted to fill the gap in indigenous entrepreneurship research as it delved on the factors influencing entrepreneurial intention and behavior in an indigenous rice farming community in the northern Philippines.
Design/Methodology/Approach – This study assessed the factors affecting the entrepreneurial intention and behavior among indigenous rice farmers in Bun-ayan, Sabangan, Mountain Province, Philippines by analyzing the entrepreneurial indicators and predictors through correlation and multiple regression analysis of responses from 74 indigenous rice farmers.
Findings – Among all the entrepreneurship predictors in this research, age, educational attainment, years in farming, occupation of the farmer's father and mother, entrepreneurial inclination, entrepreneurial role model, entrepreneurial education, personal attitude, subjective norm and perceived behavioral control were significantly related to entrepreneurial intention. Among the significant variables extracted from the correlation analysis, the following factors affecting entrepreneurial intention and behavior are age, father's occupation and entrepreneurial inclination. Furthermore, it was found that socio-demographic factors and entrepreneurial inclination determine the intention of indigenous rice farmers to engage in entrepreneurial activities. The Theory of Planned Behavior indicators become insignificant when other predictors are incorporated with it.
Research Implications – Though there is evidence of a high level of entrepreneurial intention among the indigenous farming community, challenges pertinent to culture preservation vis-a-vis the indigenous farming community's capacity to translate such intention into entrepreneurial behavior need to be addressed.

Keywords: entrepreneurial behavior, entrepreneurial inclination, entrepreneurial intention, indigenous entrepreneurship
JEL Classifications: J15, N55

[*] Co-Author and Corresponding Author,
E-mail address: *jbmadamba@up.edu.ph*

Ⅰ. Introduction

The Philippines, a culturally diverse country, has an estimated population of 14 to 17 million indigenous peoples (IPs), which accounts for about 14% of the country's population. The IPs in the Philippines are described as the most disadvantaged social group in the country due to their remote and isolated location which also stands as a barrier to their access to basic services and their living needs. Poverty, unemployment and illiteracy are prevalent to IPs which make them a marginalized sector of society and thus, affect their performance and reliability in the agribusiness industry, specifically, in the entrepreneurial field and in the market. However, entrepreneurship is now seen by many indigenous groups as the central element supporting their advocacy in upgrading their economic situation as they attempt to advance towards modernization. In addition, indigenous entrepreneurship is a holistic form of entrepreneurship wherein indigenous aspects relative to the spiritual and environmental dimensions and community are relevant (Dana, 2015).

Agricultural entrepreneurship, as it pertains to the indigenous people of the village of Bun-ayan in the municipality of Sabangan, Mountain Province, Philippines, where the majority of the population are farmland owners and farmers themselves, have the potential to provide agricultural products to nearby communities. An indigenous sector-focused research was deemed necessary to contribute critical insights to the socio-cultural and traditional aspects, such as kinship, natural preservation, and indigenous farming methods, of dealing with their beliefs and how these influence their livelihood and business farming decisions, as well as their efficiency in using their resources (Waterworth, Pescud, Braham, Dimmock and Rosenberg, 2015). Rice and highland vegetables are commonly grown in the Sabangan municipality in Mountain Province, Philippines. Rice is a staple crop of the Philippines and this is also true for over 50 percent of the world's population.

Global demand for rice is expected to reach 496 million tons in 2020, and will continue to increase to 555 million tons in 2035 (Ricepedia, n.d.). Asian rice consumption is projected to account for 67% of the total increase, from 388 million tons in 2010 to 465 million tons in 2035 despite a continuing decline in per capita consumption in China and India. Over the long run, global rice consumption growth is expected to slow down, but yields will have to continue to grow faster than at present because of pressure on rice lands in the developing world from urbanization, climate change, and competition from high-value agriculture.

In the Cordillera region in the Philippines (CAR), the Kalinga province had the biggest share in terms of rice production volume with 38.9 percent share of 117, 292 MT, followed by the Apayao province with 23.2 percent (103,335 MT) and then the Abra province with 15.6 percent (69, 477 MT). Mountain Province had the lowest production with 3.6 percent (16,239 MT).

As for highland vegetables in the Philippines, these account for a huge chunk of the industry, and such revenue-generating produce is exported to different countries. Shallot was the most exported highland vegetable after garlic, asparagus and beans (whether preserved or prepared) and are mostly in demand in Indonesia. Most of these highland vegetables are grown within CAR.

This study sought to communicate agricultural, economic and cultural concerns of indigenous people and provide awareness of the issues that need to be addressed. Among the emerging scholastic fields of academic research is indigenous entrepreneurship, which reveals some of the incompatibility with the minor assumptions of mainstream theories of entrepreneurship (Dana, 2015), but there have not been a lot of studies regarding the assessment of inclination and intention, as well as the behavior of indigenous farmers with regards to entrepreneurship.

Indigenous peoples are perceived as groups of people who are less likely to be influenced or have access to the changes in the field of modern farming practices and the technology offered by the innovative agricultural industry (Hadiprayitno, 2015). However, a report of Inso (2018) stated that a decline of manpower in agriculture is the current reality because they are not

given enough attention in terms of sustainable food production and cultivating their intention to venture into agribusiness and entrepreneurship.

The Embassy of Canada in the Philippines (2015) mentions that the lack of income-generating and sustainable entrepreneurial activities, along with ancestral land ownership issues, are some of the major causes of poverty among indigenous groups due to their vulnerability caused by marginalization, discrimination, misrepresentation and environmental problems in the Philippines (Peace & Equity Foundation, 2017). An apparent lack of indigenous entrepreneurship activities in the local Philippine setting, not to mention the dearth in indigenous entrepreneurship literature, therefore make one contemplate which factors affect the indigenous farming community's intention and behavior towards entrepreneurship.

The general objective of the study was to assess the factors affecting entrepreneurial intention and behavior among the indigenous farmers in Mountain Province, Philippines. Specifically, the study aimed to:

analyze the factors that are associated with, and effect, the indigenous farmers' entrepreneurial intention and behavior;

evaluate the entrepreneurial inclination of indigenous farmers towards entrepreneurship;

assess the issues and challenges of indigenous farmers in their farming practices and engagement in entrepreneurship; and

formulate recommendations for specific stakeholders to enhance the entrepreneurial inclination, intention and behavior of indigenous farmers towards entrepreneurship.

Ⅱ. Review of Related Literature

1. Overview of Indigenous People and Indigenous Entrepreneurship

Indigenous people are known for their resilience in nearly every aspect of their lives including farming. Perroni (2017) estimates that there are over 370 million IPs in the world who utilize 22% of the global land area. The Philippines, a culturally diverse country, has an estimated population of 14 to 17 million IPs accounting for about 14% of the country's population. They belong to 110 ethnolinguistic groups existing in the Philippines which are mainly concentrated in the Northern Luzon island, specifically, in the Cordillera Administrative Region (33%), Mindanao in the southern Philippines (61%) and some groups in the the Visayas area (UNDP, 2013). According to Pace (2015) of the Sustainable Food Center, the connection between the land and indigenous people is such that a variety of farm practices specific to their own local environments that are cohesive with natural processes, including weather, is implemented.

The Philippine government has passed an act called the Indigenous Peoples' Rights Act of 1997, which protects the rights of indigenous people over their ancestral domains, and includes sovereign independence and empowerment, social justice and human rights, and rights to their cultural identity. In 2007, the UN General Assembly adopted the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) which provides a framework for the survival, dignity, well-being, and rights of all indigenous peoples. Furthermore, the National Commission on Indigenous Peoples (Philippines) is one of the agencies under the national government of the Philippines which is responsible for protecting the rights of the indigenous peoples of the Philippines (NCIP, 2015).

There have been many academic and scholarly researches focusing on the indigenous people in the world including various definitions as to who they are and who may be called an indigenous person, but not much particularly on indigenous entrepreneurship. According to Wilmer (1993), indigenous people are those with cultures that are primarily based on traditions, those who were politically independent even before colonization, and those who are still fighting for their rights in preserving their cultural integrity, economic sovereignty, and political system against modern society and some of the policies by their nation.

Untouchables, the most excluded and disadvantaged sectors of society, remain to be positioned as indigenous peoples in the world. Discrimination, poverty, human rights abuse and other related issues are still continuously faced by these indigenous groups. One of the biggest challenges that they continue to face are issues related to their ancestral domains, which include disruptive activities such as mining, displacement and political conflict. Although some indigenous groups have found their medium of improving their socio-economic status, there are still main arguments advanced to those indigenous entrepreneurs such as the number of barriers to the development of their businesses because of their limited access to capital (Brown and Ferris, 2007).

Entrepreneurship poses many challenges in the indigenous sector. The Indigenous Corporate Training Inc. (2017) has already identified some of these problems. First, having access to capital due to low economic performance of many indigenous tribes who solely rely on hunting and food production for home consumption is a major problem (Cloete and Idsardi, 2013). Second, having access to business networks is another issue because many tribes such as the *Kankana-ey* tribe of Mountain Province, Philippines, are found in secluded areas (Furneaux and Brown, 2019). Third, lack of education and training remains a hindrance. With the limited amount of educational resources in indigenous tribes, these people are highly dependent on the government for their needs (Nesterova, 2017). Despite these challenges, many indigenous people around the world have strived to improve their economic status.

Overall, the population of indigenous agricultural enterprises all over the world is gradually increasing, especially in the Philippines, where the gross value of agricultural production and businesses is Php 429.7 billion or USD 8.468 billion (PSA, 2019). These increases can also be found in Australia, India, South Africa and other countries where businesses are rooted in agriculture (Kahan, 2012).

Indigenous peoples encounter challenges and barriers in entering the entrepreneurial field. According to Jacobs (2017), the business barriers experienced by indigenous people include the lack of education, business pathways, skills and acumen where their limited knowledge on business concepts and processes are due to their limited participation in the economy. Limited access to finance is also a factor where there are low levels of equity and personal savings to fund business ventures of indigenous people. Moreover, wealth and external prejudices leading to stigma and bias are proliferated as the indigenous people's ability to do business is questioned, thus preventing mainstream people in the business world to deal with them.

2. Farming Systems and Other Livelihood Types of Philippine Indigenous Groups

Soil fertility management practices by indigenous farmers use various techniques to improve or maintain soil fertility. The indigenous agrosilvopastoral system takes advantage of the multiple benefits provided by trees available on their farms. These benefits are extremely important in places where few alternatives exist for improving soil fertility, crop yields, and animal nutrition. Local climate plays a significant role in the lives and fortunes of farmers everywhere. Native farmers can manipulate the microclimate through retaining and planting trees (Reijntjes, Haverkort and Waters-Bayer,1992).

Each tribe has its own special products that are readily offered in the market. The Ibaloi tribe of the Benguet province in the northern Philippines showcases its woodcarving and weaving skills to the market. The Subanen from the Zamboanga peninsula in the southern Philippines are known for their beadwork and embroidery. The Higaonon tribe in the southern Philippines features handwoven goods as well as preserved jackfruit, passion fruit and calamansi (Philippine lemon) juice, while the Mangyan tribe of the Mindoro province in the southern part of the northern Philippines is known for its catfish and rattan products as well as hibiscus juice, coffee and honey.

The Atis of Panay province in the central Philippines are nomadic by nature as they keep moving from one

place to another and may occupy areas including the seashore, lowlands or uplands. Barrato and Benansing (1978) stated that the Atis were among the first indigenous group to practice slash and burn agriculture. Along the coasts of Sulu and Tawi-tawi in the southern Philippines, the sea gypsies or dwelling people, the Badjaos, engage in seaweed farming and fishing. Seaweed farming reveals their willingness to improve in terms of productivity, while fishing reflects their cultural inclination to harvest from the bounty of nature (Coop Indisco, 1995).

3. Entrepreneurial Intention

Entrepreneurial intention is an index used to analyze an individual's willingness to become an entrepreneur. This is a state of mind that offers guidance and gives direction to individuals toward the formulation of new business concepts (Bird, 1988). It also precedes action and directs attention toward a goal of carrying out entrepreneurial behavior such as building an innovative business idea (Liñan and Rodriguez-Cohard, 2004; Moriano, Gorgievski, Laguna, Stephan and Zarafshani, 2012).

4. Theory of Planned Behavior

The theory of planned behavior deals with the concepts that permit prediction and understanding of particular behaviors in specified contexts. Ajzen (1991) concluded that the three attitudinal antecedents, namely, attitudes toward the behavior, subjective norms, and perceived behavioral control, predict behavioral intention with a high level of accuracy. Personal attitude refers to the personal desirability of an individual's acuity of carrying out entrepreneurial behavior while subjective norm is a predictor of the social factor that refers to the perceived environmental pressure and valuation whether to perform or not to perform the behavior. Lastly, perceived behavioral control reflects the past experiences and the anticipated barriers and difficulties in performing the behavior; it also refers to the perceived ease or trouble of an individual in associating oneself in a certain behavior.

The intention of the individual, as the central indicator in the Theory of Planned Behavior, to perform a given behavior is assumed to capture the factors that motivate and influence a behavior such that there is willingness to exert an effort in order to perform the behavior. Thus, the higher the intention to execute the behavior, the higher the probability of undertaking it (Ajzen, 1991).

5. Entrepreneurial Inclination

According to Koh (2013), entrepreneurial inclination is significantly associated with a greater need for achievement, higher propensity to take risks, and greater innovativeness. This is also associated with physical, demographic and family characteristics. Lack of exposure, experience, and information to entrepreneurial opportunities and programs that are brought by the entrepreneurial role model and entrepreneurial education are found to be one of the factors deterring individuals from embarking in the field of creating their own businesseses (Sandhu,Wratten, Cullen and Case, 2008).

Furthermore, most of the previous studies just focused on the general issues related to the protection and security of IPs. There were research studies in the past about the traditional farming system of indigenous people, but these studies did not look into cultural and other factors that may affect their entrepreneurial inclination and intention, considering that they are also main players of the agricultural sector as producers and thus, they stand to benefit from improving their socio-economic status through entrepreneurship. Therefore, a research evaluating the entrepreneurial inclination and intention of indigenous farmers may be useful to inform interested stakeholders how indigenous peoples can be brought into the mainstream of the agribusiness sector.

Ⅲ. Research Methodology

This study was conducted primarily in the Bun-ayan village because it is largely devoted to farming,

covering a total area of 61.5 hectares. Moreover, the extent of preservation of their indigenous farming practices was another point for consideration. As for the research design implemented in this study, the exploratory and evaluative research designs were used to establish an understanding of the entrepreneurial capabilities and intention of indigenous farmers in Mountain Province, Philippines as well as determining their entrepreneurial inclination and behavior of the indigenous farming community.

Quantitative research methods used were oriented towards understanding the process and ways of IPs in their communities and how they react given these experiences. The study made use of both primary and secondary data. Primary data were collected using a structured questionnaire and through the conduct of key-informant interviews. The instrument elicited information from respondents based on their socio-demographic and farm characteristics, the family's occupational background, career goals, and the variables for entrepreneurial inclination and intention. Gathering of information regarding their farming practices used the key-informant interview guide to allow open-ended questions.

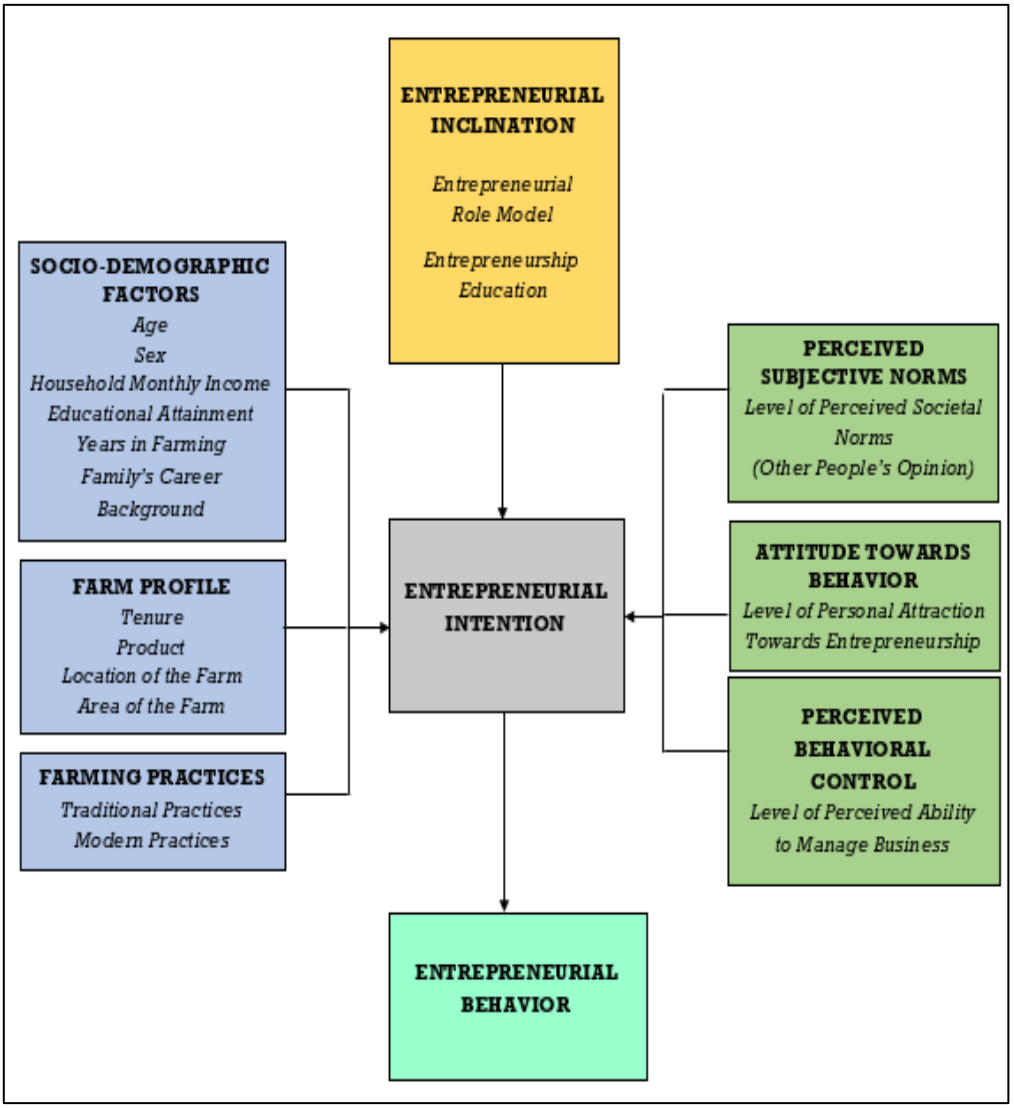
To ensure the applicability of the formulated questionnaire in the indigenous setting and the comprehensibility by the sample population, pre-testing was employed since the indicators of the questionnaire were adapted from previous research studies. The pre-test responses were subjected to statistical reliability analysis for the indicators identified. Cronbach's Alpha reliability analysis was used to validate whether the indicators in the questionnaire in each part measures the necessary qualities in the study and whether the factors and indicators identified were positively correlated with each other.

Simple random sampling was used in selecting respondents whose names were obtained from the list of households record for Barangay Bun-ayan of the Municipal Agricultural Office of Sabangan. The number of samples for the study was computed at 74 indigenous farmers selected through simple random sampling.

Descriptive statistical tools such as mean, mode, frequency counts and percent distributions were used for better interpretation and analysis of the results. Other statistical tools such as the Eta-square ($\eta 2$), Point-biserial correlation and Pearson rho correlation were also used to scrutinize relationships between significant data results, most particularly on the predictors to entrepreneurial intention relationships. Multiple regression analysis was also applied to evaluate the significant variables that were extracted from the correlation analysis and to determine the effect and the causality of the variables that were found to be the factors affecting entrepreneurial intention.

The conceptual framework for the study is presented in Figure 1 which considers a group of variables likely to influence the propensity to create a business and/or to be associated with entrepreneurial activities. In this context, socio-demographic factors (i.e., age, sex, household monthly income, educational attainment, years in farming, family's career background, and career goals), farm profile (tenure, products, location of the farm, and area of the farm), and farming practices are the factors tested to influence entrepreneurial intention. The entrepreneurial inclination of indigenous farmers, on the other hand, made use of two indicators to signal one's inclination towards entrepreneurship and these were entrepreneurial role model and the education they attained such as seminars and training on entrepreneurship. Entrepreneurial inclination has a direct effect on entrepreneurial intention as seen also in the study of Medina (2017). In addition, the three independent attributes under the Theory of Planned Behavior such as personal attitude towards behavior, subjective norms and perceived behavioral control are also factors that can affect the intention and motivation of indigenous farmers to venture into entrepreneurship (Ajzen, 1991).

Fig. 1. Conceptual Framework



Sources: Adapted from the Theory of Planned Behavior Model of Ajzen (1991) and the Entrepreneurial Intention Model of Liñan (2004).

IV. Results and Discussion

Ancestral domain management called the *At-atoan* system still remains a part of the political structure of the Bun-ayan village. It is a customary informal governance of the community elders or *am-amma* who comprise the traditional decision-making council in the community. The decisions regarding the schedule of the start and rest period in agricultural activities, sustainable management of resources, and even the formal political atmosphere are based on the rules of an indigenous socio-political institution such as this. The system's link to the farming activities of the indigenous farmers is critically relevant due to the exchange of knowledge and labor among members of the community.

1. Socio-Demographic Profile of the Farmers

The ages of the farmer respondents range from 25 to 91. Most indigenous farmers in Bun-ayan are 47 years old or older which shows that many indigenous farmers are aging. About 68% of the farmer respondents are female since they do not earn anything from their harvests inasmuch as they grow crops just for home consumption. The male population primarily preoccupy themselves by engaging in other activities such as carpentry, construction, re-propping or *cabite*, while the females who are mostly homebound are the ones who spend time farming at the foot of the sloping mountain.

Most of the indigenous farmers are married (87%), and do not generally strive for tertiary education because they believe that they are much needed in the farms. However, despite this, they were highly interested in entrepreneurship (74 percent). Moreover, most respondents gave only a rough estimate of their monthly income and not all shared household monthly income information because some preferred to withhold their income information. Based on the information they shared, they lack enough income for their family as well as for their farm operating requirements. While most of the interviewed farmers spoke in the Ilokano and *Kankana-ey* dialects, the majority of them can speak English and Tagalog.

2. Farm Profile and Characteristics

Among the 74 indigenous farmers, forty-seven (47) farmers (64%) were farm owners. Most of these farm owners inherited their farms from their forefathers directly from their parents or grandparents. Their farms were mostly located in the same *barangay* (village) where they lived and majority of the farmers interviewed had a farm size of less than one (1) hectare. Since farming is intended for home consumption, the farmers working in the field are comprised of household members, either the wife or both wife and husband.

3. Farming Methods of Indigenous Farmers

3.1. Traditional Farming Methods Inherited from Ancestors

Traditional farm production methods still exists in the Bun-ayan village, and they are still practicing them in the present. The agricultural calendar provides a synchronization of activities in facilitating the rituals to be done and foresees the need for pest management, specifically, in rice farming. The duration of various rituals last for no more than three days. Some rituals do not take a full day to be performed such as on the *de-am* or dry season which signals the time to start planting and *begnas* which is done to call and request for rain during the dry season. The ritual called *tenod/dalpa* is a ritual in which a woman in the field plants a small number of seedlings. This takes one day for the whole community. Meanwhile, the *tengao* (a ritual made before the start of transplanting involves a 3-day rest period and a sacrifice consisting of the butchering of chicken or swine), *pakde* (a ritual involving the playing of a gong and butchering of chicken of swine), and *tengao di leppas* (a kind of *tengao* conducted at the start of harvesting for thanksgiving and also entails praying for enough harvest) take three days for the community to do or to celebrate. The agricultural cycle of the Bun-ayan indigenous farmers, which incorporates their farming rituals and cultural traditions, has sudden implications on the production cycle because they can not maximize and optimize their time for their agricultural activities as there are delays in farm operations brought about by the need to perform such rituals. However, there are no relevant costs that the community spends for these rituals because the poultry or livestock subjected to butchering is a donation from the different households, while food for the celebrations is provided by the village fund. Community members provide even the smallest donation for the rituals in anticipation of bountiful harvests and a better life in general.

3.2. Modern Farming Methods Adopted by the Farmers

Indigenous farmers in the Bun-ayan village have also been adopting modern farming methods, but in a minimal way. The hand tractor, commonly known as the *kuliglig*, is the main type of mechanization adopted in their ricefields. This farming equipment is usually borrowed or rented by farmers from fellow farmers who have them. Presently, hand tractor usage allows the farmers to plow and harrow for only three hours compared to traditional land preparation which involves manual labor with tilling lasting for three days. The respondents generally mentioned that they are willing to adopt modern farm practices as long as they do not interfere with their rituals in farming. They also have a high willingness to attend seminars and undergo training on agricultural technology and entrepreneurship. However, some of them stated that the government is not centralized in its dealings with farmers and not fair with the allocation of resources and equipment to all the farming communities in Mountain Province. They hope that if the government has something to offer the farmers, such assistance must be accessible to all farming communities.

4. Cronbach's Alpha Reliability Analysis

Twelve (12) responses have been used to analyze the high internal consistency of the questionnaire using Cronbach's alpha with a minimum acceptable value of alpha 0.7 (Nunually, 1978). The construct of personal attitude scale had a high level of internal consistency, as determined by a Cronbach's alpha of 0.858. Subjective norm with a Cronbach's alpha of 0.815 was recorded indicating a high level of internal consistency. Perceived behavioral control had a high level of internal consistency, as determined by a Cronbach's alpha of 0.718. Entrepreneurial intention indicated a high level of internal consistency with a Cronbach's alpha of 0.857. Lastly, the entrepreneurial inclination construct displayed a Cronbach's alpha of 0.906, indicating a high level of consistency.

Indigenous rice farmers residing in the Bun-ayan village generally show high personal attitude with a mean score of 4.01. The subjective norm and subjective value perceived by the respondents is 4.03; in terms of the respondents' environment, its relevance is relatively high. Moreover, the indigenous farmers' perceived behavioral control is fairly high with an overall mean score of 3.60. The respondents have generally demonstrated that they clearly do have strong confidence to start their own business. Indigenous farmers seem to want to become entrepreneurs as seen in the relatively high mean score of 4.00 for entrepreneurial intention and a 4.34 mean score for entrepreneurial inclination.

5. Correlation Analysis

Table 1 presents the results of the correlation analysis between each variable in the antecedents of entrepreneurial inclination, socio-demographic factors, farm profile and characteristics and indicators of the Theory of Planned Behavior. With regard to entrepreneurial intention, entrepreneurial inclination and its antecedents (entrepreneurial role model and entrepreneurial education), age, educational attainment, years in farming, father's and mother's occupation, and the three indicators of Theory of Planned Behavior (i.e., personal attitude, perceived subjective norm, perceived behavioral control) were found to be significantly related. Such significant variables were all positively associated with entrepreneurial intention, excluding age and years in farming which implies a negative association with entrepreneurial intention.

Table 1. Relationship of Entrepreneurial Inclination and Its Antecedents, Socio-demographic/Farm Profile, and Theory of Planned Behavior Indicators to Entrepreneurial Intention of Indigenous Farmers in Bun-ayan, Sabangan, Mountain Province, Philippines (2019)

Variable	Coefficient	Estimate of the Coefficient
Entrepreneurial Role Model	Point-Biserial	0.2822***
Entrepreneurial Education	Point-Biserial	0.3404***
Sex	Point-Biserial	0.1433^{ns}
Age (in years)	Pearson's rho	-0.3654***
Educational Attainment	eta	0.3855**
Years in Farming	Pearson's rho	-0.3717***
Household Size	Pearson's rho	0.1724^{ns}
Household Income	Pearson's rho	0.0599^{ns}
Tenure	eta	0.176^{ns}
Nature/Product	eta	0.25^{ns}
Location	eta	0.221^{ns}
Area of the Farm (in sq.m.)	Pearson's rho	0.0282^{ns}
Career Goals	eta	0.263^{ns}
Father's Occupation	eta	0.402***
Mother's Occupation	eta	0.337**
Personal Attitude	Pearson's rho	0.6003***
Perceived Subjective Norm	Pearson's rho	0.645***
Perceived Behavioral Control	Pearson's rho	0.5064***
Entrepreneurial Inclination	Pearson's rho	0.7097***

Note: *significant at α=10%, **significant at α=5%, ***significant at α=1%, ^{ns}means not significant.

Entrepreneurial role model and entrepreneurial education, as variables representing entrepreneurial inclination, were found to have a relationship with the entrepreneurial intention of the indigenous farmers. However, the relationship among these variables is weak, implying that indigenous farmers can benefit from interacting with successful entrepreneurs who can share with them relevant experiences and opportunities. Conducting lectures, seminars and training on agricultural technology and entrepreneurship for indigenous farmers at the village level would intensify their intention and willingness to start their own business.

Relative to socio-demographic factors, age is significantly but negatively associated with entrepreneurial intention, which implies that as the indigenous farmers get older, the level of entrepreneurial intention decreases. Higher educational attainment is, on the other hand, significantly and positively related to entrepreneurial intention and thus, increases the likelihood that indigenous farmers will engage in entrepreneurship. Years in farming had a significant but negative relationship with entrepreneurial intention, suggesting that the longer an indigenous farmer has spent farming, entrepreneurial intention decreases, holding other factors constant. The farming family's occupational background, specifically those for both the mother and the father, is significantly and positively associated with the entrepreneurial intention of indigenous farmers. Nonetheless, parental occupation appears to significantly influence the careers pursued by the next generation. On the other hand, factors such as sex, household size, household monthly income, tenure, nature of the farm, location of the farm, farm size, and career goals were insignificant and provided no evidence to influence entrepreneurial intention.

As seen in Table 1, it is evident that personal attitude significantly and positively affects entrepreneurial intention (coefficient value of 0.60). Therefore, indigenous farmers whose personal attitude about entrepreneurship

is quite positive, have a higher propensity to engage in entrepreneurship. In addition, the relationship between the subjective norm and entrepreneurial intention shows a significant and positive effect with a coefficient value of 0.65, implying that as the subjective norm or perceived social pressure from the social environment increases, the level of entrepreneurial intention also increases. This means that people who are valued and respected by indigenous farmers play an important role in convincing them to engage in indigenous entrepreneurship. Furthermore, perceived behavioral control has a moderate relationship with entrepreneurial intention (coefficient value of 0.51) signifying that heightened perceptions of indigenous farmers of their ability to perform a given behavior, such as engagement in entrepreneurship, increase the level of entrepreneurial intention. Thus, as indigenous farmers increasingly believe in succeeding at performing the tasks needed to engage in business, the greater their entrepreneurial intention. Finally, entrepreneurial inclination shows the highest coefficient of 0.71. This result implies that the higher the level of entrepreneurial inclination of indigenous farmers, the higher the possibility or intention towards engaging in entrepreneurship.

Table 2. Multiple Regression Analysis of Independent Variables Affecting the Entrepreneurial Intention of Indigenous Farmers in Bun-ayan, Sabangan, Mountain Province, Philippines (2019)

Variable	Estimate of the Coefficient
Entrepreneurial Education	0.15^{ns}
Entrepreneurial Role Model	0.14^{ns}
Age	-0.011**
Educational Attainment	
(Elementary Level)	0.43^{ns}
(High School Level)	0.44^{ns}
(College Level)	0.24^{ns}
(Vocational Graduate)	0.22^{ns}
Years in Farming	-0.008^{ns}
Occupation of Father	
(Deceased)	0.44*
(Occupation Other Than Agriculture, Entrepreneurship and Deceased)	0.31^{ns}
Occupation of Mother	
(Entrepreneurship)	-0.046^{ns}
(Deceased)	-0.29^{ns}
(Occupation Other Than Agriculture, Entrepreneurship and Deceased)	0.29^{ns}
Personal Attitude	0.14^{ns}
Subjective Norm	0.15^{ns}
Behavioral Control	-0.006^{ns}
Entrepreneurial Inclination	0.44*
Constant	1.36

Note: *significant at α=10%, **significant at α=5%, ***significant at α=1%, ns-not significant.

6. Factors Affecting Entrepreneurial Intention

Among the significant variables extracted from the correlation analysis, the factors that have a weak to moderate effect on the entrepreneurial intention of indigenous farmers in the Bun-ayan village include age, father's occupation, and entrepreneurial inclination, as seen in the multiple regression analysis results in Table 2. On the other hand, entrepreneurial education, entrepreneurial role model, educational attainment,

years in farming, mother's occupation, personal attitude, subjective norm and perceived behavioral control are insignificant factors.

Furthermore, all of the significant variables in this model, namely age, father's occupation, and entrepreneurial inclination, were subjected to another multiple regression analysis to determine their significance relative to entrepreneurial intention. Table 3 shows that these significant variables are still significant and have a bearing on the entrepreneurial intention of indigenous farmers even if other predictors were omitted in the model.

Table 3. Factors Affecting the Entrepreneurial Intention of Indigenous Farmers in Bun-ayan, Sabangan, Mountain Province, Philippines (2019)

Variable	Estimate of the Coefficient
Age	-0.19***
Father's Occupation	
(Deceased)	0.33**
(Occupation Other Than Agriculture, Entrepreneurship	
and Deceased)	0.52**
Entrepreneurial Inclination	0.61***
Constant	2.36

Note: *significant at α=10%, **significant at α=5%, ***significant at α=1%, ns-not significant, ( ) dummy variables.

V. Conclusion and Recommendations

This study provided empirical evidence regarding the factors affecting entrepreneurial intention and behavior among the indigenous farming community in the Bun-ayan village, municipality of Sabangan, Mountain Province Philippines, as it discussed the relationship of variables such as entrepreneurial inclination and its antecedents (i.e., entrepreneurial role model and entrepreneurial education), socio-demographic factors (i.e., age, sex, household monthly income, years in farming, family's career goals, background including household size, educational attainment, mother's occupation, father's occupation), farm profile (i.e., tenure, nature/product, location of farm and area of farm) and indicators of the Theory of Planned Behavior (i.e., personal attitude, subjective norm and perceived behavioral control) with entrepreneurial intention. Moreover, issues and challenges encountered by the indigenous farming community in terms of its adoption of farming practices as well as engagement in entrepreneurship were bared in this study. Such challenges include the fact that the indigenous farmers are aging (middle-aged or older), they had no entrepreneurial training nor experience as whatever they farmed is for home consumption, their perception of unfairness on the part of the government relative to sharing technology and conducting seminars and training as well as issues pertaining to their farming rituals and cultural practices that impede entrepreneurial activities arising from the current *At-atoan* system. Though it was ascertained that the indigenous farming community was highly interested in entrepreneurship (74 percent), it is apparent that there is a need to resolve the conflict of preserving their culture, and at the same time, cater to the realities of what indigenous entrepreneurship entails if they were to pursue it.

Using correlation analysis, among all the entrepreneurship predictors in this study, age, educational attainment, years in farming, occupation of the farmer's father and mother, entrepreneurial inclination, entrepreneurial role model, entrepreneurial education, personal attitude, subjective norm and perceived behavioral control were significantly related to entrepreneurial intention.

Among the significant variables extracted from the correlation analysis, the following factors affecting

entrepreneurial intention and behavior are age, father's occupation and entrepreneurial inclination. Furthermore, it was determined that some socio-demographic factors and entrepreneurial inclination determine the intention of indigenous rice farmers to engage in entrepreneurial activities for the Theory of Planned Behavior indicators become insignificant when other predictors are incorporated with it.

Suggested recommendations for specific stakeholders include involving business groups in matching successful entrepreneurs with interested indigenous farmers who wish to foray into entrepreneurship. Moreover, the local representatives in the area from the Department of Agriculture and Department of Trade and Industry can regularly meet with the indigenous farming community on a regular basis to determine and conduct specific training and seminars on agricultural technology and indigenous entrepreneurship needed by the community. In addition, the younger generation in the indigenous farming community must be made aware through entrepreneurial education-related activities (i.e., seminar-workshops (both face-to-face and in digital format), agribusiness and trade fairs) of the benefits of engaging in agribusiness and indigenous entrepreneurship to uplift the quality of life in the community, more so in the aftermath of the current pandemic situation where food security is a priority.

Consequently, there is a need to strengthen the *at-atoan* system or the traditional leadership within the community because this is where the cultural traditions and customary laws that encourage sustainable management of resources reside. Through innovations in the *at-atoan* system which may include flexibility in scheduling ritual and entrepreneurship-related activities and allocating resources, any conflict presented by cultural practices vis-à-vis entrepreneurial activities can be counteracted.

References

Ajzen, I. (1991, December). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50* (2), 179-211. Retrieved from https://www.researchgate.net/publication/256619280_The_Theory_of_Planned_Behavior

Barrato, C., & Benansing, M. (1978). *Pinatubo negritos* (Field report series No. 5). Quezon City, Philipnes: Philippine Center For Advanced Studies Museum at University of the Philippines.

Bird, A. (2004, January 13). Dispositions and antidotes. *The Philosophical Quarterly*. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/1467-9213.00098

Brown, E., & Ferris, J. M. (2007, March 1). Social capital and philanthropy: An analysis of the impact of social capital on individual giving and volunteering. *Nonprofit and Voluntary Sector Quarterly, 36*(1), 85-99. Retrieved from https://journals.sagepub.com/doi/10.1177/0899764006293178

Cloete, P. C., & Idsardi, E. (2013). Consumption of indigenous and traditional food crops: Perceptions and realities from South Africa. *Agroecology and Sustainable Food Systems, 37*(8), 902-914. Retrieved from https://www.researchgate.net/publication/258925068_Consumption_of_Indigenous_and_Traditional_Food_Crops_Perceptions_and_Realities_from_South_Africa

Coop Indisco (1995, February). *Indigenous knowledge system and practices among selected Philippine ethnic groups and their promotion through cooperatives* (Working paper). Manila: International Labor Organization. Retrieved from https://www.ilo.org/manila/publications/WCMS_542426/lang--en/index.htm

Dana, L-P. (2015). Indigenous entrepreneurship: An emerging field of research. *International Journal of Business and Globalisation, 14*(2), 158-169.

Embassy of Canada in the Philippines (2015, October 26). *Helping Filipino indigenous peoples put business plan into action.* Retrieved from https://www.canadainternational.gc.ca/philippines/eyes_abroad-coupdoeil/BizCamp.aspx?lang=eng

Furneaux, C. W., & Brown, K. A. (2019). *Indigenous entrepreneurship: An analysis of capital constraints.* Retrieved from https://www.researchgate.net/publication/27472593_Indigenous_Entrepreneurship_An_Analysis_of_Capital_Constraints

Hadiprayitno, I. I. (2015). Behind transformation: The right to food, agricultural modernisation and indigenous peoples in Papua, Indonesia. *Human Rights Review, 16*, 123-141. Retrived from https://doi.org/10.1007/s12142-015-0353-7

Indigenous Corporate Training Inc. (2017). *Aboriginal rights, title, and the duty to consult.* Retrieved from https://cdn2.hubspot.net/hubfs/374848/ebooks/Aboriginal%20rights%20ebook.pdf?t=1502910489579

Inso, F. A. (2018, August 29). Declining farmer population. *Cebu Daily News*. Retrieved from https://cebudailynews.inquirer.net/191635/declining-farmer-population

Jacobs, C. (2017, November). *Risky business: The problems of indigenous business policy* (Research report 35). The Centre for Independent Studies. Retrieved from https://www.cis.org.au/app/uploads/2017/12/rr35.pdf

Kahan, D. (2012). *Entrepreneurship in farming*. Rome: Food and Agriculture Organization of the United Nations. Retrieved from https://www.fao.org/3/i3231e/i3231e.pdf

Koh, H. C. (2013, January). Factors associated with entrepreneurial inclination: An empirical study of business undergraduates in Hong Kong. *Journal of Small Business and Entrepreneurship*, 29-41. Retrieved from https://www.tandfonline.com/doi/abs/10.1080/08276331.1995.10600487

Liñán, F. (2004, January). Intention-based models of entrepreneurship education. Retrieved from https://www.researchgate.net/publication/235937886_Intention-Based_Models_of_Entrepreneurship_Education

Liñan, F., & Rodriguez-Cohard, J. C. (2004, September). *Entrepreneurial attitudes of Andalusian university students.* Retrieved from https://www.researchgate.net/publication/23731103_Entrepreneurial_attitudes_of_Andalusian_university_students

Medina, K. (2017). *Entrepreneurial inclination and factors affecting entrepreneurial intention among bachelor of science in agriculture (BSA) students at the university of the Philippines Los Baños (UPLB)* (Unpublished Special Problem Report). Laguna, Philippines: University of the Philippines Los Baños.

Moriano, J., Gorgievski, M., Laguna, M., Stephan, U., & Zarafshani, K. (2012, April). A Cross-cultural approach to understanding entrepreneurial intention. *Journal of Career Development, 39*(2), 162-185. Retrieved from https://research.aston.ac.uk/portal/en/researchoutput/a-crosscultural-approach-to-understanding-entrepreneurial-intention(5e7a013f-57f9-48fa-85f5-f97f56dad571)/export.html

National Commission on Indigenous Peoples (NCIP). (2015). *Information*. Retrieved from https://www.ncipro67.com.ph/#

Nesterova, Y. (2017). *Indigenous peoples: Key trends that affect their development.* Retrieved from https://impakter.com/indigenous-peoples-part-two/

Pace, K. (2015, October 7). *Indigenous agriculture and sustainable food.* Austin, TX: Sustainable Food Center. Retrieved from https://sustainablefoodcenter.org/latest/gardening/indigenous-agriculture-and-sustainable-food

Peace & Equity Foundation. (2017, December 11). *Indigenous peoples as social entrepreneurs.* Retrieved from http://pef.ph/index.php/2017/12/11/indigenous-peoples-as-social-entrepreneurs/

Perroni, E. (2017, August 14). *Five indigenous farm practices enhancing food security*. Resilience. Retrieved from https://www.resilience.org/stories/2017-08-14/five-indigenous-farming-practices-enhancing-food-security/

Philippine Statistics Authority (PSA). (2019, May). *Performance of Philippine agriculture January to March 2019*. Retrieved from http://www.pcaf.da.gov.ph/wpcontent/uploads/2019/05/PAR_January-to-March-2019-compressed.pdf

Reijntjes, C., Haverkort, B., & Waters-Bayer, A. (1992). Farming for the future. An introduction to low-external input and sustainable agriculture. London: Macmillan.

Ricepedia. (n.d.). *Rice productivity*. Retrieved from https://ricepedia.org/rice-as-a-crop/rice-productivity

Sandhu, H. S., Wratten, S. D., Cullen, R., & Case, B. (2008). The future of farming: The value of ecosystem services in conventional and organic arable land: An experimental approach. *Ecological Economics, 64*(4), 835-848.

UNDP. (2013, July 24). *Fast facts: Indigenous peoples in the Philippines*. Retrieved from https://www.ph.undp.org/content/philippines/en/home/library/democratic_governance/FastFacts-IPs.html

Waterworth, P., Pescud, M., Braham, R., Dimmock, J., & Rosenberg, M. (2015). Factors influencing the health behaviour of indigenous Australians: Perspectives from support people. *PLoS ONE, 10*(11), e0142323. Retrieved from https://doi.org/10.1371/journal.pone.0142323

Wilmer, F. (1993). *The indigenous voice in world politics since time immemorial*. Thousand Oaks, CA: Sage.

ISSN 1946-5130 (Print), ISSN 2470-4733 (Online)
http://dx.doi.org/10.20294/jgbt.2020.16.1.47

The Journal of Global Business and Trade

Journal of Global Business and Trade

https://www.pfw.edu/jgbt

The Study of the Interaction between the RMB Exchange Rate and Chinese Stock Price

Chenyang Huang[a] and Xueru Bai[b]

[a]*Department of Social Welfare, Chongju University, South Korea*
[b]*Department of International Trade, Shandong University of Politic Science and Law, China*

Received 2 February 2020, Revised 25 April 2020, Accepted 24 May 2020

ABSTRACT

Purpose – This paper aims to study the relationship between the RMB exchange rate change and the stock price change under the trend of economic globalization with more frequent global capital flow.
Design/Methodology/Approach – In order to study the relationship between the change of the RMB exchange rate and the change of stock price, this paper adopts the daily exchange rate of RMB against the US dollar from January 1, 2016 to January 23, 2020 and chooses the price of the Shanghai Composite Index. The paper then uses the data in the same order and the single integer through the first-order difference VAR model by using the Granger causality test; according to the same model, the paper further studies the relationship between the weight plate index including financial index, China Securities coal, non-ferrous metals and China Securities steel and the exchange rate.
Findings – It is found that the stock price is a one-way Granger of the exchange rate of RMB against the US dollar, while the stock price has a strong and negative response to the exchange rate change. The financial index and non-ferrous metals have an interaction with the exchange rate, while the coal index and the state bond steel have a unilateral impact on the exchange rate.
Research Implications – The Chinese government should continue to promote the market-oriented reform of interest rates, increase the regulatory role of interest rates on stock prices, and strengthen the international liquidity and voice of RMB, so as to achieve the linkage effect between foreign exchange and the stock market. In addition, a multi-tiered capital market should also be developed so that the transmission of foreign exchange risks will not be concentrated in the stock market, but in various financial markets.

Keywords: exchange rate, Granger test, Shanghai composite index, VAR model
JEL Classifications: G12, G15, O24

Ⅰ. Introduction

After the exchange rate reform in 2015, the RMB exchange rate fluctuated more frequently, and the stock market fluctuated with the exchange rate, which gradually strengthened the correlation between the two. Exchange rates influence the flow of capital in a country, and the stock market is home to much capital.

[a]First Author, E-mail: *setup521@naver.com*
[b]Corresponding Author, E-mail: *anita731013@163.com*

At the same time, exchange rate and stocks are important economic variables of a country, and their fluctuations can reflect the macroeconomic situation of the country. With the deepening of economic globalization, the increase of sino-foreign trade and the frequent exchange of capital across national borders, especially the trade war between China and the United States in 2018, more and more scholars and policy authorities have paid attention to the correlation between the foreign exchange market and the securities market.

With the development of China's currency internationalization, our country market economy has more freedom, as liberalization of capital flows between tend to be, so the research on the exchange rate and stock prices can help individual investors. Market institutions and relevant authorities grasp the changes between the two laws, enabling investors to make reasonable investments, having personal, social and international levels effectively guard against financial risks; having a certain reference value to the authorities on setting policy has a practical significance. Existing literature between the exchange rate and stock price pauses in the relationship between the index and the exchange rate. There is no further exploration of internationalization between the higher plate and the relationship between the exchange rate, so this article regarding the weight plates and currency relations research can enrich the direction of the related research, with theoretical significance.

Exchange rate changes are transmitted to affect stock prices, and their relationship to each other all have an impact on a country's economic situation. In light of these problems, the VAR model and granger causality test are used in this paper to test the relationship between the Shanghai composite index and RMB exchange rate fluctuations. It is concluded that changes in China's stock market will have a certain impact on the exchange rate market, and the impact is one-sided. On this basis, the relationship between the index of different sectors and the exchange rate is further studied, and it is found that the correlation degree between them and the exchange rate is also different, and the influence degree of each is also different. This has guiding significance to anticipate the stock price change and deals with the exchange rate change's influence.

The remains of this paper is structured as follows. The literature review of the relationship between the exchange rate and the stock market in Section II, Then, the analysis of the exchange rate and the stock market in Section III, Section IV is the analysis of the transmission mechanism, Section V is the data source and data analysis, Section VI is the impact of the exchange rate on different sectors followed by the conclusion.

Ⅱ. Literature Review

Some scholars focus on exchange rates and the market index. He et al. (2013) use the SV - TVP – SVAR while Liu et al. (2015) uses the TAP - VAR model. Yang and Liu (2018) use the VAR model on the relationship between exchange rate and stock price and found that there is a time-varying component among the two, along with changing times and background; there also is asymmetry that exists between them and in the process of transfer, has certain hysteresis. However, Jiang (2018) found that the correlation between the two was not significant through the TVP-SP-VAR model. In addition, Shi (2019), using the copulas connect model, ARIMA model and ARIMAX model also analyzed the exchange rate and the benchmark Shanghai composite index, finding that the RMB exchange rate and the benchmark Shanghai composite index between dependency and exchange rate have great influence on the Shanghai composite index.

While another part of the scholars, on the basis of bilateral quantity, join the other variables, Wu and Fu (2014) use the TVP - SV - VAR model and Yao and Zhang (2016) use the MSVAR model. Tao and Fan (2018) use QFII, the TVP - SV - VAR model in addition to the RMB exchange rate and stock price.

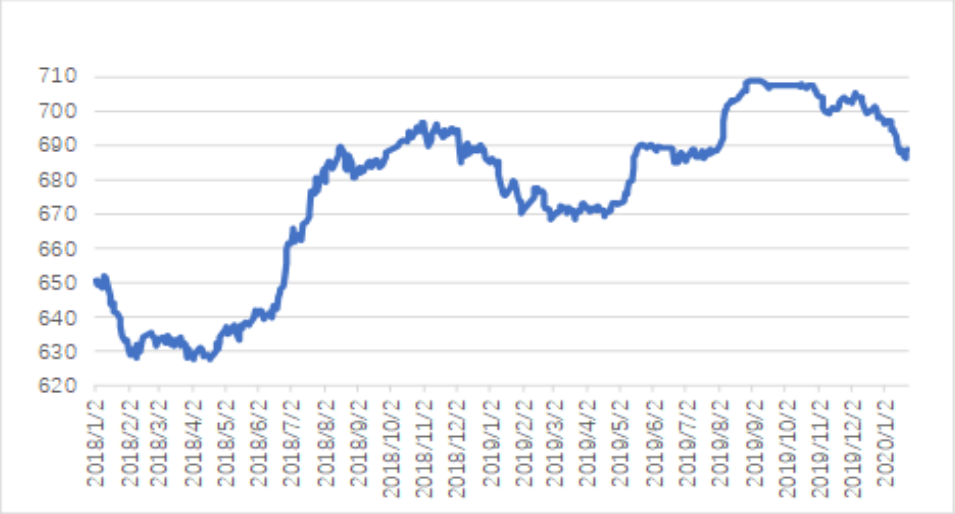
Capital projects for variables were analyzed, and they found that the opening of capital account will strengthen the impact of stock price, and is also among the changes with regard to time and background. Wang (2019) uses the TVP-SV-VAR model to introduce interest rate as the third variable, and finds that the interest rate has an inverse relationship with the stock price, while the exchange rate has a positive relationship with the stock price; however, the two have an obvious time-varying relationship on the stock price.

In general, scholars studied the two variables of the RMB exchange rate and stock price, or an additional third variable on this basis for analysis. The results all found that there was a correlation between the exchange rate, stock price and the third variable, and all of them have time variability.

Ⅲ. Analysis of the Current Situation of Exchange Rate and Stock Market

On March 23, 2018, after the United States announced a 25 percent tariff on $50 billion of Chinese goods which opened the door to a trade war between China and the United States, the exchange rate of RMB against the dollar fluctuated sharply during this period. Before the trade war turned to negotiation in November 2018, the central parity rate of the RMB against the US dollar depreciated from 6.28 to 6.96 from March 2018 to October 2018, with a fluctuation rate of 10.82%. After entering 2019, the RMB will continue to depreciate until break 7, and by the end of 2019 and early 2020, the RMB/USD central parity rate will recover to 6.88. The changes are shown in the following Fig. 1:

Fig. 1. Statement of Exchange Rate Changes



At the same time, we can introduce further the CFETS index to observe the change of RMB exchange rate. The virtue of the CFETS index is that it includes the index and a basket of currencies. On January 1, 2017, the CFETS basket, including 24 kinds of currencies including the dollar weight up to 22.4%, can eliminate the impact of the dollar index to a certain extent, which is more comprehensive to see the status of the yuan. The latest CFETS index will be implemented starting January 1, 2020. The currency category is unchanged while the weight has been changed, with the dollar still being weighted at 21.59%

at most. The change of the CFETS index is shown in the following Fig. 2:

Fig. 2. CFETS Index

As observed from the figure, the volatility of the CFETS index is quite drastic, which indicates that the trade war between China and the US has caused the participants in the exchange rate market to adjust their expectations, which is reflected in the sharp change of CFETS index, resulting in the adjustment of investors' expectations.

Meanwhile, from March 2018 to October 2018, the Shanghai composite index dropped from 3,152 points to 2,464 points, with a fluctuation rate of 21.8%. After entering 2019, the market index has recovered somewhat, floating between 2,700 points and 3,100 points. From the end of 2019 to the beginning of 2020, the volatility of the broad market index also narrowed further and stabilized between 2,900 to 3,000 points. However, in the specific events of the trade war process, the market index shows the event information effect, that is, the occurrence of the trade war and the escalation of the event show a negative impact, while the peace negotiations between the two sides or the anti-sanctions of the Chinese government send a positive signal.

At present, China still implements foreign exchange control, and China's capital and financial accounts have not been fully opened to the outside world. Most of the stock market is still dominated by domestic financial institutions or by some retail investors. At the same time, China's market is also accepting the government's partial intervention. However, China's financial openness has improved, and the correlation between the RMB exchange rate and the Shanghai composite index has gradually strengthened.

Ⅳ. Analysis of the Transmission Mechanism of Exchange Rate and Stock Price Linkage

The exchange rate has no direct influence on the stock price, but it has an indirect influence on the stock price through the interaction of various transmission intermediaries. From the micro level, the international competitiveness of changes will affect the real output of the country and the international trade balance, through the two factors influencing the securities market. Dornbusch and Fisher (1980) put forward the traffic model which emphasizes the relationship

between exchange rate and current account and at the same time, shows the current account has an assets accumulation effect. From the macro perspective, the change of stock price influences the currency price of the country through the transmission of capital, which conforms to the equity-oriented model proposed by Branson and Frankel (1983). Compared with the former, they emphasize the role of capital and financial account. In other words, the change of stock price affects the currency price of the country through the transmission of capital. Let's analyze how the intermediate factor of interest rate connects the exchange rate with the stock market and conducts the transmission between the two.

Table 1. Summary of Trade Events in CHN and USA

Time	Sino-US Trade Incident	Shanghai Composite Index
2018.3.9	The United States has formally imposed tariffs of 10 percent on Chinese exports of aluminum and 25 percent on steel	0.5705
2018.3.23	The United States has restricted Chinese companies from making acquisitions in the United States, China's commerce ministry has issued a list of counter-sanctions against $3 billion of us products	-3.3927
2018.4.4	The office of the United States trade representative (ustr) has released a 25 percent tariff list on $50 billion worth of Chinese exports, totaling 1,300 individual tariff items	-0.1760
2018.4.16	Zte was subject to a seven-year export ban	-1.5322
2018.5.3	The first round of trade talks between China and the United States	0.6388
2018.5.20	In the second round of trade talks between China and the United States, the two sides agreed to end the trade war	0.6431
2018.6.3	In the third round of trade talks between China and the United States has made positive progress	0.5220
2018.6.15	The us government officially announced a 25% increase in the tax rate on $50 billion worth of goods, which came into effect on July 6th.	-0.7312
2018.7.6	The Chinese government has announced the imposition of 25 percent tariffs on $50 billion worth of goods from the United States.	0.4882
2018.8.23	The fourth round of trade talks between China and the United States	0.3690
2018.8.23	The United States announced a 25 percent tariff increase on $16 billion worth of Chinese imports, while China implemented an anti-sanctions policy of the same size ($16 billion) and the same tax rate (25 percent).	0.3690
2018.11.1	Chinese prime minister met with the us delegation, and the trade war between China and the us entered a stage dominated by negotiation and consultation	0.1327
2018.12.2	The White House issued a statement, saying that the us and China have reached consensus on a number of issues, sending a positive signal.	2.5736
2019.2.21	The seventh round of high-level consultations between China and the United States has yielded breakthroughs on a range of issues.	-0.3411

According to Keynes' theory of flow preference, the interest rate has a great influence on the stock price, and the influence is negatively correlated. The mathematical expression is as follows:

$$P=\frac{D}{R-g}$$

Where P is the stock price, D is the expected dividend per share, R is the discount rate, and g is the annual growth rate of the dividend. However, the discount rate R also includes r and I, and the relationship is $R=r+i$, so the expression can be expressed as:

$$P=\frac{D}{r+i-g}$$

It can be seen that the stock price P and the market interest rate r have an inverse relationship.

The interest rate affects the operating condition of the enterprise by changing the production cost of the enterprise and then affects the stock price. At the same time, the interest rate can achieve the purpose of capital transfer or redistribution by changing the investment intention, so as to affect the stock price. In addition, interest rates can change the ratio of people's consumption to investment to change the demand in the stock market.

By adjusting the interest rate, it affects the size and direction of international capital flow, further affects the international demand for domestic currency, and thus influences the exchange rate level of domestic currency. However, this effect can also work in reverse; that is, the rise of the domestic currency interest rate will lead to the decline of spot exchange rate. Interest rates can also cause exchange rate changes by affecting market demand, but this effect is also reversed.

Exchange rate can also affect the stock price by affecting the performance of listed companies and the investment and withdrawal of international hot money in the stock market. At the same time, due to the different degree of internationalization of different industries, the response of exchange rate and interest rate to different industries is different, and the flow of capital between different sectors will also cause changes in stock prices.

In sum, the exchange rate and the conduction process of share price (interest rate as the medium) is as follows: when the exchange rate drops, promote products exports, and imports rising costs causes the domestic price level to rise. This results in a decline in the real interest rate temporarily, eventually making nominal interest rates rise, changing the investment direction of residents, reducing investment in the stock; in turn, this affects the stock market. When the exchange rate declines, the export of products is restricted and the cost of imported goods is reduced, leading to a temporary rise in the real interest rate, which eventually leads to a decline in the nominal interest rate, a change in residents' investment direction, and more capital is invested in the stock market, thus affecting the stock price.

V. Empirical Analysis of Data

1. Data source and Variable Selection

China has carried out several exchange rate reforms before 2015, resulting in a certain degree of deviation in the impact of exchange rate on stock prices. In order to avoid the impact of the results, this article selects January 1, 2016 to January 23, 2020 degrees data, including the yuan against the dollar, the Shanghai index (code: 000001), Financial index (code: 399240), Non-ferrous metals (code: 000819), China coal (code: 399998), National certificate steel (code: 399440). The reason why Financial index, Non-ferrous metals, China coal and National certificate steel are selected is that these industries have a high degree of internationalization. Through the analysis of these industries, we can see the impact of exchange rate on specific industries.

After removing the data lost due to the stock market closure, six groups of 991 observation points were observed in each group, totaling 5,945 observation points. The data of the exchange rate are from the National Bureau of Statistics, and the data of the Shanghai composite index and the weighted sectors are from the Netease Financial database.

Table 2. Variable

Variable	Meaning
E	The exchange rate
DE	The first difference of exchange rate
I	The Shanghai composite index
DI	The first difference of the Shanghai composite index
CO	Index of coal
DCO	The first difference of the coal index
F	Financial index
DF	The first difference of a financial index
M	Non-ferrous metal index
DM	The first difference of the non-ferrous metal index
S	The steel index
DS	The first order difference of the index of steel

Table 3. Descriptive Statistics

Variables	Mean Value	Standard Deviation	Skewness	Kurtosis
E	673.06	20.43	-0.35	-0.70
I	3029.90	226.42	-0.25	-0.47
CO	1502.65	210.15	0.41	-0.77
F	1068.10	125.90	-0.72	-0.40
M	4139.31	702.05	0.38	-0.62
S	1475.38	208.63	0.15	-0.72

According to the descriptive statistical characteristics, from the point of view of mean value and standard deviation, the fluctuation of exchange rate is more stable than that of the stock market, the financial index in the stock market is more stable than that of other sectors, and the volatility of non-ferrous metals is the most notable. In terms of skewness and kurtosis, compared with the normal distribution with skewness of 0 and kurtosis of 3, the Shanghai composite index, the financial index and exchange rate show the characteristics of left skewness, while other variables show the characteristics of right skewness, and all variables show the characteristics of thin tail, which do not conform to the normal distribution.

2. Preliminary Analysis

Fig. 3. Chart of Exchange Rate and Shanghai Composite Index

As can be seen from Fig. 3, there is a certain correlation between the exchange rate and the stock price, but the correlation is uncertain. Both positive correlation and negative correlation exist in the figure, and there is a certain time lag in the changes of the two. The two moves are partly the same and partly diverging, but violent swings always go hand in hand.

3. Empirical Analysis

3.1. Variable Stationarity Test

Since the data used are time series, in order to avoid the influence of non-stationary time series on the model results, we need to conduct a stationarity test on the data. In this paper, the ADF unit root test method is adopted.

Table 4. Unit Root Test

Variate	ADF	P	1% Confidence Level	5% Confidence Level	10% Confidence Level	Result
E	-1.2729	0.6440	-3.4367	-2.8642	-2.5683	non-stationary
I	-2.4622	0.1252	-3.4367	-2.8642	-2.5683	non-stationary

From this, we can see that both the exchange rate and the SSE composite index are non-stable data, so we conduct differential processing on the data. The ADF test was conducted after the first-order difference treatment of the two variables, and the results were as follows:

Table 5. Unit Root Test after First Order Difference

Variate	ADF	P	1% Confidence Level	5% Confidence Level	10% Confidence Level	Result
DE	-30.1364	0.0000	-3.4367	-2.8643	-2.5683	stationary
DI	-33.8049	0.0000	-3.4367	-2.8643	-2.5683	stationary

Table 6. Determining the Number of Lag Periods of VAR

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-6562.066	NA	2192.977	13.3688	13.3787*	13.3726
1	-6550.511	23.0394*	2159.492*	13.3534*	13.3832	13.3648*
2	-6547.676	5.6407	2164.623	13.3558	13.4055	13.3747
3	-6543.056	9.1748	2161.891	13.3545	13.4242	13.3810
4	-6540.209	5.6403	2166.978	13.3568	13.4465	13.3909
5	-6536.743	6.8548	2169.337	13.3579	13.4675	13.3996
6	-6534.199	5.0212	2175.781	13.3609	13.4904	13.4101
7	-6532.630	3.0889	2186.586	13.3659	13.5152	13.4227
8	-6528.613	7.8962	2186.512	13.3658	13.5351	13.4302

After the first-order difference of variables is made, the null hypothesis is rejected at the significant levels of 1%, 5% and 10% for all ADF values. Therefore, we can determine the variables DE and DI after the first-order difference as first-order integration. The purpose of this paper is to study the short-term changes between variables, and the sequence is stable, which meets the conditions of establishing the VAR model. The next step is to establish the VAR model.

3.2. The Determination of the Lag Period of VAR Model

The lag order of the VAR model is the key to establish it. In this paper, various information criteria and the majority principle are adopted to determine the optimal lag period.

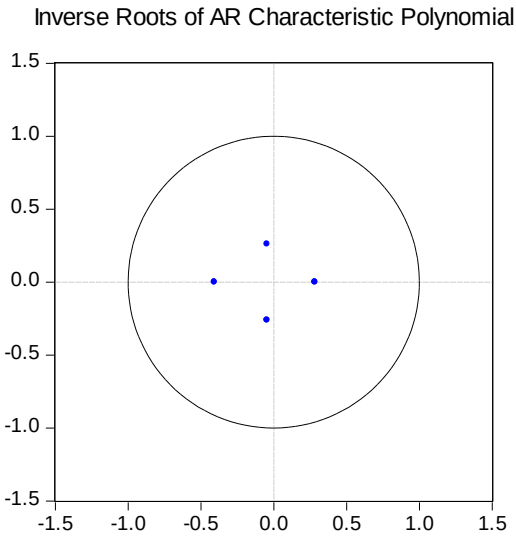
As can be seen from the table, according to the majority principle, the optimal lag stage of the VAR model is 1. The model expression is as follows:

$$Y_t = \begin{bmatrix} 0.0286 & 0.0058 \\ 0.7671 & 0.0682 \end{bmatrix} Y_{t-1} + \begin{bmatrix} -0.0076 & -0.0030 \\ -1.0040 & 0.0672 \end{bmatrix} Y_{t-2} + \begin{bmatrix} 0.0332 \\ 0.3813 \end{bmatrix}; Y_t = \begin{bmatrix} DE \\ DI \end{bmatrix}$$

3.3. Granger Causality Test

Before doing the Granger causality test, we need to determine the stationarity of the model, so we use AR root to test whether the model meets the conditions for the Granger causality test. The results are as follows:

Fig. 4. AR



As can be seen from fig. 4, the AR roots all fall within the unit circle, which indicates that the VAR model is stable. Next, we will conduct the Granger causality test on the VAR model to determine the significant relationship between variables. The results are as follows:

Table 7. Granger Causality Test

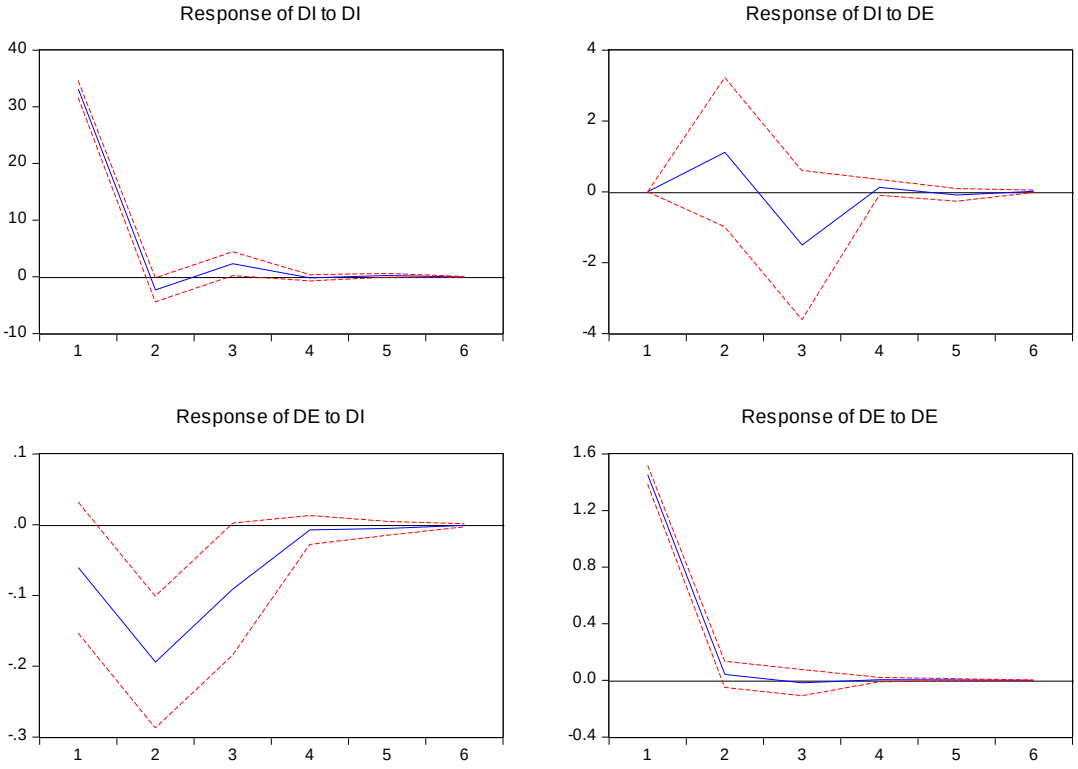
Hypothesis	F	P	Result
DE does not Granger cause DI	1.4756	0.2292	Accept
DI does not Granger cause DE	10.2400	0.0000	Reject

By the results can be found in the table, under the 1% significant level, the Granger causality shows a relationship between exchange rate and the benchmark Shanghai composite index, but the causal relationship between the two is one-way; the change of stock price to a certain extent, affects the rate of change.

3.4. Impulse Response

In order to clarify the dynamic change between the two, we need to conduct a dynamic analysis of the population; that is, an impulse response analysis to see how the variable changes under the impact.

Fig. 5. Impulse Response



As can be seen from Fig. 5, when DI was under its own impact, DI dropped from phase I 35 to the lowest point of phase ii -3 and then gradually recovered to phase iii when it reached 3 and the response weakened to phase iv 0. When DE was impacted by DI, DI immediately made a positive reaction in the first phase, reached its peak in the second phase, turned to a negative reaction, and reached the lowest point of -2 in the third phase. Then the negative effect gradually weakened, returned to the positive reaction and gradually disappeared in the fourth phase.

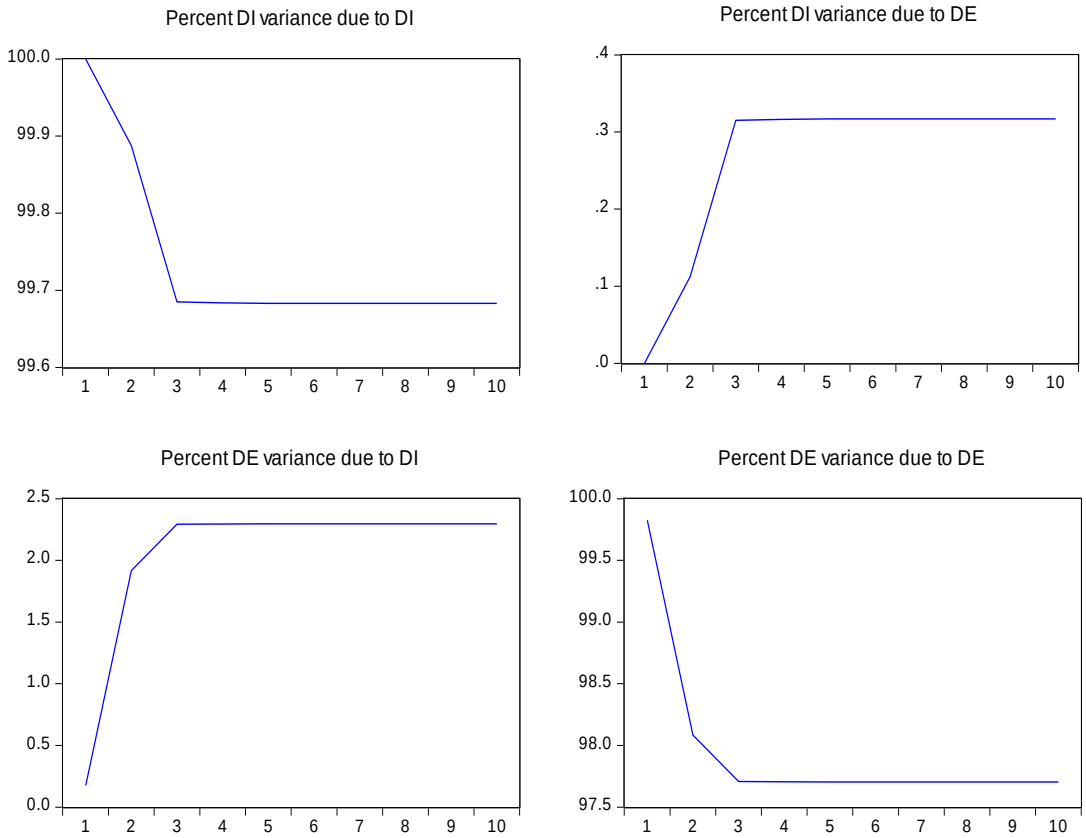
On the contrary, when DI is impacted by DE, DE changes sharply in the negative direction from stage 1 to stage 4, and gradually rises to 0 in the fourth stage after reaching the lowest point from stage 2 to stage 2, and then maintains a relatively stable state. However, such reactions are all negative, indicating that the influence of stock price on exchange rate is only negatively correlated in the short term. When DE was impacted by itself, it quickly dropped from the peak of 1.5 in the first phase to 0.1 in the second phase and gradually disappeared.

In conclusion, the exchange rate has, after the first stage, negative effects on the Shanghai composite index. The Shanghai composite index under the influence of the exchange rate is overall is essentially negative; two variables of impulse response at the same time is short, but not because someone is affected by the impact and cause long-term.

3.5. Variance Decomposition

In addition to the response when the variable is impacted, we need to know the weight change of the specific variable itself and other variables in the change, so the variance decomposition can be more intuitive and clearer.

Fig. 6. Variance Decomposition



As can be seen from Fig. 6, with the increase of the number of periods, the variation variance of the Shanghai composite index DI gradually decreased from 100% in the first period to 99.6% in the fourth period, and the value of the part explained by the change of exchange rate DE gradually increased, reaching a peak in the fourth period, i.e., about 0.3% of the variation variance was explained by DE.

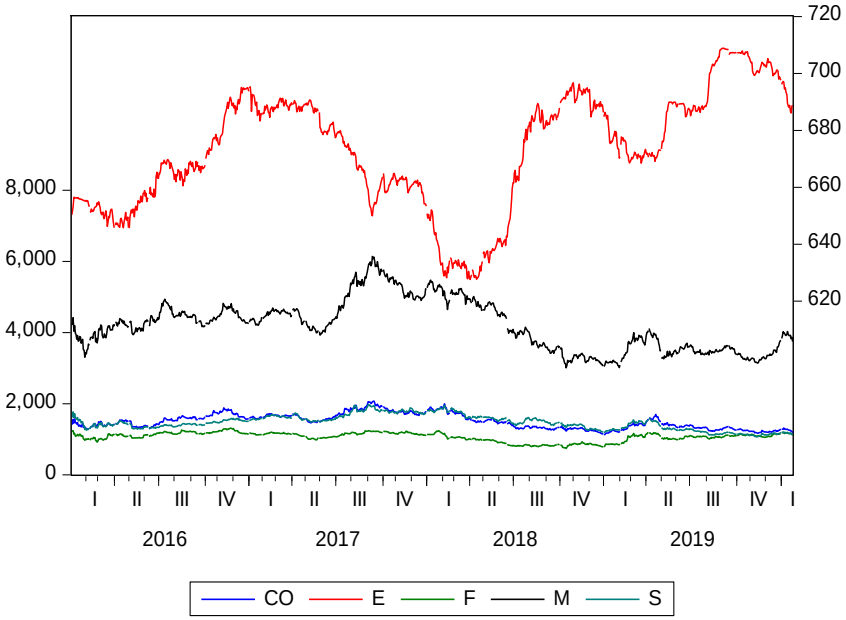
At the same time, with the increase of the number of periods, the variance change of exchange rate gradually increased from 0.2% in the first period. From the fourth period to the peak, namely, 2.3% of DE variance was explained by DI, while the part of DE variance explanation of its own changes decreased from 99.8% in the first period to 97.7% in the third period.

Ⅵ. Exchange Rate Fluctuations on the Weight of the Plate

In the section, only the market situation and the exchange rate from the Shanghai stock exchange are analyzed and the relationship between them is studied. There is no more in-depth analysis of the stock market; we will then discuss the influence of the exchange rates for specific industries, the selection of variables for the financial index (F), non-ferrous metal (M), the China steel index (S) and coal index (CO). The time selected is the same as the Shanghai composite index and the exchange rate, both of which are January 1, 2016, solstice, through January 23, 2020.

1. Preliminary Analysis

Fig. 7. Exchange Rate and Industry Sector Index Chart



As can be seen from Fig. 7, there is a certain relationship between non-ferrous metals and the trend of the exchange rate, while the trend of the other three industries is not very obvious. However, when the exchange rate fluctuates violently, all industries will fluctuate with the exchange rate. However, due to different degrees of internationalization, the degree of fluctuation is also different.

2. Empirical Analysis

2.1. Variable Stationarity Test

In order to avoid the influence of the non-stationary sequence on the established model, we need to conduct a stationarity test on the data. In this paper, ADF unit root test is used to find that the original data is not stationary. After making a first-order difference on the data, it is found that these weighted plates are integrated in the same order.

Table 8. First Order Difference Unit Root Test of Weighted Plates

Variate	ADF	P	1% Confidence Level	5% Confidence Level	10% Confidence Level	Result
DCO	-34.1491	0	-3.4367	-2.8643	-2.5683	stationary
DF	-33.1930	0	-3.4367	-2.8643	-2.5683	stationary
DM	-33.0236	0	-3.4367	-2.8643	-2.5683	stationary
DS	-33.8997	0	-3.4367	-2.8643	-2.5683	stationary

It can be seen from the table that the ADF values reject the hypothesis at all significant levels. At the same time, the variables are all integrals of the same order. The sequence is also stable, which meets the conditions of establishing the VAR model. The next step is to establish the VAR model.

2.2. The Determination of the Lag Period of VAR Model

Before establishing the VAR model, we need to determine the number of lag periods of the VAR model. However, the criteria and test methods used in many cases are not the same. Based on the synthesis of various criteria, this paper adopts the majority principle to determine the number of lag periods.

Table 9. The Number of Lag Periods of VAR Model

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-19266.01	NA	7.64e+10*	39.2485*	39.2734*	39.2580*
1	-19241.37	48.9905*	7.64e+10	39.2492	39.3986	39.3060
2	-19226.15	30.0895	7.80e+10	39.2692	39.5430	39.3733
3	-19210.96	29.8890	7.96e+10	39.2891	39.6875	39.4407
4	-19199.87	21.6969	8.18e+10	39.3175	39.8403	39.5164
5	-19185.93	27.1428	8.37e+10	39.3400	39.9873	39.5862
6	-19175.03	21.1287	8.62e+10	39.3687	40.1405	39.6623
7	-19160.07	28.8147	8.79e+10	39.3891	40.2854	39.7301
8	-19146.16	26.6557	9.00e+10	39.4117	40.4325	39.8000

It can be seen from the table that the optimal lag period of the VAR model is 0, and the model expression is as follows:

$$DE=\begin{bmatrix}-0.0043\\0.0364\\-0.0055\\0.0004\\0.0019\end{bmatrix}Y_{t-1}+\begin{bmatrix}0.0028\\-0.0095\\-0.0107\\0.0001\\0.0009\end{bmatrix}Y_{t-2}+0.0351;Y_t=\begin{bmatrix}DCO\\DE\\DF\\DM\\DS\end{bmatrix}$$

$$DCO=\begin{bmatrix}-0.0212\\0.2417\\0.0821\\-0.0127\\-0.0959\end{bmatrix}Y_{t-1}+\begin{bmatrix}-0.1000\\-1.1444\\0.1285\\0.0008\\0.0490\end{bmatrix}Y_{t-2}-0.3927;\quad Y_t=\begin{bmatrix}DCO\\DE\\DF\\DM\\DS\end{bmatrix}$$

$$DF=\begin{bmatrix}-0.0752\\0.4866\\-0.0137\\0.0368\\-0.0666\end{bmatrix}Y_{t-1}+\begin{bmatrix}0.0039\\-0.8604\\0.1073\\0.0009\\-0.0689\end{bmatrix}Y_{t-2}-0.1811;\quad Y_t=\begin{bmatrix}DCO\\DE\\DF\\DM\\DS\end{bmatrix}$$

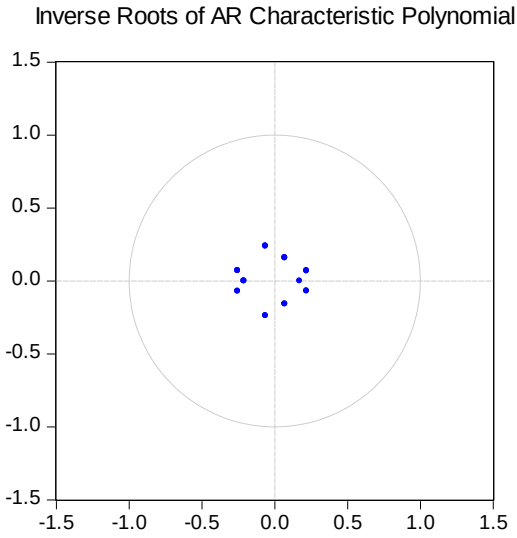
$$DM = \begin{bmatrix} -0.2153 \\ 2.9895 \\ 0.3899 \\ -0.0095 \\ -0.1345 \end{bmatrix} Y_{t-1} + \begin{bmatrix} -0.2418 \\ -2.9847 \\ 0.4535 \\ 0.0329 \\ -0.0437 \end{bmatrix} Y_{t-2} - 0.7983; Y_t = \begin{bmatrix} DCO \\ DE \\ DF \\ DM \\ DS \end{bmatrix}$$

$$DS = \begin{bmatrix} -0.0630 \\ 0.0735 \\ 0.0940 \\ 0.0070 \\ -0.0866 \end{bmatrix} Y_{t-1} + \begin{bmatrix} -0.0764 \\ -0.8807 \\ 0.1394 \\ 0.0011 \\ 0.0239 \end{bmatrix} Y_{t-2} - 0.6753; Y_t = \begin{bmatrix} DCO \\ DE \\ DF \\ DM \\ DS \end{bmatrix}$$

2.3. Granger Causality

Similarly, we need to determine the stability of the model before the Granger causality test, so we use the AR root to judge whether the model is stable or not. The results are as follows:

Fig. 8. AR



As can be seen from fig. 8, the AR roots all fall within the unit circle, which indicates that the VAR model is stable. In order to determine the causal relationship between variables, we conducted the Granger causality test on variables, and the results are as follows:

Table 10. Granger Causality Test

Hypothesis	F	P	Result
DE does not Granger cause DCO	2.0165	0.1337	Accept
DCO does not Granger cause DE	3.3943	0.0340	Reject

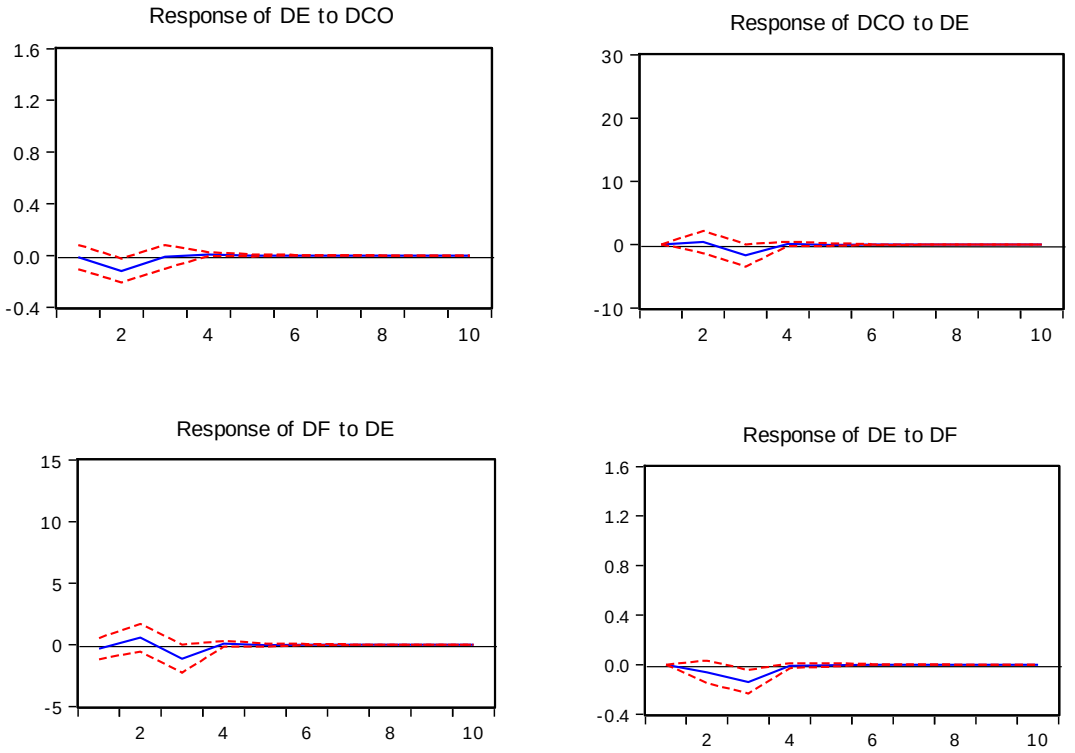
DE does not Granger cause DF	2.4214	0.0893	Reject
DF does not Granger cause DE	6.6535	0.0013	Reject
DE does not Granger cause DM	3.2214	0.0403	Reject
DM does not Granger cause DE	2.3365	0.0972	Reject
DE does not Granger cause DS	1.3221	0.2670	Accept
DS does not Granger cause DE	2.4178	0.0897	Reject

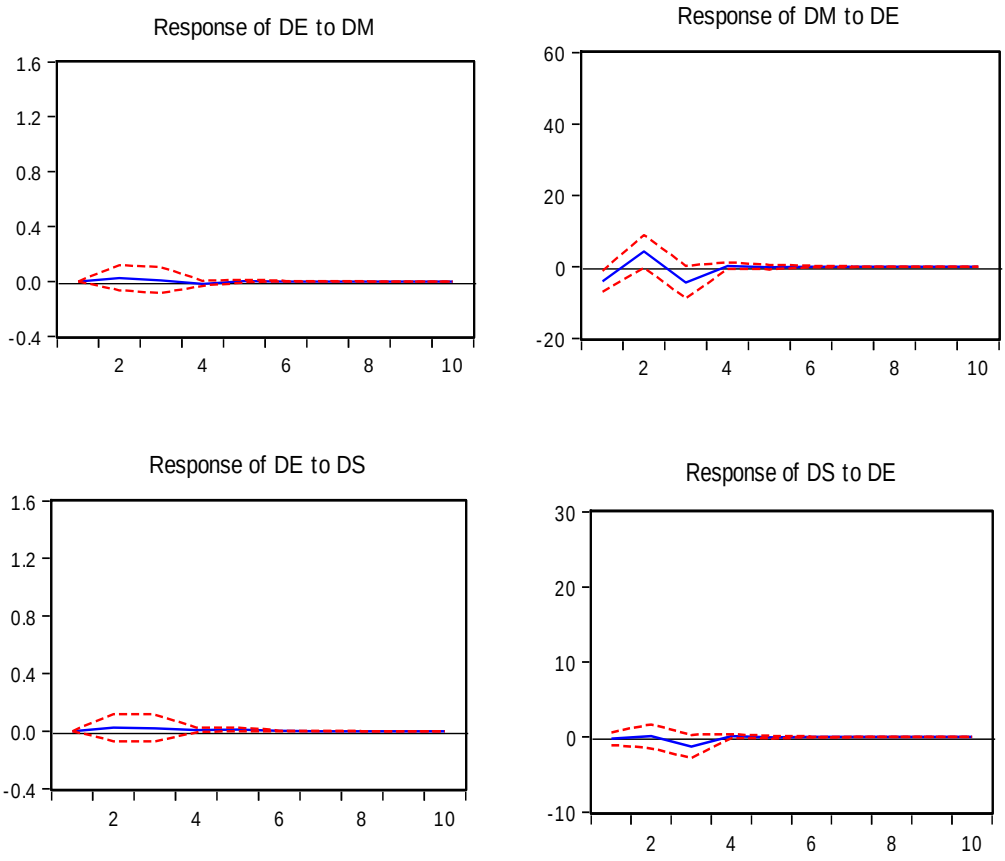
According to the table, at the significant level of 10%, there is a Granger causality between the exchange rate and the coal index, the financial index, the non-ferrous metal index, and the national steel index. Among them, the exchange rate and financial index and non-ferrous metal two plates is a two-way causal relationship, while the coal index and domestic steel two plates have a unilateral causal relationship on the exchange rate.

2.4. Impulse Response

Next, we made an impulse response to the VAR model to better observe the specific relationship between variables, and the results were as follows:

Fig. 9. Impulse Response





As can be seen from Fig. 9, when DE has an impact on DCO, DCO has a negative reaction in phases 2-4 and reaches its peak in phase 3; when DCO has an impact on DE, DE makes a rapid negative reaction in phase 1, reaches its peak in phase 2 and falls back in phase 3.

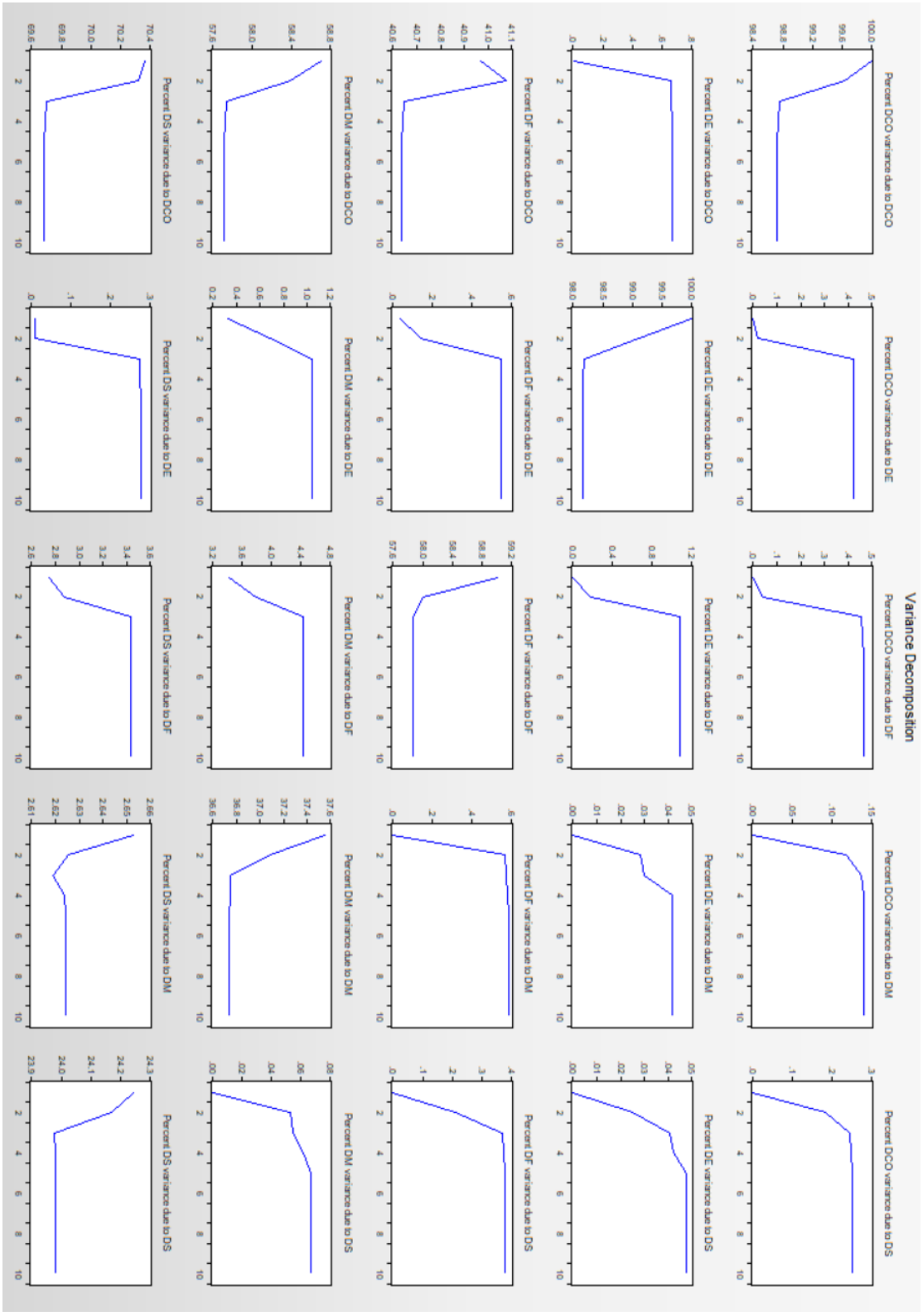
When DE has an impact on DF, DF makes a positive reaction in phases 1-2 and then quickly turns to a negative reaction. It reaches the peak in phase 3 and then falls back in phase 4. However, when DF makes an impact on DE, DE starts to make a negative reaction in phase 1 and gradually disappears in phase 4.

When DM and DS made an impact on DE, DE did not react violently, and only showed a slight positive change in phases 2-3. However, when DE made an impact on DM, DM quickly turned to a negative reaction after a peak of positive reaction in phases 1-2, and gradually disappeared in phase 4, resulting in a severe overall response. After DE makes an impact on DS, DS only has a slight negative reaction in phases 2-3. All of the above responses to shocks occurred within a period of 4 years, after which the fluctuation was reduced to a slight level and gradually disappeared.

2.5. Variance Decomposition

Similarly, we will observe the weight of each variable on the variance decomposition of other variables through variance decomposition:

Fig. 10. Variance Decomposition



Here Fig. 10 shows that in the variance decomposition diagram of DCO coal, coal fluctuation variance may be found by the changes in their own interpretation of proportion. It shifts in the first period from 100% to 98.7% in the fourth period; exchange rate DE, financial DF, the non-ferrous metal DM and steel DS are a part of the explanation for coal's respective increase from 0% to 0.41% in the third period, and the fifth issue of 0.46%, 0.13% and 2.5%.

Exchange rate DE is similar to coal in that the variance explained by itself decreases from 100% in the first phase to the lowest point of 98.2% in the fourth phase. Coal, finance, non-ferrous metals and steel increased from 0% in the first phase to 0.65% in the second phase, 1.1% in the fourth phase, 0.05% in the sixth phase and 0.45% in the sixth phase.

The variation variance of financial DF was mainly explained by itself and coal, which accounted for 57.8% and 40.65% of the lowest value in the fourth phase, respectively. The exchange rate, non-ferrous metals and steel accounted for 0.5% of the third phase, 0.59% and 0.38% of the fifth phase, respectively.

The variance variation of nonferrous metals and steel is explained by coal rather than by itself. Coal accounted for 58.7 percent and 70.36 percent, respectively, in the first phase. By the time of the fourth phase, it had dropped to its lowest points of 57.72% and 69.68%, respectively. The explanatory part of the difference between oneself and the other side changes, respectively, decreased after the third phase accounting for 36.74% and 23.98%.

Ⅶ. Conclusion

Through the use of the unit root test, the VAR model and the Granger causality test along with other measurement methods, this paper studies the exchange rate change between RMB and the US dollar and the stock price change in China, and comes to the following conclusions:

Share prices are a one-way Granger causality of exchange rates. As the yuan becomes more internationalized, stock market movements that reflect China's economic situation further affect the exchange rate. At the same time, accompanied by some systemic risks brought by political factors, the impact of exchange rate fluctuations on the stock market will be further weakened.

When the RMB exchange rate changes, many foreign capital will not choose to directly invest their money in China's stock market, but in the real economy. The production of the real economy, sales and other links need time. From this, the reflection of the stock market has a certain lag.

From the perspective of the weighted sectors, the financial index and the non-ferrous metals have a two-way Granger causality with the exchange rate, among which the non-ferrous metals have a more dramatic impact on the exchange rate, while the steel and coal index have a one-way Granger causality with the exchange rate.

In this context, the Chinese government should continue to promote the market-oriented reform of interest rates, increase the regulatory role of interest rates on stock prices, and strengthen the international liquidity and voice of RMB, so as to achieve the linkage effect between foreign exchange and the stock market.

At the same time, in order to avoid the short-term volatility of the stock market and too much impact on the foreign exchange market, related institutions can open abundant foreign exchange options, futures and other financial derivative products, allowing qualified institutions and reasonable use of these derivatives, give full play to its function of avoiding risk, but also increase the liquidity of the market. In addition, a multi-tiered capital market should also be developed so that the transmission of foreign exchange risks will not be concentrated in the stock market, but in various financial markets.

Finally, the Chinese government should diversify the foreign exchange market. The central bank should reduce its direct intervention and relax the requirements for foreign investors to some extent so

that qualified foreign investors can participate and so that industrial and commercial enterprises, non-bank financial institutions and commercial banks can play a more positive role. Diversified subjects can also increase market competition, improve the quality of trading products and the efficiency of trading process.

References

Chai, J. L. (2019). *Study on the impact of the trade war between China and the United States on the yield and volatility of RMB exchange rate* (Master's Thesis), Beijing: China Foreign Affairs University.

He, C. Y., Liu, L., Xu, X. Y.,& Wang, Z. H. (2013). Foreign intervention, exchange rate movements and stock price fluctuations: Theoretical model and empirical study based on investor's heterogeneity. *Economic Research Journal, 48*(10), 29-42, 97.

Jiang, C. (2018), *Research on the Connection between Interest Rate, Exchange Rate and Volatility of Chinese Stock Market* (Doctoral Dissertation), Anhui, China: Aanhui University of Finance and Economics.

Liu, L., Meng, Y., & Yang, K. (2015). Structural change, RMB exchange rate and China's equity price: Theoretical analysis and empirical study", *Studies of International Finance*, 2015(5), 3-14.

Shi, Y. (2019). Correlation analysis of stock price and RMB exchange rate: Based on Copula-ARIMA model. *Journal of Shanxi Finance and Economics University, 41*(S2), 14-19.

Sina Financial Futures Daily (2016, 4). Analysis of the transmission mechanism between exchange rate and stock price.

Tao, S. G., & Fan, J. Y. (2018). The dynamic relationship between QF II, RMB exchange rate and stock prices: An empirical test based on TVP-SV-VAR Model. *Shanghai Economic Review, 2018*(2), 61-73.

Wang, H. Y. (2020). Study on the time-varying relationship between interest rate, exchange rate and stock market: Test of TVP-SV-VAR model. *China Business & Trade, 2020*(1), 45-47.

Wang, J. Q. (2017). *A study on the correlation between exchange rate changes and stock market prices in China: Based on quantile regression* (Master's thesis), Jiangsu, China: Nanjing University.

Wu, L. H., & Fu, G. M. (2014). RMB exchange rate, short-turn capital flows and stock price. *Economic Research Journal, 49*(11), 72-86.

Xiong, Y. L. (2018). *The study of the correlation between RMB exchange rate and Shanghai composite index* (Doctoral Dissertation), Yunnan, China: Yunnan University of Finance and Economics.

Yang, Z., & Luo, Y. (2018). The capital market transmission mechanism of RMB exchange rate to the real economy: Empirical research based on VAR model. *Securities Futures of China, 2018*(6), 69-79.

Yao, Z. Q., & Zhang, Y. J. (2016). The influence of RMB exchange rate reform and capital account opening on the development of stock market. *Economic Review, 2016*(7), 79-87.