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Effects of the No-plastic-bag Policy on Impulse Buying Behavior

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Abstract

While addressing the environmental issue concerning nonbiodegradable waste, the no-plastic-bag policy also has an economic impact on the retail sector as it potentially reduces impulse buying behavior. This study uses questionnaires to examine factors affecting impulse buying and test the effect of the no-plastic-bag policy on impulse buying in Chiang mai, Thailand. As the no-plastic-bag policy is already implemented in all convenience stores, the study cannot collect data on the controlled group where buyers can still get free plastic bags. Therefore, this study uses the bring-your-own-bag (BYOB) behavior as a proxy for the no-plastic-bag policy. Realizing the potential self-selection biases of the BYOB behavior, the impact is estimated using the endogenous treatment effect model. The results show that people who bring their own bags make 19.2 percent more impulse purchases than those with no bag. This indicates that the no-plastic-bag policy significantly reduces impulse buying behavior. In addition to the key objective, this study also examines factors influencing buyers' decision to bring their bags to shop. The results indicate that those who bring bags do it due to the deontological rather than teleological ethical evaluation. The BYOB campaign has been implemented. The results suggest that the campaign's performance can be improved by focusing on developing a sense of moral obligation to reduce nonbiodegradable waste. The successful BYOB campaign can reduce the negative impact from the impulse buying reduction and induce the stores to continue supporting the no-plastic-bag policy.

Keywords: Impulse buying, no plastic bag, bring your own bag, endogenous treatment effect

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1. Introduction

Retail is one of the important sectors in Thailand. According to Statista (2021), retail sales in 2018 were worth USD 113.5 billion and accounted for 22.4 percent of GDP. In addition, the growth of the retail sector is interesting. From 2011 to 2018, the retail sector grew approximately 13 percent to USD 13 billion (Statista, 2021). Since the retail sector significantly impacts the economy, a vital part of the retail store's revenue is unplanned purchasing or impulse buying. The literature has studied impulse buying for many decades. According to Stern (1962), impulse buying or unplanned purchasing increased every year and about 40 to 50 percent of purchasing was unplanned. If 40 to 50 percent of the value of the purchasing seems to be big, it would be surprising because not just in the past but also in recent decades. Using the data from the Point of Purchase Advertising Institute (POPAI) in 2012, Suryawardani et al. (2017) showed that 76 percent of in-store purchasing was by impulse purchasing, a 70 percent increase compared to 1995. It meant impulse buying had a significant impact on the revenue of in-store purchasing and the buyers' behavior.

Due to environmental concerns, Thailand launched a no-plastic-bag policy on January 1, 2020. Ministry of Natural Resources and Environment stated that Thai people use about 45,000 million plastic bags per year, or each Thai uses eight plastic bags per day (BLTbangkok, 2019). According to the announcement of the vice president of the Chamber of Commerce in February 2020, many department stores, retail stores, and convenience stores were impacted after the no-plastic-bags policy had been introduced. Their sales revenue was obviously reduced because the buyers bought fewer products, especially those who forgot to bring their own bags (Thairath, 2020).
The study was done in Chiang Mai, Thailand where is the researchers' hometown also the important business city of the Northern part of Thailand, as well as because of the limitation of budget and the pandemic of the COVID-19 virus. This study collected a survey to test and measure the effect of the policy on impulse buying. Specifically, this study examines factors determining impulse buying behavior and the effects of the no-plastic-bag policy in Ching mai, Thailand on impulse buying behavior. As the no-plastic-bag policy is already implemented in all convenience stores, the study could not collect data on the controlled group where buyers can still get free plastic bags. Therefore, this study uses the bring-your-own-bag (BYOB) behavior as a proxy for the no-plastic-bag policy. Realizing the potential self-selection biases due to the BYOB behavior, the impact is estimated by the linear regression with endogenous treatment effect model, which is the treatment-effects model developed by Rees and Maddala (1985). As a result of the estimation, the model can also examine factors affecting the BYOB behavior. This study also gives insight into the environmental consciousness and practical factors affecting the BYOB shopping behavior from the BYOB selection equation. The result of this study could help convenience stores whose revenues are affected by the no-plastic-bag policy to understand the impact of the no-plastic-bag policy on impulse purchasing and improve their strategies.

In addition, there are two methods to measure impulse buying that are the direct survey method asking for the percentage of unplanned to total purchase (Stern, 1962)

and the Buying Impulsiveness Scale (BIS) method (Rook & Fisher, 1995). This study compares two impulse buying measurement methods, an academic contribution to further study impulse buying.

2. Literature Review

2.1 Definition, types and measurements of impulse buying

Impulse buying, which can generally be called unplanned buying, is a buying behavior where the buyers buy a product that they did not plan to buy before. It is related to how easily the buyer can buy the products. According to Stern (1962), impulse buying can be classified into four types. First, pure impulse buying happens when the buyers buy other products that are not in their shopping plans by the emotional spark to the products. Second, reminder impulse buying occurs when buyers realize that they need to buy the products from their experience. The third suggestion impulse buying happens when the buyers see the products for the first time and realize that they need them, even though they have no experience or knowledge. Last, planned impulse buying arises when the buyers plan to buy some products. However, they also expect and intend to buy other products that depend on special prices, coupon offers, and other sale promotions.

There are two main approaches to measure impulse buying. The first is the ratio of unplanned purchase to total purchase expenditures, which was proposed by Stern (1962). For the survey process of this approach, buyers are asked what they intend to buy prior to the shopping trip and are asked again what they actually buy after their shopping trip. The impulse buying can be calculated from the spending gap. The second approach is to measure using the Buying Impulsiveness Scale (BIS) developed by Rook and Fisher (1995). The BIS has nine indicators based on impulse buying phenomenology (Rook, 1987) and the general measures of impulsiveness (Eysenck & McGurk, 1980). (See Table 2 for the BIS indicator list.)

2.2 Factors for impulse buying

For the factors influencing impulse buying, Ganesan and Bhakat (2013) reviews 34 studies on impulse buying behavior and summarizes that there are four main groups of factors including external stimuli, internal stimuli, situational factors, and demographics socio-cultural factors, which is consistent with Stern (1962).

For the external stimuli, the main factors are store characteristics, such as instore display and store ambient, that the seller can control to induce the buyers' buying behavior (Applebaum, 1951; Suryawardani et al., 2017). The instore display factors are such as point of purchase display or attractive shelf display (Sulatana & Uma, 2014) and the store ambient factors are such as color, window decoration music and crowd (Ganesan & Bhakat, 2013; Suryawardani et al., 2017). In addition, the external factors also include sale promotion and social interaction, such as the presence of peers and family (Luo, 2005; Husnain et al., 2019).

H1: External stimuli including instore display, store ambient, sale promotion and the presence of peers and family have positive impacts on impulse buying.

Internal stimuli are the internal characteristics of the individual buyers that influence the buyer to buy the products impulsively rather than the shopping environment or the external stimuli (Bhakat, 2013). Positive emotions, such as happiness and enthusiasm, leads to more impulse buying (Chang et al., 2011; Selton et al., 2021).

H2: Internal stimuli including happiness and enthusiasm have positive impacts on impulse buying.

Situational factors are buyers' limitations such as time and money. Buyers with more money and time tend to impulse purchase more (Jeffrey & Rebecca, 2007; Sulatana & Uma, 2014; Husnain et al., 2019).

H3: Situational factors including time and money availability have positive impact on impulse buying.

For buyers' demographics, the difference in education, culture, gender, and income can lead to the difference in the level of impulse purchasing; for example, the low-income household tends to have impulse purchasing (Dittmar & Susanne, 1995; Wood, 1998).

H4: For demographics, women with low education and low income are likely to impulse purchase more.

2.3 Factors for bring your own bags (BYOB) behavior

According to Chan et al. (2007), factors that influence buyers to bring their own bags include two basic moral philosophies, which are deontological and teleological ethical evaluations. Deontological ethical evaluation is an action that considers the moral good of the action itself, not because of the consequence of that action, such as the buyers bring their own bags because they think that it is a duty to bring. On the other hand, teleological ethical evaluation, or it can be called consequentialist ethics or consequentialism, is the evaluation base on the consequence of the action; for example, the buyers bring their own bags because they care about the environment or want to reduce unnecessary waste (Chan et al., 2007).

H5: Deontological ethnics including duty and moral for environment have positive impacts on BYOB behavior

H6: Teleological ethnics including reducing unnecessary waste and providing better living environment for future generation have positive impacts on BYOB behavior.

In addition, Lam and Chen (2006) suggests that self-efficacy or practical evaluation, which are the evaluation whether the buyers can carry out the intended action, also influences the buyers to bring their own bags. The factors are such as when buyers think that it was not hard for them to bring their own bags, they will bring their bags and reuse plastic bags at home instead of buying bags.

H7: Practical evaluation including ease to bring bags and intention to buy large volume have positive impacts on BYOB behavior.

2.4 Effects of no-plastic-bag policy

No-plastic-bag policies have been implemented in many countries. The policy impacts have been examined by many studies in Malaysia, which implemented the no-plastic-bag policy every Saturday. As a result of the policy, Zen et al. (2013) shows that the sale revenue decreased by 30 percent during the first six months because the buyers rearranged their shopping plan to Sunday. Approximately 55 percent of buyers forgot to bring their own bags more than two out of five times on shopping trips. From Assuni et al. (2015), only 28.75 percent of the participants bring their own bags on plastic bag ban day and 52.3 percent avoided paying for the plastic bag levy by using other methods to carry their goods such as hands, pockets, handbags, as well as trolleys. Although there is no study directly evaluating the policy impact on impulse buying, it is likely that a part of the revenue reduction can be due to the impulse buying reduction.

H8: No-plastic-bag policy has a negative impact on impulse buying.

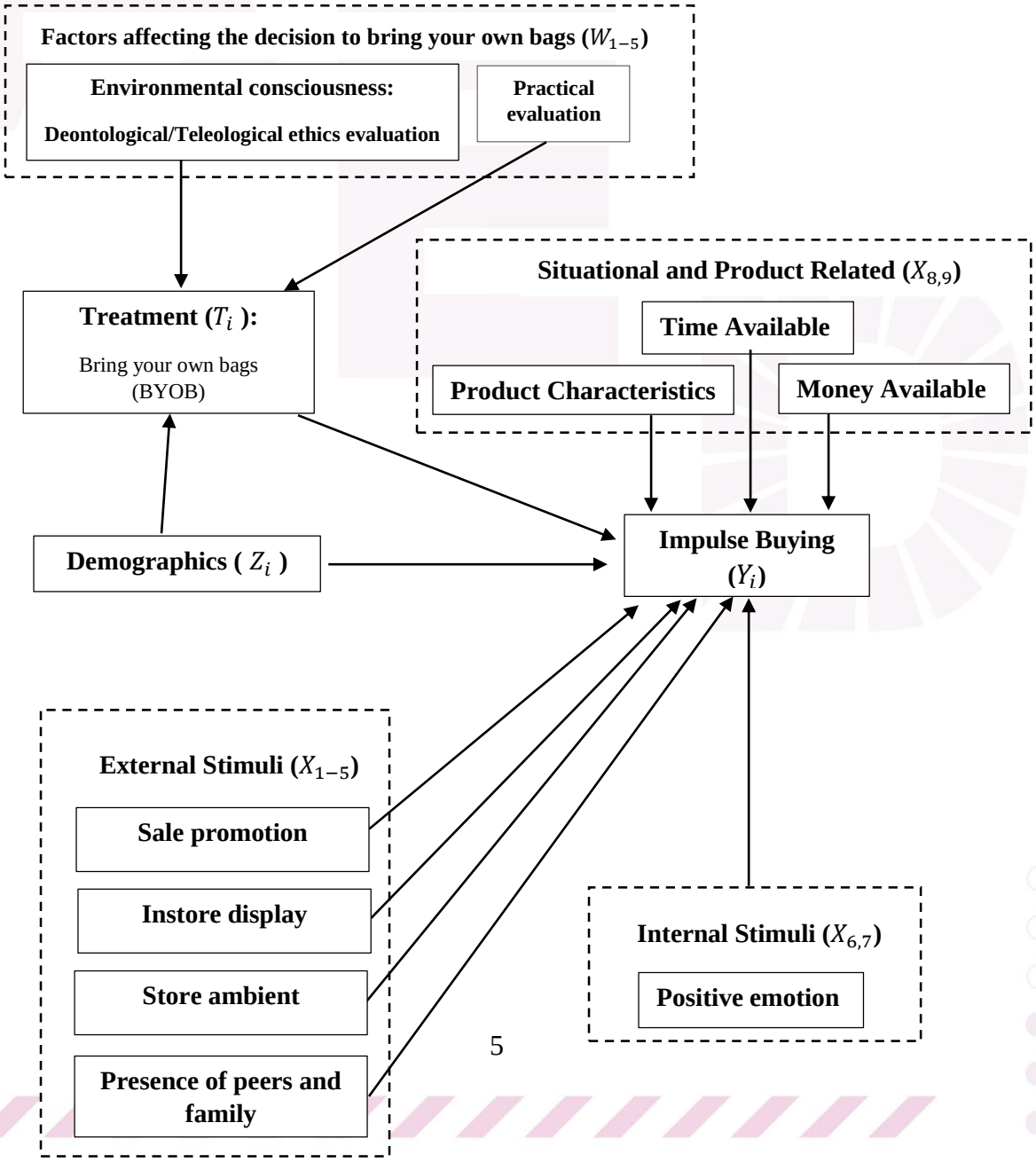


Figure 1 Conceptual framework
Note: (1) Factors affecting impulse buying include 1. External Stimuli 2. Internal Stimuli 3. Situational and Product Related 4. Demographic (Stern, 1962)
(2) Factors affecting bring your own bags include 1. Deontological ethics evaluation 2. Teleological ethics evaluation 3. Practical evaluation (Chan, Wong, and Leung, 2008).

3. Methodology

This study collected a survey to measure the impact of the no-plastic-bag policy on impulse buying behavior using the endogenous treatment effect model with the bring-your-own-bags (BYOB) behavior as a proxy for the policy treatment. In the estimation process, this study also answers three sub-objectives, which are to (1) identify factors determining the bring-your-own-bags (BYOB) behavior, (2) identify factors determining the impulse buying behavior, and (3) compare two measurements of impulse buying. The survey and methodologies for the three sub-objectives are as follows.

3.1 The Survey

The questionnaire used in this study has five parts. The first part is demographics factors. The second part is the information about the shopping trip, such as shopping time, spending on this trip, planned purchase value, and unplanned purchase value. The third part is the factors influencing impulse buying, such as external and internal stimuli. The fourth part is the bring your own bags (BYOB) factors, including deontological ethics, teleological ethics, and practical evaluation. The last part is the nine questions to measure Buying Impulsiveness Scale (Rook & Fisher, 1995).

As some standard questions used in this study were published in English and the survey was collected in Thai language, professional translators conducted a back-to-back translation to ensure that the questions were consistent with the literature. Moreover, this study conducted 30 pilot surveys to pretest all the questionnaire surveys with the target group with different ranges of demographics such as age and sex. Cronbach's alpha was used to measure the internal consistency or the reliability of the variables.

For the survey, 394 samples were collected from 40 retail stores in the city of Chiang Mai in January and February 2021. The respondents were interviewed immediately after finishing their shopping trips to avoid the possibility that the buyers would forget their shopping information.

3.2 Regression analysis

$$T_i = \begin{cases} 1, & if\ W_1\delta_1 + W_2\delta_2 + W_3\delta_3 + W_4\delta_4 + W_5\delta_5 + Z_1\gamma_1 + Z_2\gamma_2 + Z_3\gamma_3 + Z_4\gamma_4 + u_i > 0 \\ 0, & otherwise, \end{cases}$$

Model 1 (Probit): Factors determining bring-your-own-bags (BYOB) shopping behavior can be estimated using the following Probit model.

Where T_i is the treatment for BYOB and deontological ethnics evaluation variables include duty (W_1) and moral (W_2). Teleological ethics evaluation variable includes better environment (W_3). Practical valuation variables include large volume purchasing (W_4) and the ease to bring their own bag (W_5). Demographics variables include female (Z_1), marital status (Z_2), average monthly income variable (Z_3) and highest education (Z_4).

Model 2 (Endogenous treatment): Factors determining impulse buying behavior and the effects of the no-plastic-bag policy in Chiang mai, Thailand on impulse buying behavior can be estimated using the following endogenous treatment model.

$$Y_i = \alpha T_i + X_1\beta_1 + X_2\beta_2 + X_3\beta_3 + X_4\beta_4 + X_5\beta_5 + X_6\beta_6 + X_7\beta_7 + X_8\beta_8 + X_9\beta_9 + Z_5\gamma_5 + \epsilon_{i,}$$

$$T_i = \begin{cases} 1, & if\ W_1\delta_1 + W_2\delta_2 + W_3\delta_3 + W_4\delta_4 + W_5\delta_5 + Z_1\gamma_1 + Z_2\gamma_2 + Z_3\gamma_3 + Z_4\gamma_4 + u_i > 0 \\ 0, & otherwise, \end{cases}$$

The dependent variable Y_i represents impulse buying, which is the ratio of unplanned purchase expenditure to total expenditure. The independent variables determining impulse buying include External stimuli, Internal stimuli, Situational factor and demographic. External stimuli variables include coupon (X_1), attractive shelf display (X_2), Odor and music (X_3), crowd (X_4) and presence of peers and family (X_5). Internal stimuli variables include enthusiastic (X_6) and happiness (X_7). Situational factor variables include time available (X_8) and money available (X_9). Demographic variable includes number of children (Z_5). This model is developed by Rees and Maddala (1985) and estimated using *etregress* (StataCrop, 2021).

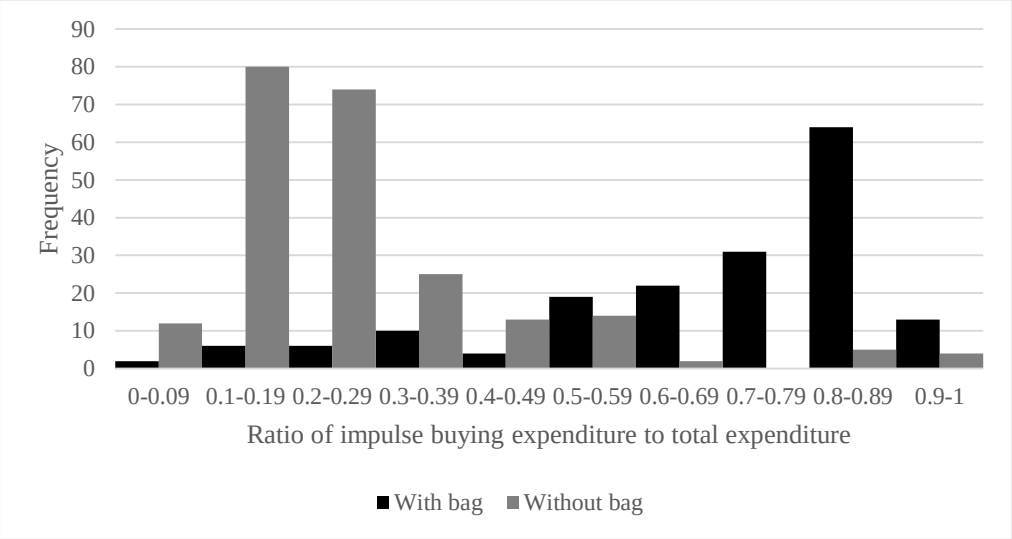
Model 3 (OLS): Comparing two impulse buying measurement methods, which are (1) the direct survey method asking for the percentage of unplanned to total purchase and (2) the Buying Impulsiveness Scale (BIS) method.

$$Y_i = \beta_0 + \beta_1 BIS1 + \beta_2 BIS2 + \beta_3 BIS3 + \beta_4 BIS4 + \beta_5 BIS5 + \beta_6 BIS6 + \beta_7 BIS7 + \beta_8 BIS8 + \beta_9 BIS9 + \epsilon_i$$

where BIS is the Buying Impulsiveness Scale (BIS) method, which is a set of nine questions that respondents can identify the level of agreement between one to five. For the questions, BIS1 is “I often buy things spontaneously”. BIS2 is "Just do it describes the way I buy things”. BIS3 is “I often buy things without thinking”. BIS4 is "I see it, and I buy it describes me”. BIS5 is "Buy now, think about it later describes me”. BIS6 is “Sometimes I feel like buying things on the spur of the moment”. BIS7 is “I buy things according to how I feel at the moment”. BIS8 is “I carefully plan most of my purchases”. Lastly, BIS9 is “Sometimes I am a bit reckless about what I buy”.

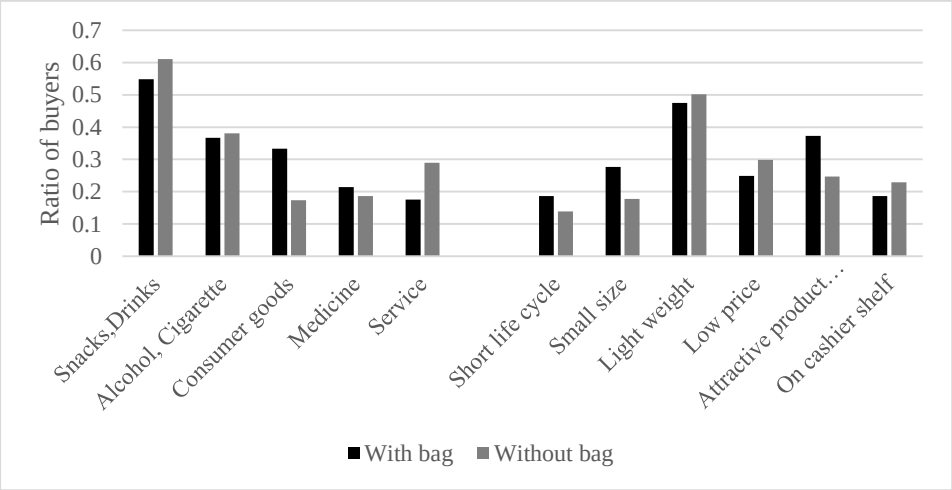
4. Results

For the survey respondents' characteristics, 55 percent were female with the average age of 34 years old and an average monthly income of THB 14,106. The majority of the respondents had at least a bachelor's degree. For the shopping behavior, the average shopping time was 12 minutes, 33.25 percent of the buyers shopped alone in this shopping trip and the average spending was THB 172.93.



Graph 1: Ratio of impulse buying expenditure to total expenditure of buyers with and without a shopping bag

This study uses the ratio of impulse buying, which is the amount of impulse buying over total spending on the shopping trip. On average, buyers impulse purchase 45.4 percent of their total purchase. In this study, buyers are classified into two groups: buyers who bring their own bags and those who do not bring their own bags. Buyers with bags impulse buy 66.3 percent of their purchases, while buyers without bags impulse only 27.9 percent. The distribution of the impulse buying ratio differs significantly between the two groups. From Graph 1, the majority of buyers with bags (52 percent) impulse purchase 70-90 percent of their total spending. In contrast, most buyers without a bag (66 percent) only impulse purchase 10-30 percent of their total spending.



Graph 2: Ratio of buyers (with and without shopping bag) who impulse purchase by product types and characteristics

For both buyers with bag and without bag, the main types of products that buyers impulse purchase the most were snacks/drinks and alcohol/cigarettes. Overall, 58.3 and 37.5 percent of the buyers reported to impulse purchase snacks/drinks and alcohol/cigarettes, respectively. For other product types, buyers with bag and without bag have different tendencies to impulse purchase. Specifically, buyers who brought their own bag tended to purchase more buyer goods than those without bags. In contrast, the buyers who did not bring their own bag impulse purchased more services than buyers with bags.

For product characteristics, both buyers with bag and without bag reported that lightweight is the key character. When interviewed, 49 percent reported to impulse purchase products with light weight. For other characteristics, buyers who brought their own bag tended to impulse purchase more products with short life cycle, small size, and attractive product display compared to the buyers without bag. In contrast, a buyer who did not bring their own bag tended to impulse purchase products with low price and were presented on the cashier shelf.

Factors determining BYOB behavior: The Probit model was used to examine the effects of the environmental consciousness and demographic factors on bring-your-own-bags (BYOB) shopping behavior. Demographic factors that have statistically significant impacts on the BYOB behavior are female and college educated. Females are 68.8 percent more likely to bring a bag to shop comparing to male. Moreover, people with a college degree are 44.4 percent more likely to bring a bag than those with no college degree. The environmental consciousness factors found that the deontological ethics evaluation, which is the evaluation based on the action of BYOB (moral or duty), has more significant effects than the teleological ethics evaluation, which is the evaluation based on the consequence of BYOB. In particular, a higher level of agreement that the BYOB is the morally right thing to do leads to a 42.8 percent increase in the likelihood of BYOB. For the teleological ethics evaluation, a higher

level of agreement that the BYOB is providing a better living environment for future generations leads to a 20.2 percent increase in the likelihood of BYOB. In addition, practical reasons are also highly significant. Specifically, those who plan to make a large volume purchase or find that bags are easy to bring are 37.8 and 35.9 percent more likely to bring their bags.

Factors determining impulse buying behavior: From the endogenous treatment effect model, the factors affecting impulse buying are categorized into external stimuli, internal stimuli, situational and product-related factors, and demographics. The external stimuli that significantly affect impulse buying behavior are the odor and music, a crowd in the shop, and peer presence while shopping. The external factor that has the most considerable effect was the peer presence, which leads to a 2.89 percent increase in the percentage of impulse buying expenditure to total expenditure. For internal stimuli, factors that affect impulse buying are enthusiasm and happiness. For the internal stimuli with the highest impact, a level higher of enthusiastic feeling while shopping leads to a 3.71 percent increase in the percentage of impulse buying expenditure. Significant factors include time spending on shopping, self-payment, and attractive shelf display for the situational factors. The self-payment factor has the highest impact of 14.5 percent. For the demographic factors, significant factors are education and income. While people with a higher income tend to impulse purchase more, people with a college degree impulse purchase less by 3.73 percent. For the key result for the no-plastic-bag policy evaluation, this study found that people who bring their own bags make 19.2 percent more impulse purchases comparing to those with no bag. This indicates that the no-plastic-bag policy significantly reduces impulse buying behavior. The model was estimated using maximum likelihood method, the Wald Chi-squared statistics was 854.93 (p-value is 0.0000). The AIC and BIC were -66.79301 and 44.54482, respectively.

Impulse buying measurement comparison: This study estimates the correlation between the unplanned to total purchase ratio and each of the nine variables used to construct the Buying Impulsiveness Scale (BIS). As shown in Table 2, BIS 1, BIS 2, BIS 3, BIS 4, BIS 5, BIS 7, and BIS 9 are statistically significant with an R square of 0.56. The indicators with the highest correlation to the unplanned purchase ratio are BIS3, BIS1, and BIS9, indicating that buyers who spend large money on unplanned purchases consider themselves buying things without thinking spontaneously and can be a bit reckless about what they buy.

Table 1. Factors determining BYOB behavior and impulse buying behavior

Variables	Probit for Bringing bag	Endogenous Treatment (Impulse buying)
Demographics: Female	0.69***	-0.03
	(0.21)	(0.02)
Demographic: Marriage status	0.20	0.02
	(0.22)	(0.02)

Variables	Probit for Bringing bag	Endogenous Treatment (Impulse buying)
Internal stimuli: Enthusiastic		0.04***
		(0.01)
Internal stimuli: Happiness		0.03**
		(0.01)
Demographic: Number of children		-0.00
		(0.02)
Bring their own bag		0.19***
		(0.04)
Deontological ethnics evaluation: Duty	0.08	
	(0.11)	
Deontological ethnics evaluation: Moral	0.43***	
Practical evaluation: Large volume purchasing	0.38***	
	(0.12)	
Practical evaluation: Easy bringing own bag	0.36***	
	(0.11)	
athrho		-0.03
		(0.12)
lnsigma		-1.86***
		(0.04)
Constant	-6.58***	-0.55***
	(1.30)	(0.13)
Observations	394	394
Demographic: Highest education	0.44*	-0.04*
	(0.23)	(0.02)
Demographic: Average monthly income	0.08	0.03**
	(0.14)	(0.01)
Situational factors: Time available		0.03**
		(0.01)
Situational factors: money available variable (Self-payment)		0.15***
		(0.04)
External stimuli: Coupon		0.01
		(0.01)
External stimuli: Attractive shelf display		0.02*
		(0.01)
External stimuli: Odor and music		0.03***
		(0.01)
External stimuli: Crowd		0.02**
		(0.01)
External stimuli: Presence of peers and family		0.03***
		(0.01)

Table 1. Factors determining BYOB behavior and impulse buying behavior
Note: Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

Table 2. Impulse buying measurement comparison

Variables	Impulse buying ratio
BIS 1: I often buy things spontaneously.	0.03***
	(0.01)
BIS 2: "Just do it" describes the way I buy things.	0.02*
	(0.01)
BIS 3: I often buy things without thinking.	0.04***
	(0.01)
BIS 4: "I see it, I buy it" describes me.	0.03**
	(0.01)
BIS 5: "Buy now, think about it later" describes me.	0.02**
	(0.01)
BIS 6: Sometimes I feel like buying things on the spur-of-the-moment.	0.01
	(0.01)
BIS 7: I buy things according to how I feel at the moment.	0.02*
	(0.01)
BIS 8: I carefully plan most of my purchases.	-0.01
	(0.01)
BIS 9: Sometimes I am a bit reckless about what I buy.	0.03***
	(0.01)
Constant	-0.18***
	(0.04)
Observations	394
R-squared	0.56

Note: Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

5. Conclusion and Discussion

This study measures the impact of the no-plastic-bag policy on impulse buying behavior using the endogenous treatment effect model with the bring-your-own-bags (BYOB) behavior as a proxy for the policy treatment. In addition, this study also has three sub-objectives to identify factors determining the BYOB behavior, identify factors determining the impulse buying behavior and compare two measurements of impulse buying.

For the factors determining the BYOB behavior, females with a college degree are more likely to bring their own bags. For environmental consciousness, those who believe that BYOB is a morally right thing to do have a higher tendency to bring their bags. This suggests that the deontological ethnics evaluation dominates buyers' behaviors in Chiang mai, Thailand, which contradicts the results from Chan et al.,2007 that teleological evaluation has more influence in China. This may be due to socio-cultural value in the two countries. In addition, buyers expecting to buy many products and feeling that BYOB is easy are more likely to bring their bags to shop.

Consistent with previous literatures, every category of factors influencing impulse buying are significant. The most influential factor is the BYOB behavior. Specifically, people who bring their own bags make 19.2 percent more impulse purchases than those

with no bag. Among other categories of factors, situational, internal stimuli and buyers' demographics including money available (self-payment), the enthusiastic emotion, shopping time and monthly income are the most influential factors. The external stimuli, although have slightly smaller effects, are crucial to discuss as they can be adjusted by stores to improve revenue (Ganesan & Bhakat, 2013). From the results, the pleasant odor and music is a key factor leading to higher impulse buying. Moreover, the crowd reduces impulse buying. Therefore, stores should pay attention to the subtle elements like odor and music that create desirable ambient, as well as to balance the size of the store and the crowd.

For the no-plastic-bag policy evaluation, although the no-plastic-bag policy positively affects the environment, the policy also reduces impulse buying behavior leading to a revenue reduction of the retail stores. The results show that people who bring their own bags make 19.2 percent more impulse purchases than those with no bag. The result indicates that the no-plastic-bag policy significantly reduces impulse buying behavior. It creates a disincentive for the stores to continue participating in the no-plastic-bag policy. For the no-plastic-bag policy to be sustainable, the BYOB campaign has been implemented parallelly and partially successful as 43.6 percent of the survey respondents brought their bags. In order to improve the percentage of success, the BYOB campaign should focus on deontological ethnics to develop a sense of moral obligation to reduce nonbiodegradable waste.

In addition, this study also has an academic contribution to the measurement of impulse buying by comparing two impulse buying measurement approaches: the direct survey method asking for the ratio of unplanned to total purchase and the Buying Impulsiveness Scale (BIS) method. The result shows that buyers that spend a large ratio of money on unplanned purchases consider themselves to buy things without thinking, buy things spontaneously and can be a bit reckless about what they buy. Comparing to Rook and Fisher (1995) factor analysis, the indicators with the highest factor loading are buying things spontaneously, describing their behavior as "Just do it" and buying things without thinking. Therefore, impulse buying is most associated to the spontaneous behaviors without thinking. These results can be useful for future studies that do not use direct survey method that requires researchers to interview buyers both before and after their shopping trip.

It should be noted that this study collected data in January and February of 2021, which were during the COVID-19 outbreak. Although the empirical estimation already controls for buyers' income, the crisis may affect other aspects of their shopping behaviors.

Ethnical Clearance

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Covid-19 Pandemic Consequences on Consumers' Panic Buying: The Role of the Fear and Uncertainty

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Abstract

The worldwide COVID-19 epidemic has drawn the attention of researchers, civil authorities, and the general public on the practice of "panic buying," which is defined as the excessive purchasing of certain materials—particularly food and hygiene-related products—in expectation of a scarcity. This phenomenon has been well-documented in the aftermath of a number of natural and man-made disasters, but its global scope and severity in the context of COVID-19 are unprecedented. The current COVID-19 epidemic has led to a spike in panic buying in several nations, which has resulted in stockouts and supply chain problems. Therefore, it has attracted the attention of academics and retailers. On the basis of the health belief model, perceived scarcity theory, and expected regret theory presented in this work, we developed a theoretical model that connected the drivers of panic purchasing and examined their interrelationships. As a relatively new and uncharted topic in consumer behavior research, this study aims to uncover and synthesize the psychological reasons of panic buying. Individuals' perceptions of the health crisis and scarcity of products, fear of the unknown, and coping behaviour is all implicated in panic buying, as well as social psychological factors. As part of its contribution to the literature, this study consolidates the sparse and scattered research on the causes of panic buying, gaining greater theoretical insights into each cause, and offering some implications for health professionals, policymakers, and retailers on implementing appropriate policies and strategies for managing panic buying. Future research is also recommended.

Keywords: Panic buying; health belief model; perceived scarcity; COVID-19; health crisis

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1. Introduction

Panic buying refers to a disorder in behaviour, in which customers buy an excessively high amount of goods, to avoid future shortfalls (Zheng, Shou, & Yang, 2021). In return, the consequences of panic buying on supply chains, macroeconomic systems, retail and public policy are considerable. During the COVID-19 pandemic, the safety and livelihood of persons have risen by 49 per cent (Zwanka & Buff, 2021). Individuals may turn to a panic mechanism to purchase as a reaction to this unease.
The present research indicates a complicated and diverse phenomenon in terms of panic buying. It may be associated or induced by cognitive impairment, affective components such as anxiety and worry (Bentall et al., 2021). Despite this research, Frost, Steketee, and Tolin (2015), suggest that the panic buying phenomenon is still very much a mystery and requires more investigation. More specifically, Grisham, Brown, Savage, Steketee, and Barlow (2007), argued that analysis of the panic buying phenomenon through a neuropsychological lens had been limited. Therefore, future studies should examine and analyze the effect of cognitive function on this phenomenon.

COVID-19 has had a devastating influence on global economy ever since the globe was shaken by fear and uncertainty as a result of the pandemic outbreak. Due to government-imposed limitations, many small and medium-sized businesses were forced to shut down (Allington, Duffy, Wessely, Dhavan, & Rubinf, 2020). People were terrified by the increasing number of illnesses and fatalities. It seemed as though a holocaust was about to happen. WHO has revealed that the COVID-19 worldwide spread has reached over 207 million infected cases and is approaching 4.37 million fatalities, according to current figures (WHO Corona Disease Dashboard, 2021). It's no secret that the COVID-19 epidemic offered a unique challenge to the world's health authorities.

As a result of the COVID-19 epidemic, people throughout the world faced a unique problem (Islam et al., 2021). As soon as the new Coronavirus (Mahase, 2021) was discovered in China, it swiftly spread throughout the world. It was declared a "pandemic" on March 11, 2020, by WHO's Director-General (WHO, 2020). There was no effective COVID-19 vaccination available, therefore governments throughout the world had to enforce social distance and proclaim country-wide lockdowns as precautionary measures to keep the virus from spreading (Arafat, Kar, & Kabir, 2020; Hall, Prayag, Fieger, & Dyason, 2020).

Panic acquiring has been defined as “the phenomena of a rapid surge in the purchase of one or more necessary items in excess of normal need caused by adversity, generally a tragedy or an outbreak, resulting in an imbalance between supply and demand.” PB has addressed several significant elements, such as a sudden rise in the acquisition of vital necessary items in excess of necessities, which is generally prompted by bad occurrences (Arafat, Kar, Menon, et al., 2020). It might be spontaneous or deliberate. However, PB has a number of negative consequences, including supply chain disruption, fake commodities shortages, and stock price increases (Naeem, 2021). Furthermore, big crowds and lines in retail areas and businesses may result in further clusters. Some preventative techniques have been offered, including responsible media reporting, kinship promotion, rationing, authority assurance, and psychological interventions to prevent the incidents (Billore & Anisimova, 2021).

On March 13, 2020, it was announced that there are 197 confirmed coronavirus cases in Malaysia (Ministry of Health Malaysia, 2020a). Due to an upsurge in

coronavirus infections, the MOHM recommended individuals to practice good personal hygiene and use facemasks if they have respiratory infection symptoms. Travel restrictions to a few countries affected by the Covid-19, including as China, Japan, Iran, Italy, and the Republic of Korea, are among the other actions made by the Malaysian government. Anxiety, worry, and hypochondriacal thinking have been provoked by the increasing number of Covid-19 instances reported on a daily basis. As a result, Malaysian buyers, like those in Singapore and Hong Kong, have gone into panic shopping mode (New Straits Times, 2020b). Panic buying over Covid-19 has been recorded all across the world, with the trend focusing on non-medical commodities like toilet paper, quick noodles, and dried food. There is currently little agreement in Malaysia on how to best quantify the triggers of panic buying behavior. There is a scarcity of empirical evidence about the elements that cause panic buying among Malaysian consumers. Despite the fact that there has been a lot of research on coronavirus, (Phang, Balakrishnan, & Ting, 2021; Zwanka & Buff, 2021) not many studies in Malaysia have looked at the customers' perspective on panic buying. As a result, the nature of panic buying is yet unknown. A new line of evidence regarding panic buying behavior is presented in this research. The study's main question is, "What are the elements that cause panic buying behavior among Malaysian consumers?" The major goal of this study is to determine the elements that cause panic buying among Malaysian consumers. This research offers a wonderful chance to learn more about panic buying behavior caused by Covid-19. The paper is unable to give a complete review and empirical evidence of panic buying behavior due to conceptual constraints. The study starts with an introduction to a literature review debate, and a conclusion. The conclusion discusses the consequences, limitations, and future investigations.

2. Literature Review

2.1. Underpinning Theory

This research utilizes three ideas to characterize the factors of panic purchasing. They are the health belief model, perceived scarcity, and expected regret theories. Based on psychology, these frameworks evaluate the cognitive, affective, and behavioral aspects of panic buying (Iacob, Ionescu, Avram, & Cojocaru, 2021; Yuen, Leong, Wong, & Wang, 2021).

The health belief model has been used in a variety of community-based health intervention situations, and its components (i.e., perceived vulnerability, perceived severity, result expectancy, signals to action, and self-efficacy) explain the causes of product scarcity in the pandemic. As a result of this imagined scarcity, people tend to anticipate regret and spend in a frenzy. The health belief model has historically been used to determine the reasons for people's inability to implement disease prevention procedures or screening exams for early illness detection (Sim, Chua, Vieta, & Fernandez, 2020), and it has been proven to affect the adoption of health prevention practices (Islam et al., 2021). It is a frequently used paradigm in the realm of health behavior to explain the implementation and maintenance of health-related interventions. In the context of the current study, panic purchasing may be viewed as a preventative health activity that serves to reduce the likelihood of becoming infected

with COVID-19 and being affected by a stock out of products and services as a result of supply chain disruptions (Naeem, 2021).

The elements in the health belief model are thought to influence consumers' perceptions of scarcity of goods and services because they influence customers' understanding of the availability of resources while making purchasing decisions. In essence, perceived susceptibility and severity (i.e., perceived vulnerability to and risk of contracting COVID-19), as well as self-efficacy in protecting oneself from the pandemic, are directly related to consumers' level of worry, task, and response orientation (Iacob et al., 2021) toward ensuring the availability of goods.

In other words, perceived scarcity is the belief that something is scarce (Hall, Fieger, Prayag, & Dyason, 2021). This causes customers to increase their purchases as a result of heightened urgency or perceived worth of the product (Yuen et al., 2021). One reason might be the fear of losing one's independence, which could increase one's desire to obtain a near alternative that may become unavailable soon. As a result of their assumption that their flexibility in carrying out certain behaviors is constrained panic buying behaviors (Arafat, Kar, & Kabir, 2020; Hall et al., 2020).

2.2. The Factors That Influence Perceived Scarcity

It's important to note that in this study, perceived scarcity is a consumer's perception of resource abundance or availability in this COVID-19 epidemic. Consumers' perceived shortage leading to panic buying has only been studied in a few studies. As a result of existing research, it appears that perceived scarcity is affected by factors such as a sense of insecurity and instability (Arafat, Kar, Menon, et al., 2020; Hesham, Riadh, & Sihem, 2021), as well as supply chain disruptions. When it comes to their sense of scarcity, consumers as social animals are influenced by herd instinct (the intensity of reactions from others around us) Hall et al., 2021) and this is amplified by media narratives (Allington et al., 2020), which may increase the fear of acquiring COVID-19. Desperation is also impacted by our primitive brains, which are able to influence our judgments and decisions that are vital to our survival (De Kock et al., 2021). Decreased uncertainty and anxiety as well as an enhanced sense of control are also factors that impact perceived scarcity (Moore, Wierenga, Prince, Gillani, & Mintz, 2021). Finally, perceived scarcity is impacted by consumers' perceptions of vulnerability owing to their lack of trust in the government, which leads to an overestimation of risk and an underestimation of aid (Barnes, Diaz, & Arnaboldi, 2021; Naeem, 2021; Prentice, Quach, & Thaichon, 2020).

2.3. Perceived Susceptibility's Effect on Perceived Scarcity

Customers' perception of risk or the possibility of getting COVID-19 is defined in this study as perceived susceptibility. Depending on their physiological and psychological health, as well as their trust in the future handling of the pandemic, they may see themselves as more vulnerable. If you'd like to learn more about COVID-19, click here. When it comes to health-related behavior, perceived vulnerability is a powerful motivator (Arafat, Islam, & Kar, 2021; Arafat, Kar, & Aminuzzaman, 2021). Customers will experience scarcity more strongly if they believe they have a significant chance of getting COVID 19. There is an increased likelihood of limitations on freight

movement if there is a higher risk of contracting COVID-19, which in turn slows down supply chain inventory replenishment. The availability of items is reduced, resulting in more frequent stockouts and a sense of scarcity.

2.4. Fear of the Uncertainty

General mental discomfort such as dread and anxiety is expected during a disease outbreak (Arafat, Kar, Menon, et al., 2020; Untaru & Han, 2021). As a result of humans' incapacity to anticipate the outcome of an outbreak, the human domination over nature is threatened (Singh et al., 2021). Having no idea what to expect when it comes to a health crisis or sickness might lead to fear of the unknown. Due to this, people tend to ruminate and picture various situations, which in turn produces dread (Jin, Li, Song, & Zhao, 2020; Taylor, 2021). Fear, rather than the epidemic itself, has been shown to influence buying behavior (Sim et al., 2020). To prepare for the unexpected, according to past statistics, consumer spending at retail outlets surged considerably in anticipation of imminent calamities (Wang & Na, 2020). However, Naeem (2021) claim that fear encourages people to make purchases because it provides them with a sense of security, comfort, and a momentary escape from their problems. As a result, people often buy things because they want to manage their bad feelings and not because they actually need them.

2.5. Panic Buying and the Direct Effects of Perceived Scarcity

It is defined as an individual's belief that a product is only available in restricted quantities, leading to the anticipation that it would become unavailable very soon owing to the COVID-19 pandemic. When customers perceive a product to be scarce, they feel threatened by their own freedom, and this generates a psychological reaction that increases their desire to purchase a substitute that may soon become unavailable (Barnes et al., 2021; Brandtner, Darbanian, Falatouri, & Udokwu, 2021; Prentice et al., 2020). The loss of freedom (i.e., restricted or decreased access to product) is said to impact the perception of scarcity (Prentice et al., 2020). Because of the apparent loss of freedom, the limited products and services become more appealing to people, leading to a greater desire to carry out the forbidden acts (i.e., panic buying the limited goods and services).

The impression of scarcity also affects consumers' willingness to take preventative measures in order to avoid getting COVID-19 and suffering its effects, since they perceive themselves to be unprotected and vulnerable (Jin et al., 2020). To reduce the frequency of their shopping excursions and the danger of getting COVID-19, they are more prone to panic purchase. It is because of this psychological reaction that consumers are more likely to panic purchase items that are seen as limited (Brandtner et al., 2021; Untaru & Han, 2021).

2.6. Panic Buying and the Indirect Effects of Perceived Scarcity

As a result of this study, panic buying is predicted to be indirectly influenced by perceived scarcity through expected regret. There are three components to regret: it's unpleasant and best avoided, it's different from other unwanted sensations and there's a counterfactual reasoning component (Billore & Anisimova, 2021). In order to

avert a negative consequence, anticipated regret is the consideration of regret when making a decision (Singh et al., 2021).

According to this scenario, a perceived scarcity event would be a demand-driven limited-quantity scarcity. Consequently, observed scarcity will likely raise perceived customer competition and perceived price instability for accessible product. Due to the increased sense of competition and price uncertainty, customers will be more likely to anticipate regret if they do not successfully outrun other consumers who are racing to stock up on the products in limited supply before they run out. For example, if people wait until the price jumps to buy things, they may regret it (Wang & Na, 2020).

2.7. Perceived Scarcity favorable effect

Consumers expect regret if they do not make a panic purchase while they still have the chance (Hesham et al., 2021). This emotion is a result of a rejected alternative (i.e., panic buying). Anger is expressed when an alternative (panic buying) proves to be superior to what was intended (Sim et al., 2020). There's a good chance that customers regret paying a greater price when they buy something later compared to when they buy it early in the form of panic purchasing. Another possibility is that the consumer regretted not buying more quickly when given the option.

Because of perceived scarcity and in accordance with the prospect theory, which analyzes decision-making behaviors in uncertain conditions such as loss prevention, customers are more likely to experience regret than joy for not panic-buying. As a result of the uncertainty of the future, customers choose to take preventative action and panic purchase in order to avoid paying a higher price or facing a stockout scenario in the near future. Researchers have shown that anticipating regret increases intentions (Somani & Kumar, 2021) or strengthens the link between existing intentions and behaviors (Wang & Na, 2020). A third component, expected regret, shows a moderate to high connection with the behavioral intention to panic buy (Taylor, 2021). When presented with a dangerous perceived scarcity event, the desire to panic purchase is enhanced by expected regret for not panic purchasing, increasing the chance of real panic buying behavior.

3. Summary

Identifying the causes of panic purchasing and understanding their interrelationships is the goal of this research project. According to this study, the factors of panic buying may be explained using the health belief model, perceived scarcity theory, and expected regret theory. We believe that both perceived scarcity and expected regret influence panic purchase. As a result of customers' impression of restricted stock availability, they anticipate regretting a missed opportunity to acquire items in limited quantity while they still can, which encourages panic purchasing. As a result, they feel compelled to make a hasty purchase. Additionally, the components of the health belief model, which offers five health belief model elements that contribute to the sense of scarcity, may be used to justify perceived scarcity. The firm's internet channels were used to conduct the survey. There were 508 valid data points collected in the poll. Health belief model factors (i.e., perceived vulnerability, perceived severity, result anticipation, signals to action and self-efficacy) are found to be mediated by

perceived scarcity in panic buying. Desperation purchasing is also influenced by perceived shortage and expected regret. Perceived scarcity has the biggest impact on panic purchasing, according to the total effect study. Predicted regret and result expectations are the next three elements, with perceived vulnerability, self-efficacy, and perceived severity being the least influential.

3.1 Theoretical Contributions

A major contribution to academic research has been made by this article. As a first step, the paper tackles a gap in the research on panic purchasing by using and modifying three theories, namely the health belief model theory, perceived scarcity theory, and expected regret theory, in order to identify and evaluate the variables impacting panic buying behavior. The existing theoretical study on panic buying is extremely limited at this time. A majority of studies use the stimulus-organism response model (Laato, Islam, Farooq, & Dhir, 2020), the protective action-decision-model (Nakayachi, Ozaki, Shibata, & Yokoi, 2020), the competitive arousal model (Davis, Gustafsson, Callow, & Woodman, 2020), or its expansion by including concepts such as fear or trust (Bäuerle et al., 2020; Degerman, Flinders, & Johnson, 2020) and flocking behavior (Ang, Wei, & Arli, 2021). As a follow-up to the work of (Ang et al., 2021; Naeem, 2021; Somani & Kumar, 2021), this research study presents an alternate examination of the factors that contribute to panic purchasing. So, for example, (Taylor, 2021) combined perceived scarcity and expected regret based on competitive hedonic incentives, while (Prentice et al., 2020) synthesized a model based on perceived danger and anxiety, coping strategies, and social psychological variables.

These theories, such as the health belief model, have been studied and used in this work, despite certain overlaps in their concepts. Health belief model, perceived scarcity and expected regret are all assumptions that draw on different paradigms, such as psychology, decision-making and abundance/scarcity research in order to provide a complete analysis on the causes of panic purchasing. It also contributes to current research by identifying, proposing, and operationalizing the different drivers of panic purchasing, such as perceived vulnerability, perceived severity, result expectations, signals to action, and self-efficacy. A significant portion of the panic purchasing variance is due to these reasons (55.2 percent). Thus, a combination of ideas has a higher explanatory power than a single hypothesis, as demonstrated in studies of panic purchasing. It appears that these ideas work together to explain panic buying, which is a significant finding.

In spite of this, it's crucial to highlight that each theory's adequacy in describing panic purchasing differs from one another. Analysis of overall impacts shows that health belief model hypothesis explains the most. As a second option, there is the perceived scarcity idea. In addition, this article provides a deeper nomological understanding of the connections among the variables driving panic purchasing in the financial market. Consumers' perceived vulnerability, perceived severity, outcome expectations, signals to action, and self-efficacy are all variables that influence their decision to panic purchase, according to the study's findings. Fear of running out and regret are also factors that contribute to panic buying. Consumers' decision-making process begins with the appraisal of their sense of scarcity, which leads to the

expectation of. regret. As a result, the impression of shortage leads to panic buying. The same study by Brandtner et al., (2021) also found that signals to action, provided by a variety of information sources, can affect customers' purchasing decisions. In addition, this study contributes to the quantification or operationalization of the notions in question. Health belief model, perceived scarcity theory, and expected regret theory components were synthesized from research articles on the pandemic to guarantee their suitability in the setting of panic buying. This article argues that a consumer's ability to predict remorse must be based on something. Therefore, if customers view a product as rare, they will acquire a sense of regret. When consumers analyze health belief model components including perceived susceptibility and severity as well as result expectations and cues to action, perceived scarcity is influenced.

3.2. Limitations and Recommendations for Policy Implications

There are few key constraints to consider in this study article. Firstly, future studies should investigate empirically the causes of panic buying in Malaysia. Secondly Malaysia, which is largely dependent on commerce, the perception of shortage may be more pronounced. In this way, customers are more likely to perceive scarcity and anticipate regret if they don't make a hasty purchase while they can. Consequently, future studies might assess the generalizability of the study model by comparing it to other scenarios. Several recommendations are made for policymakers to control perceived shortages and prevent panic purchasing in this article. Plunging into a frenzy of impulse purchases has a number of negative effects on many stakeholders, including food manufacturers and distributors as well as retail shop management and the general public. In order to properly control panic purchasing, relevant stakeholders need to grasp the necessity of managing customers' perceptions of scarcity. After that, reducing the consumer's impression of scarcity would be the next objective. It's possible for the government to set limits on the quantity of vital goods that a single customer may buy, relieving the strain on products in short supply. To avoid empty shelves from occurring, retail businesses should increase the frequency of replenishing shelves. They can also prioritize disadvantaged groups in society so that their perceived susceptibility to contracting COVID19 is reduced. Due to their impression of scarcity, panic purchasing is commonly performed by consumers who fear stockouts, therefore lowering scarcity perception would also diminish panic buying behavior. Accordingly, governments might invest in marketing initiatives that educate consumers on the real preparedness level of existing national stocks in order to convince them that the degree of scarcity is not nearly as great as they first thought it was. As a further step, governments and store owners might explore focusing on other variables such as result expectation and expected regret. Retailers should stock their shelves with goods that have a shorter expiration date so that panic buying will be less beneficial owing to the earlier expiration of food items. To avoid stockouts and the impression of bare shelves, retailers can stock shelves more often, but in lesser numbers each time. Next, policymakers and retailers might focus on additional characteristics, such as result expectancy, expected regret, perceived vulnerability, self-efficacy, and perceived severity, in order of decreasing significance. Because of the early expiration of food products, store owners can fill their shelves with things having a more imminent expiration date, reducing the potential advantage of panic buying. A community leader, a close friend or a family member might dissuade and criticize the socially irresponsible

behavior of panic purchasing since it robs others in the community of items with limited supply.

Redirecting the consumer's attention away from panic shopping and toward more productive and successful preparatory methods might also minimize expected regret. Politicians can educate the public on accurate and effective ways to prepare for COVID-19 such as maintaining physical (i.e., doing regular exercise, getting enough sleep), mental (meditation to manage stress and anxiety), and emotional (i.e. checking in with friends and family) well-being instead of panic buying. Finally, employers can reassure their employees that their employment will not be affected if they contract COVID-19; family and friends can regularly check in on each other to provide emotional assurance and support, and individuals can remind themselves that the healthcare system is robust and the mortality rate is less than 1 percent if they ever contract COVID-19; Individuals perceive COVID-19 as less severe, which decreases their perception of scarcity, leading to a reduction in panic buying. Therefore, this paper acknowledges the possible influence of varied occupation requirements and flexibility on the panic purchasing behavior of consumers and admits that additional research may be done to discover the link between consumers' type of job and panic buying behavior.

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The Availability Analysis of Halal Services in the Meeting Businesses : A Case of Chiang Mai Province

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Abstract

This study aims to examine the availability of Halal services in meeting businesses in Chiang Mai province. Accordingly, previous studies defined the components that are crucial for determining the availability of Halal services in meeting businesses into 10 aspects: Accessibility, Amenity, Activity, Attraction, Area/venue, Accommodation, Agency, Accountability, Award, and Advance in Business Opportunity; in which consists of 36 Halal items. The data used in this study is the primary data, obtained from questionnaires rated by service providers involved in meeting businesses in Chiang Mai province, consisting of 150 – consider the following: conference agencies, business/company conference organizers, hotel service providers, restaurants/caterers, transportation service providers, tourism service providers. The Confirmatory Factor Analysis (CFA) method was used in data analysis. The result of the model consistency test and the preliminary data indicated that the Goodness of fit Indices was excellent (χ^2 / df = 1.077, GFI = 0.999, AGFI = 0.997, RMSEA = 0.023 and SRMR = 0.039). The Factor Loading of the 10 aspects is up to the standard and are able to calculate the availability of Halal services of each factor. The results revealed that Chiang Mai province has the availability of Halal services in meeting business rate of 3.45 Chiang Mai has the highest availability of Halal services in meeting businesses in terms of Amenity, whereas the lowest availability of Halal services in meeting businesses was in terms of Advance in Business Opportunity. The availability of Halal services in meeting businesses in Chiang Mai is still needed improvement and development simultaneously, especially in terms of information, basic principles, and guidelines about Halal services that are rudimentary for the Meeting business service providers. Both public and private agencies responsible for moving the MICE business in Chiang Mai must cooperatively research and plan to support the Muslim travelers and Muslim Mice business groups in the future.

Keywords: Halal, Halal services, Meeting, MICE

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1. Introduction

In the present, as Muslims travel more often, travel expenditure tends to continuously increase. In 2014 the travel expenditure rate of Muslims has reached 142 million USD, which is considered as the third highest travel expenditure rate of the Word Traveling Organization (WTO) (Haupt, 2017). And if we carefully examine the purpose of the travel, the data implies that Muslims tend to travel for business purposes (Master Card & Crescent Rating, 2015), which is also known as MICE, which consists of Meeting, Incentive Travel, Convention, and Exhibition.

In Thailand, MICE can make 2-3 times more national revenue than normal traveling, which gained Thai businesses the attention of MICE travelers who have high purchasing power in each MICE activity. Thailand is a country with potential and advantages as a MICE Destination thanks to its traits such as diverse venues, standardized services, splendid tourist attractions, unique culture, the ever-developing infrastructures, and facilities that are essential for MICE events (TCEB., 2015). Considering the statistical data of MICE events during 2014-2018, the trend of MICE events, the number of foreign MICE travelers, and the revenue generated from MICE businesses in each category especially the meeting businesses which had the highest numbers of events organized were continuously increasing each year. The skyrocketing trend of MICE results in the highest increase in the number of travelers joining the meetings, and the revenue generated from the meetings was considered as highest compared to other MICE business categories (as shown in Table 1). Although the growth trend of domestic meeting businesses is increasing, it still needs to strengthen meeting businesses in order to play a part in the sustainable business competition as well as other MICE businesses.

Table 1. The number of MICE activities, the number of foreign MICE travelers, and revenue from each category of MICE businesses for the years 2014 – 2018

Categories of MICE	Data	Year				
		2014	2015	2016	2017	2018
Meeting (M)	Number of events	2,674	2,764	2,829	2,847	3,248
	Number of foreign travelers (persons)	232,736	262,538	258,483	259,901	335,992
	Revenue from the business (million baht)	25,174	28,397	23,445	26,749	30,473
Incentive Travel (I)	Number of Groups	1,980	2,039	2,093	2,235	2,753
	Number of foreign travelers (persons)	240,546	254,125	263,556	271,793	369,370
	Revenue from the business (million baht)	15,274	16,136	16,217	16,696	20,669
Conference (C)	Number of events	2,637	2,716	2,670	2,689	2,612
	Number of foreign travelers (persons)	287,886	294,371	298,564	300,273	317,396
	Revenue from the business (million baht)	26,737	27,339	25,789	26,145	25,325
Exhibition (E)	Number of events	86	89	91	104	110
	Number of foreign travelers (persons)	157,069	284,961	180,480	215,992	233,228
	Revenue from the business (million baht)	13,616	24,003	15,686	18,869	19,156

Source: MICE Statistic Report 2014, 2015, 2016, 2017, 2018 (TCEB.)

The shift in the environmental factors such as the economy, society, and politics internationally and nationally are the means of the effects on MICE businesses in Thailand since the events and happenings have an impact on the destination and attendance in meetings of MICE travelers. Both public and private agencies are united in order to develop and elevate the meeting businesses to go international and make Thailand become the center of MICE or even attract as many MICE travelers as we can. Presently, Thailand has 5 MICE cities: Bangkok, Pattaya, Phuket, Khon Kaen, and Chiang Mai, which Chiang Mai is well-known for its reputation as a Northern travel destination for both Thai people and foreigners.

Chiang Mai has potential in terms of tourism and economy. The province itself is worth investing in. The aforementioned factors are responsible for the rapid and advanced development of the province. Additionally, the prominent point of Chiang Mai as a MICE city is the capability to be the Center Hub of the North which helps in interlinking between other provinces, the capability to be Center Airline Hub, the capability to be the Center Hub of Education, and lastly, the capability to be the Creative and Innovation City (TCEB, 2017). However, in order to develop Chiang Mai to be a replete and potent MICE city, it is necessary to be incessant, and new ideas should be applied to avoid making recurring images and to create a model MICE city for other provinces.

From the MICE statistics, it is shown that the meeting businesses group has the highest number of events, the highest number of foreign MICE travelers, and generated the most revenue among other MICE business categories. These are the reasons that motivated the researcher to study the availability of Halal services in meeting businesses by using Chiang Mai as the case study. And after considering the statistics of Chiang Mai's Corporate and Non-Corporate Meetings between 2013 – 2017, it can be said that the number of events and attendees continuously increased each year (as shown in Table 2). On the other hand, compared to the other 5 MICE cities of Thailand, Chiang Mai is the fourth in order. In each year, the events organized in Chiang Mai are approximately 9% of all meeting events, and the number of participants is approximately 8.5% of all participants.

Table 2. The number of meeting events, the number of attendees from meeting businesses in Chiang Mai for the years 2013 – 2017

Categories of meeting	Data	Year				
		2013	2014	2015	2016	2017
Corporate Meeting	Number of events	186	188	194	208	225
	Number of attendees (persons)	17,839	18,111	18,883	23,075	23,718
Non-Corporate Meeting	Number of events	298	302	328	314	309
	Number of attendees (persons)	46,842	47,122	50,894	48,522	48,845
Total	Number of events	484	490	522	522	531
	Number of attendees (persons)	64,681	65,233	69,777	71,597	72,507

Source: MICE Statistic Report 2014, 2015, 2016, 2017 (TCEB.)

Developing MICE businesses to provide "Halal" services is a way for developing MICE city to be able to accommodate Muslim MICE attendees, and it also creates business opportunities along with the development of Halal tourism in Chiang Mai. At present, Muslim tourists in Chiang Mai consist of: Thai Muslim tourists, ASEAN Muslim tourists, Middle Eastern Muslim tourists (Nilawan, D. & Others, 2016). Moreover, The researchers studied Halal tourism management in terms of accommodation, food and drinks, itinerary, tourist attractions, and so on, in order to create confidence and trust or even impress Muslim tourists – as well as words spreading among them that will bolster the image of Halal tourism for Chiang Mai (Kittachet Krivart, Apaporn Sookhom & Chalisa Sirithammaket, 2019).

The study of the availability of Halal services in meeting businesses was undertaken according to Halal tourism research, as the meeting businesses or Halal MICE businesses are considered scarce in Thailand, and there are still no standardized Halal MICE businesses. This brings to the research question: What type and components of services should be available in Halal meeting businesses in Chiang Mai? And what is the availability rate of Halal service in meeting businesses in Chiang Mai. Studying the availability of Halal services in meeting businesses in Chiang Mai not only creates recognition of the availability and potential of Halal services between the meeting businesses providers but also allows formulating a service plan to satisfy the needs of Muslim attendees, the study can also be used as a guideline for managing Halal services in other categories of MICE businesses.

2. Literature Review

2.1 Concepts related to the 10 components of Halal services in Meeting businesses

Various are the studies and research of the availability and potential of MICE businesses in Thailand, for example, Chompoophan P. (2010) has studied the potential of the meeting and event arrangement of Chiang Mai province in 9 factors: Organizing, Logistics, Facility, Accommodation, Security, Restaurant, Tour Agency, Activity and Entertainment, and Souvenir Shop. The researcher had executives, foremen, entrepreneurs/owners, general managers, and managers related to conference and exhibition organizing as the sample group. The research instruments used are questionnaires and indepth interviews. The researcher analyzed data statistically by mean, mean of percentage, S.D., and F-test and the result of the study showed that the overall potential of the 9 components of the businesses is rated considerably well, and the comments are not distinct in each factor. Finally, it can be implied that Chiang Mai has the potential to hold conference and exhibition in Chiang Mai and has the capability to accommodate many tourists.

The study of the availability of MICE industries in Phuket for the domestic MICE market by Manat Chaisawat et.al. (2009) has given 5 indicators: the quality of the venue/area, the accessibility, the fundamental structure, the assistance of the government, and the leisure areas. By using questionnaires and surveys to collect data of individuals related to MICE industries in Phuket, and applying the descriptive statistics to assess the data, it is concluded that Phuket has the capability to hold MICE businesses and national events under the 5 indicators as following: 1) The availability and quality of MICE event venue. 2) The various types of transport and the convenience

of the commute between the accommodation and the event or neighboring areas. 3) The availability of supporting services and personnel related to the meeting. 4) The sales promotion policy by the government in order to boost the domestic MICE market and development of the tourism industry. 5) the participants and followers are able to access to various types of tourism spots before and after the event.

While Dusadee Chuaysook and Donruetai Kovathanakul (2015) studied the condition and the potential of Khon Kaen in order to become leading MICE city of Thailand in 6 ways: the fundamental structure, the facilities, the security, the assistance of public and private agencies in the city, images, and attractions of the city, MICE personnel. Combining Qualitative and Quantitative research methods, the researcher had given the in-depth surveys concerning MICE in Khon Kaen province to both public and private agencies, direct and supporting businesses, and organizers including the MICE event attendees. The result of the research indicates that in terms of the overall potential to be a MICE city, Khon Kaen has the capability to be MICE city. The province only requires heightening the quality of MICE personnel, assistance from neighboring businesses, improving the infrastructure, facilities, and the overall tourism industries of the province respectively.

According to previous studies, it is clear that the process of studying the availability and potential of each city uses different variables. Thus, the availability and potential of MICE businesses of each city cannot be compared.

Thailand Convention and Exhibition Bureau (Public Organizer) or TCEB., a public organizer that supports MICE business in Thailand specified 3 fundamental elements as the MICE city analyzers, consider the following: Infrastructure, Facility, and Attraction. Whereas there are 8 indicators for determining the potential of a MICE city: the convenience of moving to the city/event location, how the city supports the MICE event, extra activities aside from the meetings, hotels, and accommodations, the image and fame of the city, the environment and surroundings of the city, and security.

Moving on, the components of Halal services in meeting businesses are based on the 10 aspects of a MICE destination (10A), which consists of 1) Accessibility 2) Amenity 3) Activity, 4) Attraction 5) Area/venue 6) Accommodation 7) Agency 8) Accountability 9) Award/awareness and 10) Advance business Opportunity (Piboonrungroj P., Buranasiri B. & Janapiraganita T., 2015). We have found that these 10 aspects are the supply chain that drives MICE-related services from the service providers to MICE travelers, and more importantly, they can be used to inclusively analyze the availability and potential of a MICE city. Pongsakorn Saelim (2015) applied the 10 aspects to analyze the availability and potential of Chiang Mai as a MICE city and found that the aforementioned province was well-equipped in terms of the venue and considered ready for business opportunities to the highest degree, while the least well-equipped factor was transportation. The preparedness of Chiang Mai as a MICE city will affect its economy, it can be said that it can drastically increase the revenue in the business sector of Chiang Mai province.

2.2 Concepts relevant to the provision of Halal services in meeting businesses

Battour and Ismail (2016) stated that Halal services were not restricted only to Muslim countries, non-Muslim countries can also provide Halal services, products, and innovation in order to assist Muslim travelers as well. Therefore, studying and researching Halal principles is necessary for non-Muslim service providers since doing so grants them opportunities to plan services such as tourism, businesses trip, and activities for Muslim travelers properly. As Muslims travels, the tour operator and service providers must know and understand the guidelines for providing services throughout the journey of Muslim tourists and must refrain from providing services that violate Muslim principles. The accommodations, restaurants, transportation, and logistics services must comply with the Halal standards. Moreover, the design of Halal tourism products such as accommodation, restaurants, traveling programs must be based on the Halal principles. Creating a Muslim-friendly environment is also considered essential in order to attract more Muslim tourists (Kalesar, 2010).

Therefore, the Halal service provision in MICE businesses has derived from the Halal services in traveling as the data that concerns the provision of Halal or Muslim friendly services in MICE businesses was seldom mentioned. However, in the literature review and related documents, the data showed that TCEB (2017) established Thailand MICE Venue Standard (Category: Meeting Room) to assess the quality of meeting rooms and facilities by pointing out that the standard measurement indicators for physical meeting rooms must consist of basic structures and facilities, including a religious prayer room by the meeting venue. Additionally, the efforts to upgrade Muslim-friendly services in academic conference businesses and trade exhibitions have driven the research and development of the components for establishing guidelines for arranging Muslim-friendly academic conferences and trade exhibitions. The Department of MICE Industry Development (Thailand Convention and Exhibition Bureau (Public Organizer): TCEB) in collaboration with the Halal Institute and the Faculty of Management Science, Prince of Songkhla University had specified the following components of a Halal Service:1) Prayer room 2) Area for taking Wudhu (Washing area) 3) Preparation and provision of Halal food and beverages 4) Main dining area 5) Snack and beverage area 6) toilets 7) other services such as meetings during the fasting month and 8) officers/service providers.

3. Research Methodology

3.1 Sample group and Sample size

This study was conducted with the group of meeting businesses service providers in Chiang Mai, which consists of organizers, professional organizing businesses and companies, venues providers, hotel service providers, Halal restaurants/caterers, transportation services (within the city), and tour operators. And as Halal in meeting businesses are considered as new services in MICE businesses, the Muslim MICE attendees may need some special services related to Islamic principles. At the present, there are even Halal tourism service providers that lack knowledge and that may reduce the ability to attend Muslim tourists. (Battour M.& Ismail M.N., 2015). Thus, the providers (supply side) of the meeting businesses or MICE is to clearly understand Halal services and its details in each component as the abilities of the service

providers/organizers of the meeting businesses affect the meeting, MICE events, and the service availability for customers and attendees (Chompoophan P., 2010).

This Study used the Confirmatory Factor Analysis (CFA) method in data analysis which required a large sample size (Hair et al., 2010). However, Netemayer et al. (2006) suggested that very large sample size may not always be appropriate. In the case of unknow the number of population so the calculation of the sample size used in the study was based on Thorndike's formula which specified the ratio of 10:1 and add 50 more samples at the final stage ($n \geq (10k) + 50$). There are 10 main components in this study, thus the sample size should be at least 150. However, in order to determine the suitability of the used sample size, the researchers are to recalculate the KMO and Bartlett's test of Sphericity before analyzing the data.

3.2 Research Instruments

The quantitative research of this study used a questionnaire as a tool for data collection. The questionnaire is divided into 3 parts: 1) the general information of the respondents 2) questions concerning the availability of Halal services in MICE businesses (consisting of 10 main components and 36 Halal questions – as shown in Table 3) which the researchers used the Linkert Scale method to measure the scores (1 = least agree to 5 = most agree) and 3) suggestions of the respondents.

The questionnaire was used to find the reliability before collecting the actual data. It was found that the Cronbach's alpha coefficient of the questionnaire was 0.96 which was greater than 0.6. This indicates that the questionnaire stable for implementation.

Table 3. Halal Items

Components	Halal Items	Description
1.Accessibility (ACC)	ACC1	Muslim-friendly travel information services are provided for Muslim travelers entering the city where the meeting was held. (Such as Airlines that offers Halal food.)
	ACC2	Facilitating Muslim attendees in terms of traveling to the city where the meeting was held.
	ACC3	Assisting and guiding Muslim attendees to mosques and Halal restaurant near the venue /within the city.
2. Amenity (AME)	AME1	Providing suitable accommodation for Muslim attendees such as Halal / Muslim-friendly hotels.
	AME2	Arranging the meeting venue and provide necessary equipment and sites for Muslim attendees. (Such as installing a bidet shower in the toilets, arranging prayer room and Halal kitchens, etc.)
	AME3	The availability of additional services to accommodate Muslim attendees. (Such as language services.)
	AME4	Preparing staff to facilitate and assist Muslim attendees in particular.
3. Activity (ACT)	ACT1	Arranging the appropriate time for meetings and activities. (Such as breaks for religious activities.)
	ACT2	The availability of various services when a meeting was held during the fasting month (Ramadan).
	ACT3	Organizing and arranging activities suitable for Muslim attendees. (Such as recreational activities for entertainment, festivals, local cultural activities, various events, etc.)

Components	Halal Items	Description
4. Attraction (ATT)	ATT1	Diverse tourist attractions and suitable for Muslims.
	ATT2	Places of interest within the city which related to Muslims such as mosques, and Muslim communities were available.
	ATT3	A place where Muslims can perform daily religious activities conveniently within the city.
	ATT4	Halal foods of various types were available. (Such as Thai food, local food.)
	ATT5	Tour companies in the area can provide services specifically for Muslim tourists.
5. Area/Venue (ARE)	ARE1	Necessary equipment required for Muslim attendees at the meeting venue was available. (Such as the installation of a bidet shower in the toilets.)
	ARE2	Daily religious practice rooms with facilities near the meeting venue with men site and women site separated were available. (Such as prayer room, area for taking Wudhu (washing area), prayer rugs, etc.)
	ARE3	Halal kitchen is available in the meeting venue.
	ARE4	Special Halal Catering Service is available in case the meeting venue goes without a Halal kitchen.
	ARE5	Staffs were placed on standby in the venue to provide services, especially to Muslim attendees.
6. Accommodation (ACO)	ACO1	Halal hotels were ready to serve Muslim attendees in particular.
	ACO2	Muslim-friendly Hotels were available to Muslim attendees.
	ACO3	Hotels provided professional services. (Such as hotel staff trained in Halal practices.)
7. Agency (AGE)	AGE1	Business/conference organizing companies were ready to hold meetings for Muslim groups in particular.
	AGE2	The meeting organizers had the ability to provide services to Muslim attendees. (For example, they can prepare Halal food and prayer room in the meeting venue.)
	AGE3	The meeting organizers were professional and expertise in the Muslim market.
8. Accountability (ACU)	ACU1	Public and private agencies in local communities provided support and participated in organizing meetings.
	ACU2	Local people co-operated and participated in organizing meetings.
	ACU3	Local religious organizations can educate and provide advice on Halal services for organizing meetings.
	ACU4	The destination city was promoted as it has the ability to support/organize meetings for Muslim groups.
9. Award (AWA)	AWA1	The conference organizers had been awarded a guarantee of Halal service capability in MICE businesses.
	AWA2	The conference organizers had a reputation for organizing diverse kind meetings.
	AWA3	Muslim attendees were confident and approved various Halal services.
10. Advance in Business Opportunity (ADV)	ADV1	Halal businesses in the city that held meetings were increasingly promoted. (Such as Halal hotels, Halal restaurants, Halal souvenir shop.)
	ADV2	The destination city has the capability of being a central hub for Halal meetings.
	ADV3	The Halal services provided in MICE businesses can be applied to other types of businesses.

3.3 Methods of Data Analysis

The Confirmatory Factor Analysis (CFA) was implemented in this study to find the Factor Loading of the 10 components, including the Factor Loading of 36 Halal items. In which, the Factor Loading value should be greater than 0.5 (Hair et al, 2010). Meanwhile, the Construct Reliability Analysis used a similar calculation to Cronbach's alpha Coefficient, which the CR > 0.6 and the Construct Validity by considering the Average Variance Extracted of each component – AVE > 0.5 (Fornell and Lacker, 1981).

The assessment of the availability score of the Halal service in meeting businesses of the 10 components was calculated by using the average mean of the respondents' opinion in each component which the amount was derived from the availability of the Halal service present multiplied by Factor Loading in each component. While the availability score of the Halal services in meeting businesses of Chiang Mai is considered as the weighted average availability score, calculated by bringing the sum of the availability score of the 10 components to divide with the sum of the weight of the availability score of the 10 components as well, in order to assess the overall availability of the Halal services in a meeting. The highest availability score of the Halal services in each component overall will be at 5.

4. Results of Data Analysis

4.1 Results of General Data Analysis

The results of the analysis of the general data of the 150 respondents can be seen in Table 4. Most of the respondents were female (71.33%), aged between 30 - 39 years (44%), and had the highest level of education at the bachelor's degree level (74.67%). In terms of occupation information, the business type engaged the most in a hotel-related business (26%); whereas, for the data relating to MICE businesses, respondents were most relevant to the trade shows and exhibition business (68%), and had experience working in the MICE industry (51.33%) but never had experience in organizing meetings with Muslim attendees (74.67%).

In terms of assessment of the suitability of the sample, the KMO value is 0.789, and Bartlett's Test of Sphericity was significant at 0.000 (P-value < 0.05), implying that the sample range and the data used were appropriate for analyzing the components.

Table 4. The general data of the respondents

Data		Frequency	Percentage
Gender	Male	107	71.33
	Female	43	28.67
Age (year)	20 – 29	34	22.67
	30 – 39	66	44
	40 – 49	38	25.33
	50 – 59	10	6.67
	60 or older	2	1.33
Level of education	Below B.A.	22	14.67
	B.A.	112	74.67
	M.A.	16	10.66
Type of business	Meeting organizer	1	0.67
	Hotel service provider	39	26
	Caterer	38	25.33
	Tourism services	25	16.67
	Transportation services	5	3.33
	Venue provider	6	4
	MICE event arranger	1	0.67
	Others	35	23.33
Relation to MICE business in each category	Meeting provider	73	48.67
	Incentive travel	35	23.33
	International conference	13	8.67
	Trade shows and exhibition	102	68
	Festival	38	25.33
	Business Event	17	11.33
Have experience and associated with meeting businesses	Yes	73	48.67
	Never	77	51.33
Have experience and associated with meeting that includes Muslim attendees	Yes	38	25.33
	Never	112	74.67

4.2 Results of Confirmatory Factor Analysis (CFA)

The results of the model consistency tested with preliminary data showed that all Goodness of Fit indices were good (χ^2 / df = 1.077, GFI = 0.999, AGFI = 0.997, RMSEA = 0.023 and SRMR = 0.039) by using the criteria of Schumacher and Lomax (2010) as follows: χ^2 / df < 3.0, GFI > 0.9, AGFI > 0.9, RMSEA < 0.08 and SRMR < 0.05. Moreover, the results of the Factor Loading analysis of the 10 components and the Factor Loading of the 36 Halal items are seen in Table 5. The data indicates that the Factor Loading of the 10 components was between 0.076 – 0.870.

Furthermore, the CR values were between 0.435 – 0.819. which only the accommodation component was less than 0.6. Meanwhile, the AVE values were between 0.329 – 0.571. Only 3 components: accessibility, agency, and accountability were greater than 0.5. However, the CR values were higher than all AVE values.

Table 5. Results of CFA

Component/Item	Factor Loading	CR	AVE
1.Accessibility (ACC)	0.725	0.795	0.571
ACC1	0.779		
ACC2	0.774		
ACC3	0.712		
2. Amenity (AME)	0.841	0.648	0.342
AME1	0.550		
AME2	0.502		
AME3	0.717		
AME4	0.469		
3. Activity (ACT)	0.870	0.688	0.442
ACT1	0.663		
ACT2	0.717		
ACT3	0.620		
4. Attraction (ATT)	0.837	0.777	0.425
ATT1	0.730		
ATT2	0.698		
ATT3	0.646		
ATT4	0.481		
ATT5	0.657		
5. Area/Venue (ARE)	0.692	0.765	0.426
ARE1	0.679		
ARE2	0.537		
ARE3	0.702		
ARE4	0.540		
ARE5	0.593		
6. Accommodation (ACO)	0.482	0.435	0.229
ACO1	0.409		
ACO2	0.571		
ACO3	0.597		
7. Agency (AGE)	0.105	0.708	0.503
AGE1	0.765		
AGE2	0.698		
AGE3	0.774		
8. Accountability (ACU)	0.445	0.819	0.524
ACU1	0.808		
ACU2	0.667		
ACU3	0.822		
ACU4	0.562		
9. Award (AWA)	0.420	0.699	0.448
AWA1	0.639		
AWA2	0.534		
AWA3	0.820		
10. Advance in Business Opportunity (ADV)	0.076	0.627	0.384
ADV1	0.631		
ADV2	0.393		
ADV3	0.631		

4.3 The results of the availability of Halal services in the meeting businesses in Chiang Mai Province

The assessment of the availability value of the 10 components of Halal services in meeting businesses implied that the component that has the highest availability rate of Halal services is Amenity, which rated 2.87. And the component that has the least availability rate of Halal services is Agency and Advance in Business Opportunity which rated 0.44 and 0.32 respectively from 5. Additionally, the availability rate of Halal services in meeting businesses can be seen in Table 6.

Table 6. The assessment results of the availability value of Halal services in Meeting business, Chiang Mai Province

Component	Mean	Factor Loading	Availability value
1. Accessibility	3.18	0.725	2.31
2. Amenity	3.41	0.841	2.87
3. Activity	3.17	0.870	2.76
4. Attraction	3.32	0.837	2.78
5. Area/Venue	3.77	0.692	2.61
6. Accommodation	3.70	0.482	1.78
7. Agency	4.22	0.105	0.44
8. Accountability	3.41	0.445	1.52
9. Award	3.70	0.420	1.55
10.Advance in Business Opportunity	4.22	0.076	0.32

Furthermore, the overall availability value of Halal services in meeting businesses in Chiang Mai, which is calculated from the total of the 10 components of availability value divided by the Factor Loading of the 10 components (= 18.942/5.943) results in 3.45 score from 5.

5. Discussions and Recommendations

The result of the study of the availability of the Halal services in meeting businesses in Chiang Mai showed that the availability value of components of Halal services in meeting businesses from highest to lowest as following: Amenity (2.87), Attraction (2.78), Activity (2.76), Area/venue (2.61), Accessibility (2.31), Accommodation (1.78), Award (1.55), Accountability (1.52), Agency (0.44), and Advance in Business Opportunity (0.32). And if we compare the result of this study with the study of the evaluation of Chiangmai as a MICE city by Phongsakorn Saelim (2015), it can be said that the highest availability value of components as a MICE city was in the criteria of Area/venue and Advance in Business Opportunity. But the study of the availability of Halal services in meeting businesses in Chiang Mai, the criteria of Advance in Business Opportunity have the least score, which the differed results of the evaluation may come from the difference in an item in terms of the business opportunity.

If we carefully consider the result of the study, what Chiang Mai needs to improve in order to fully provide Halal services was the Advance in Business Opportunity. In which, we must develop and increase the potential of Halal-revolved businesses in Chiang Mai in order to support Muslim attendees. For example, the Halal or Muslim-friendly hotels, Halal restaurants, Muslim-friendly tourism services, Halal souvenir shops, and so on. Developing the meeting business to have the potential to provide

Halal services may lead Chiang Mai to accelerate to be a Destination City and a central hub of Muslim-friendly Halal meetings of Thailand.

Still, there are other components of Halal services that have a low availability rate (Availability value lower than 2) such as Agency, Accountability, Award, and Accommodation which all components should be developed and improved with the Advance in Business Opportunity simultaneously. The aforementioned availability components with low value may be caused by the lack of ability to provide and arrange the fundamental equipment and areas of the meetings which specified for Muslims, for example, 1) Arranging the prayer room and the washing area which provides the Muslim attendees the ability to perform religious practices throughout the day and 2) Installing fundamental equipment such as bidet shower in the toilet. Aside from preparing the fundamental equipment and areas for Muslim attendees, the organizers must have the ability to: 1) Prepare and provide Halal foods for Muslim attendees in the meeting. 2) Arrange staffs who are able to provide knowledge and service to Muslim attendees and have to ability to solve immediate problems. And 3) Provide other services in case the meeting was held on a special or religious day, or fasting month, and so on.

Even though the components of Amenity, Attraction, Activity, and Accessibility have a high availability value of Halal services (Availability value higher than 2) especially Amenity which has the highest Availability value but not far too high compared to other components. If we consider the details of Amenity, it is shown that the Halal meetings in Chiang Mai must take place in Halal/Muslim-friendly hotels, requires fundamental equipment and areas for Muslims in the meeting venue, preparation of Halal foods, staffs must be arranged to assist the Muslim attendees, and special services must be prepared if needed by Muslims (e.g., interpreter or translator service) and etc. Meeting businesses in Chiang Mai has the potential to provide each aforementioned service as it correlates with Halal tourism in the present, which the data are collected from interviewing those who associate with Halal tourism in Chiang Mai.

It can be said that the availability of Halal services in meeting businesses is important, but what matters the most is to have the agencies, organizing companies, and service providers associated with the meetings the knowledge and information of Halal services, principles, and guidelines. Both public and private agents who supervise MICE business in Chiang Mai must co-operate and plan to handle Muslim MICE travelers in the future and onwards.

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Factors affecting teachers' Job Satisfaction and Job Mobility in International Schools in Chiang Mai

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Abstract

This study examined the factors determining job satisfaction and intention to leave job of international school teachers in Chiang Mai. An online survey was used to collect data from 110 teachers from 15 international schools. The factors examined included teacher demographic characteristics, teaching level, work characteristics and environment, and internal incentives. The Ordered Probit model was then used to estimate the relationships between the explanatory factors and the job satisfaction and intention to leave variables.

The results showed that teacher characteristics had little effect on job satisfaction or intention to leave, except for nationality and years of experience. Thai teachers with more years of experience tended to be less satisfied with their jobs, but also had a lower tendency to quit. Teachers at the kindergarten level tended to be more satisfied than teachers who taught at a higher level or at multiple levels. Job characteristics and work environment were the most important factors. Specifically, teachers who felt they were under a lot of time pressure or felt they were being paid unfairly were more likely to be dissatisfied and more likely to leave their jobs. Teachers who received advice from their supervisors were significantly more satisfied, and teachers who stated to have challenging students were less likely to report leaving their jobs. Regarding internal incentives, only teachers who felt accomplished were significantly more satisfied and less likely to leave their jobs.

Since the most important factors in both job satisfaction and intention to leave are time pressure, fair pay, and a sense of accomplishment, international school administrators should prioritize teacher time management and a fair payment-reward structure.

Keywords: Job satisfaction, Job mobility, International school teachers
JEL Classification: J01, J28, J60

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1. Introduction

International education in the globalization is growing very rapidly. Specifically, in Asia, a high demand for a "Western-style" education and the growing prominence of the International Baccalaureate and Cambridge Assessment system. (Top universities, 2019). As for international schools in Thailand that allowed to open since 1975 also has similar to the world's trend which are under the international education school in Thailand's policy. There were four main curriculums includes American curriculum, British curriculum, International Baccalaureate curriculum (IB) and other national curriculums such as Australian, Canadian, French, German, Japanese, and Singapore. (Office of the private education commission, 2019)

According to Office of the private education commission (2019) reported that the number of international schools in Thailand continuous increasing year by year from 2008 to 2012. The number of international schools in Bangkok increased from 81 to 91 schools while the number of international schools in others such as Chiang Mai, and Chonburi, has increased from 33 to 47 schools. In addition, the trends of international schools in Chiang Mai are continually expanding over 10 years with number of international schools from 11 schools in 2015 to 15 schools in 2019. (Prachachat, 2019)

However, there is the teacher shortage problem that Thailand is facing even if the international school international school in the region area has trend that always increase. (Office of the private education commission, 2019) In addition, the turnover rate for international school teachers in Chiang Mai was high at 13% and varied across schools ranging from 5 % to 25% which overseas teachers recruited per year ranging from 4 to 15 teachers. (Teacher horizons, 2021) Some of the results that international school faced the turnover problem is most of international school's teachers is foreigner. The working contract is around two years and then they decided to move on for new school or go back to their country (Bangmai, 2015). The turnovers reduce efficiency of the education industry as it occurs higher training costs and experienced teachers are more likely to be more productive. The understanding of factors affecting satisfactions or the decision to leave are key information needed to develop solution leading to decent jobs and economic growth. (SDGs 8)

Some of the results that international school faced the turnover problem is most of international school's teachers is foreigner. The working contract is around 2 years and then they decided to move on for new school or go back to their country (Bangmai, 2015).

From previous studies, teachers' job satisfaction and intention to leave affected by many variables which can separated into external factors and internal factors. Alshmemri et al. (2017); Rani et al. (2018); Federici & Skaalvik (2012) reported that advice from supervisor and relationship of teachers are positively affected to job satisfaction. Teachers who had more time pressure from their workload would have less job satisfaction and teachers who felt fair with their money condition would more satisfied with their job. (Skaalvik & Skaalvik, 2011; Mudor & Tooksoon, 2011; Khani & Mirzaee, 2015; Rani et al., 2018) However, the student's behavior was not be realized as discipline problem by the teachers. (Skaalvik & Skaalvik, 2017)

Furthermore, teachers who receive more achievement and freedom to design their teaching processes would more satisfied with their job. (Skaalvik & Skaalvik, 2017; Rani et al., 2018) On the other hand, teachers who felt energy loss and had more

insensitive feeling would have more intention to leave their job. (Skaalvik & Skaalvik, 2011; Federici & Skaalvik, 2012; Skaalvik & Skaalvik, 2017)

As a result, the problem of international school teachers that has turnover rate over the year should be solve and concern. The aims of this study were (1) to examine factors affecting job mobility in international school teachers in Chiang Mai. and (2) to examine factors affecting job satisfaction in international school teachers in Chiang Mai.

2. Methodology

2.1 Data

In this study, the questionnaires were used to collect the data of 110 respondents (30 Thai teachers and 80 foreign teachers) from 15 international schools. This is accounted for 27.5% of total international school teachers in Chiang Mai. The questionnaires were separated into three parts includes (1) demographic data, (2) teacher and school characteristic and (3) factors affecting to job satisfaction and job mobility.

2.2 Variables

Factors affecting can be separated into two parts include a) external factors b) internal factors. (Alshmemri et al. 2017)

a) External factors

Work attitude or work environment refers to external factor that come from outside of the individual includes Advice, Relationship, Student's behavior, Time pressure and Money aspect.

b) Internal factors

Internal factors refer to individual emotional that driven by an interest or enjoyment which take by themselves include Accomplished, Freedom, Energy loss and Insensitive feeling.

2.3 Ordered Probit model

The object of this study is to examine factors affecting job mobility and job satisfaction in international school teachers in Chiang Mai. Since the value of job satisfaction and motivation to leave is rating scale, the Ordered Probit model was used to analyze the underlying to be characterized as follow,

$$y^* = x^T\beta + \varepsilon$$

where y^* is the exact but unobserved dependent variable; x is an independent variable vector including teachers' demographics, teaching levels, Work attributes/ environment and Internal stimuli and β is the vector of regression coefficients which we wish to estimate. y is taking one of the values y = 1,2,3,4 and 5 as follow:

$$y = \begin{cases} 1 \text{ if } y^* \leq \mu_1, \\ 2 \text{ if } \mu_1 < y^* \leq \mu_2, \\ 3 \text{ if } \mu_2 < y^* \leq \mu_3, \\ 4 \text{ if } \mu_3 < y^* \leq \mu_4, \\ 5 \text{ if } y^* \geq \mu_4 \end{cases}$$

Then the Ordered Probit technique will use the observations on y, which are a form of censored data on y^*, to fit the parameter vector β. (Greene & Hensher, 2010)

3. Results and discussion

In this study, the objective was to examine factors that affecting job mobility and job satisfaction in international school teachers in Chiang Mai included teachers' demographics, teaching level, work attributes/environment and internal stimuli.

The results from 110 respondents in international school in Table 2 described Dependent variables, Teachers' demographics, Teaching level, Work attributes/ environment and Internal stimuli. For the teacher's demographic, it shows that there was female for 58% which is 64 of total respondents. The average of ages is around 34 years old. In term of the nationality shows that 27 percent of teachers are Thai and most of those teachers have no child. In addition, teacher that teach in only kindergarten was 5%, elementary which combine primary and junior high or middle school for 41% and high school level for 35%.

The results of average rate of work attitude/environment in term of external factors can be separated into five variables. This implied that most of teachers agree that they received an advice or recognitive from their supervisor (3.62), had good relationship toward their student, colleague and supervisor (3.94) and felt fair their monetary aspect (4.21). On the other hand, the sample did not have time pressure (2.35). Moreover, they felt neutral with the student's disruptive behavior (2.73).

The average rate of internal stimuli can be separated into four variables. In this study, it found that most teachers agree that they felt free (4.45) and felt successful of achievement with their work (3.95). On the other hand, the sample disagree with feeling of energy loss (1.54). Moreover, they did not have insensitive feeling with their work (1.46).

In this study, to measure job satisfaction, respondents were asked to fill their levels of agreement to three rating questions including; (Satisfaction1) Working as a teacher is extremely rewarding, (Satisfaction2) I enjoy working as a teacher and (Satisfaction3) If I had to start my career again, I would take my current job. To measure the intention to leave, two rating questions were asked including; (Leave1) I wish I had a different job to being a teacher and (Leave2) I often think of leaving my current workplace. The average rates of satisfaction are 4.55 (very satisfied), 4.80 (very satisfied) and 4.34 (satisfied) respectively. The average rates of intention to leave are 1.76 (somewhat improbable) and 1.58 (somewhat improbable) respectively.

Table 3 shows the Ordered Probit model. For the job satisfaction models, the higher order implies to the higher satisfaction level. For the intention to leave models, the higher order imply to the higher intention to leave which the interpretation shows in Table 1. The result shows that gender and age have no effected to job satisfaction and intention to leave. In addition, teachers who teach in only kindergarten level were more satisfied than teachers in other wise.

In addition, Teacher who has more intention to leave was positively significant related to time pressure as follow as Skaalvik & Skaalvik (2017) In contrast, this makes it possible to the students' behavior has negatively relationship with intention to leave which related to the result of Skaalvik & Skaalvik (2011) reveal that disruptive behavior of students were unrelated to their expected that some of students' behavior may not be realized as discipline problem by the teachers.

For teachers' job satisfaction, there was positively significant related to internal stimuli which is accomplished. Furthermore, there was related to external variables that refer to work attributes/environment which show the positively significant relationship with advice and money aspect while time pressure was negatively significant related to teachers' job satisfaction according to Skaalvik & Skaalvik (2011); Skaalvik & Skaalvik (2017) found that there was positively relationship among the supports from school leaders and monetary compensation with teachers' job satisfaction while time pressure from over workload was negatively related to teachers' job satisfaction.

Table 1. Result Interpretation by 5-point Likert scale

Scale	Result	Job satisfaction	Intention to leave
1.00 – 1.49	Strongly disagree	Very dissatisfied	Not probable
1.50 – 2.49	Disagree	Dissatisfied	Somewhat improbable
2.50 – 3.49	Neutral	Neutral	Neutral
3.50 – 4.49	Agree	Satisfied	Somewhat probable
4.50 – 5.00	Strongly Agree	Very satisfied	Very probable

Table 2. Variable description

Variable	Description	Mean	SD
Dependent variables			
Satisfaction 1	Working as a teacher is extremely rewarding.	4.55	0.63
Satisfaction 2	I enjoy working as a teacher.	4.80	0.46
Satisfaction 3	If I had to start my career again, I would take my current job.	4.34	0.85
Leave1	I wish I had a different job to being a teacher.	1.76	0.89
Leave 2	I often think of leaving my current workplace.	1.58	1.01
Teachers' demographics			
Gender	Gender dummy variables (=1 if female only, =0 otherwise)	0.58	0.50
Age	Age of the respondent in years.	33.95	9.08
Thai	Nationality dummy variables (= 1 if the respondent is Thai, =0 otherwise)	0.27	0.45
Children	Number of children (person)	0.49	0.74
Total year of teaching experience	Total year of teaching experience (years)	9.60	8.11
Teaching level (Baseline: Teach multiple levels)			
Kindergarten	Kindergarten dummy variables (=1 if teaching kindergarten only, =0 otherwise)	0.05	0.23
Elementary	Elementary dummy variables	0.41	0.49

Variable	Description	Mean	SD
	(=1 if teaching for 1 level only, =0 otherwise)		
High school	High school dummy variables (=1 if teaching for 1 level only, =0 otherwise)	0.35	0.48
Work attributes/ environment			
Advice (+)	Teacher's experiences of receiving cognitive and emotional support from the school leadership.	3.62	0.63
Relationship (+)	Teacher has a good relationship among teacher, collages, parent and student.	3.94	0.59
Student's behavior (-)	Students at school have disruptive behavior and difficult to be controlled.	2.73	0.68
Time pressure (-)	Teacher's workload or workday.	2.35	1.02
Money (+)	Income or money that teacher receive is fair.	4.21	0.72
Internal stimuli			
Accomplished (+)	Feeling of successful achievement in teacher's work.	3.95	1.00
Freedom (+)	Feeling of freedom while working.	4.45	0.60
Energy loss (-)	Feeling of energy loss from working.	1.54	0.80
Insensitive feeling (-)	Insensitive feeling toward students and colleagues.	1.46	0.64
N	110		

Table 3. Factors determining Job Satisfaction and Intention to Leave

	Satisfaction 1	Satisfaction 2	Satisfaction 3	Leave 1	Leave 2
Teachers' demographics					
Gender	-0.201	-0.179	-0.317	0.019	0.232
	(-0.619)	(-0.410)	(-1.081)	(0.067)	(0.652)
Age	0.043	0.002	0.050	-0.003	0.062
	(0.904)	(0.040)	(1.087)	(-0.064)	(1.146)
Thai	-0.679**	-0.432	-0.009	0.137	-1.021**
	(-1.993)	(-0.906)	(-0.029)	(0.448)	(-2.410)
Children	-0.089	0.373	0.312	-0.134	-0.704
	(-0.261)	(0.744)	(0.973)	(-0.427)	(-1.393)
Teaching experience	-0.093*	-0.059	-0.056	0.002	-0.115*
	(-1.931)	(-0.967)	(-1.209)	(0.061)	(-1.708)
Teaching level (Baseline: Teach multiple levels)					
Kindergarten only	-0.735	0.905	2.115**	0.441	0.777
	(-0.998)	(0.704)	(2.466)	(0.634)	(1.058)

	Satisfaction 1	Satisfaction 2	Satisfaction 3	Leave 1	Leave 2
Elementary only	-1.170***	-0.994	-0.113	1.196***	0.286
	(-2.619)	(-1.616)	(-0.311)	(2.888)	(0.536)
Junior/High school only	-0.686	-1.434**	0.270	0.280	0.650
	(-1.517)	(-2.287)	(0.699)	(0.653)	(1.217)
Work attributes/ environment					
Advice	0.898***	1.209***	0.911***	-0.399	-0.218
	(3.167)	(2.906)	(3.455)	(-1.593)	(-0.608)
Relationship	0.476*	0.053	0.014	0.422*	-0.479
	(1.685)	(0.126)	(0.058)	(1.756)	(-1.480)
Student's behavior	-0.134	0.318	0.407	-0.808***	-0.732**
	(-0.444)	(0.729)	(1.439)	(-2.945)	(-1.982)
Time pressure	-0.189	-0.750**	-0.667***	0.645***	0.713**
	(-0.889)	(-2.249)	(-3.265)	(3.194)	(2.368)
Money aspect	0.197	1.052***	0.502**	-0.331*	-0.568**
	(0.892)	(3.502)	(2.476)	(-1.651)	(-2.272)
Internal stimuli					
Accomplished	0.359**	0.372*	0.581***	-0.644***	-0.211
	(2.368)	(1.691)	(3.987)	(-4.222)	(-1.177)
Freedom	0.478*	0.289	-0.298	-0.016	-0.529
	(1.655)	(0.778)	(-1.149)	(-0.061)	(-1.563)
Energy loss	0.665	1.061	0.737	0.171	1.548***
	(1.303)	(1.166)	(1.588)	(0.411)	(2.707)
Insensitive feeling	-0.770	-0.992	-0.499	0.704	-0.979
	(-1.302)	(-1.055)	(-0.933)	(1.412)	(-1.538)
Cut 1	5.842**	6.173*	4.347*	-2.795	-5.708**
	(2.451)	(1.756)	(1.869)	(-1.364)	(-2.182)
Cut 2	7.560***	8.062**	4.950**	-1.249	-4.677*
	(3.111)	(2.261)	(2.174)	(-0.614)	(-1.803)
Cut 3			6.205***	0.596	-3.833
			(2.721)	(0.295)	(-1.493)
Cut 4			7.479***	1.409	-0.981
			(3.239)	(0.684)	(-0.373)
N					110

Note: (1) z-statistics in parentheses
(2) *** p<0.01, ** p<0.05, * p<0.1
(3) No respondents answered 1 or 2 for Satisfaction 1 and Satisfaction 2. Therefore, Model 1 and Model 2 have no coefficient for Cut 3 and 4.

5. Conclusion and recommendation

In this study, factor affecting on job satisfaction or intention to leave can be explained by teachers' characteristic, external and internal factors. On the other hand, the result show that there was factor that non-affected and affected with positively and negatively relationship with teachers' job satisfaction and intention to leave. The results show that Thai teachers with more year of experience has less job satisfaction but also had less intention to leave their job. In addition, for the education level show that kindergarten's teachers had more satisfaction with their job than teachers who taught at other education levels. In the work attitude and work environment factors refer to external factors show that teacher who had more time pressure from workload and felt unfair with their monetary aspect would have more intention to leave. On the other hand, teachers with less time pressure from their workload and felt fair with their monetary has more job satisfaction. Furthermore, there was only accomplished that significant as an internal factors. This factor reveals that teachers who felt accomplished would be more satisfied and less intention to leave.

As a result, there were time pressure, money aspect and accomplished that affected to both job satisfaction and intention to leave. the recommendation from this study to international school administrators would be prioritize teacher time management and a fair payment-reward structure. Policies to improve job satisfactions and reduce turnover, not only will create more decent jobs for teachers, but also improve quality of education leading to better human capital development. In addition, it would be helpful for the further research to obtain additional factors that would be affected job satisfaction and intention to leave in this area or even if other areas.

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The Impact of Air Quality Perception on People's Averting Expenditure in Chiang Mai

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Abstract

PM2.5 is an air pollution problem that affects public health. People need to protect themselves by wearing a PM2.5 mask, using an air purifier, or spending more time indoors. Self-protective behaviors are often based on the perception of air quality. The objectives of this study were (1) to examine the relationship between the air quality perception (AQP) and socioeconomic characteristics and (2) to examine the effect of the AQP on averting costs. Data were obtained from a survey of 600 people who had lived in Chiang Mai for at least one year.

In this study, the perception of air quality was based on Deguen et al. (2012). These variables ranged from 0 to 1, where 0 means no perception of air quality and 1 means perfect perception of air quality. The regression model with robust standard error was used to examine the relationship between air pollution perception and socioeconomic characteristics. The Seemingly Unrelated Regression Estimation (SURE) model was used to estimate the effect of air pollution perception and other control variables on the three averting costs (wearing a PM2.5 mask, using an air purifier, and spending more time indoors).

The results showed that the mean and median values of AQP were 0.3990 and 0.3874, respectively. The perceived quality level was higher if the sample was Generation Y, female with a bachelor's degree or higher. Moreover, number of family members with respiratory diseases, living in an area with PM2.5 concentration above the standard and knowledge level about PM2.5 were also significant factors. The perception of air quality was found to significantly increase all averting costs. Samples with a bachelor's degree or higher also had higher pollution prevention costs for all items. In addition, income had a positive effect on the cost of using air purifiers only. This is due to the fact that air purifiers were more expensive than other measures. Generation Y respondents had significantly lower expenditures for staying indoors than Generation X respondents.

Exposure to air pollution can cause respiratory problems. Self-protection can significantly reduce adverse health effects. As self-protective behavior increases with perception of air quality, information on the health risk associated with PM2.5 should be made available to all.

Keywords: Air pollution, air quality perception, averting costs, avoidance behavior
JEL Classification: I12, Q53

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1. Introduction

Pollution of the air, water, soil and workplace is an important threat to human development. The UN Sustainable Development Goals (SDGs) have a strong focus on reducing environmental pollution (UN, 2015). Specifically, SDG 3.9 seeks to "substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination" by 2030.

Global Assessment of Air Pollution Legislation (GAAPL) provides recommendations to strengthen air quality governance as well as guides countries to effectively address air pollution and contribute to achieving the Sustainable Development Goals (SDGs) (UN, 2021).

Thailand faces serious air pollution problems, with PM2.5 concentrations the third highest on Southeast Asia after Indonesia and Vietnam. The main source of air pollution is generally open burning and vehicle combustion. In particular, pollution associated with the expansion of monocultures contributes to transboundary air pollution in neighboring countries such as Singapore, Brunei, Malaysia, the Philippines and Thailand (SIIA, 2016).

Air pollution problems often affect people's health. They need to protect themselves from being exposed to air pollution by changing their behavior or refraining from outdoor activities (Matthew, 2006; Neidell, 2009; Graff Zivin and Neidell, 2009). Some of them have to spend more time at home when smog is present (Sheldon and Sankaran, 2017). People need to wear PM2.5 masks when they are outdoors (Liu T., He G., & Lau A, 2018; Zhang and Mu, 2018). Air purifiers are commonly used to clean indoor air. Therefore, due to air pollution, some people have to spend more money that they would use on other consumer products, and some of them restrict themselves indoors to reduce health risks.

The risk defined by experts, does not always coincide with nonexpert perceived risk (AFSSET, 2006). In general, risk perception is subjective and depends on personal characteristics, social and cultural background. (Finucane, 2005; Setbon, 2006; Bickerstaff, 2004) Individuals are willing to take risk partly because they balance between exposure costs and perceived benefits (Setbon, 2006). This emphasizes that variation in perceived risk would lead to different averting behaviors.

Previous research studies have found that air pollution perception, such as smelling or seeing smog, is related to air pollution avoidance behaviors (Bresnahan, et al., 1997; Qin & Zhu, 2018). This is because each person attaches different importance to protection from air pollution problems. Previous studies have found that perceptions of air quality are related to age, education level, health status, gender, and smoking behavior (Guo et al., 2016; Pantavou et al., 2018).

Chiang Mai is affected by forest fires, with the largest burned areas in the north of Thailand (Department of Forest Fire Control, 2021). Due to its geographical location, air pollution in Chiang Mai is one of the most serious problems in the country. The objectives of this study were (1) to examine the relationship between AQP and socioeconomic characteristics and (2) to examine the impact of AQP on averting cost.

2. Methodology

2.1 Data

Data are from a survey of 600 people in Chiang Mai. The sample is people with Thai nationality who have lived in Chiang Mai for at least one year. The questionnaire includes (1) socioeconomic characteristics, (2) knowledge of PM2.5, (3) perception of air quality during January to April 2021, (4) averting behavior by wearing PM2.5mask, using an air purifier, and staying home (in-door) longer, and (5) costs incurred from avoidance behavior.

2.2 Variables

The variables computed from the survey data consisted of 2 variables: a) perceived air quality and b) 3 averting costs of wearing a PM2.5 dust mask, using an air purifier. and spending more time at home

a) air quality perceptions *(AQP)*

The AQP index used in this study is based on Deguen et al. (2012). They developed a new tool including many aspects of the perception related to air pollution exposure to an individual scale of AQP. To measure individual perceptions of air quality, respondents must answer a series of questions related to sensory irritations such as unpleasant odors and perceived risks related to health or quality of life. For each question, there are four response options ranging from 0 to 3, where 0 is never, 1 is occasionally, 2 is frequently, and 3 is always. However, if respondents are unable to indicate the level of irritation, they have the option to answer "do not know". This is counted as a missing response. The AQP index can be calculated as follows:

$$AQP_i = \frac{\left(\sum_{j=1}^{k} X_{ij}\right)}{\left[3\left(k - m_i\right)\right]}$$

Where AQP_i = perception score of respondent i

X_{ij} = answer choice of question j of respondent i

k = total number of questions

m_i = missing responses of respondent i

These variables ranged from 0 to 1, where 0 means no perception of air quality and 1 means perfect perception of air quality.

b) *Averting costs*

Averting cost method is a technique of valuing the environment by examining the cost to individuals of not being exposed to undesirable things, or the cost of not being exposed to pollution. Individuals would engage in pollution avoidance behavior

as long as the damage value of pollution is greater than the cost of avoiding pollution. P.M 2.5 in the air is considered harmful to human health. Due to the pollution, people therefore have behaviors to avoid or reduce risks through various methods, such as wearing a PM2.5 mask, using an air purifier, or spending more time at home. In this study, only the costs associated with the three averting behaviors were evaluated because these methods are the most practical according to our survey. The respondents may use more than one method or none at all. Costs were calculated for 4 months (January to April 2021) when air pollution is at its highest in a year. The details of the cost evaluation are shown in Table 1.

Table 1 Assessment of averting cost of air pollution

Method	Cost calculation
wearing a PM2.5 mask	Number of masks used in 4 months times average price per piece. In the case where respondents have more than one purpose for wearing masks, such as preventing Covid-19, the cost is estimated to be only 50 percent. However, if respondents wear PM2.5 masks primarily to prevent Covid-19, mask expenditures are not evaluated.
using an air purifier	Depreciation cost from the use of air purifiers during 4 months and the cost of air purifier filters
spending more time at home	Number of additional hours spent at home in 4 months times amount of electricity per unit hour.

2.3 Cost estimation

The robust standard error regression model was used to examine the relationship between perceptions of air pollution and socioeconomic characteristics. Since people can have more than one risk avoidance behavior, each element can be substituted by another. Therefore, the Seemingly Unrelated Regression Estimation (SURE) was used to estimate the effects of air pollution perception and other control variables on the three averting costs (wearing a PM2.5 mask, using an air purifier, and spending more time indoors). (Greene W., 2012, p.332)

3. Results and Discussion

The results of the survey of 600 people living in Chiang Mai are presented in Table 2. It was found that most of the samples were female and accounted for 66.5 percent of the total sample. The average age of the respondents was 37.33 years[5]. When the samples are divided into generations X and Y, the percentages are 39.3% and 60.7% respectively. In addition, 52.8% of the samples lived in areas with excessive PM2.5 standard levels (above 50 $\mu g/m^3$). Data on the economic status of the sample revealed that 4.8% were persons performing public health related tasks, such as Village Health

[5] The subjects were between 25 and 50 years old, as the study was part of Time Preferences for Money and Health Effects from COVID-19 and Air Pollution. Therefore, there is a limitation on the age of the sample.

Volunteers (VHVs), patient care workers, or rescue workers. The average personal income was 12,768.38 baht per month. The knowledge score on PM2.5 problem was an average of 8.305 points out of 12.

a) perceptions of air pollution and socioeconomic characteristics

The AQP index ranged from 0 to 1. The air quality perceived by the sample was low, with a mean of 0.3990 and a median of 0.3874. Most respondents perceived the air quality as low and moderate, accounted for 48.3% and 37.7% respectively. There was only 1.0% of the respondents perceived air quality as highest.

The estimation of the relationship between perceptions of air pollution and socioeconomic characteristics, suggested perceived quality level was higher if the sample was Generation Y, female with a bachelor's degree or higher. Moreover, number of family members with respiratory diseases, living in an area with PM2.5 concentration above the standard and knowledge level about PM2.5 were also significant factors (Table 3). The effects of education level and household characteristics in this study are consistent with previous studies. People with higher education have a better understanding of the health effects of air pollution and are more concerned about environmental problems (Badland and Duncan, 2009; Guo et al. 2016). In addition, women and people under 40 years old have a better perception of air pollution (Pantavou et al., 2018). This is because they focus on air pollution than men and over 40s (Liao et al., 2015).

b) Air pollution averting costs and perception of air quality

The Averting behaviors from air pollution used in this study consisted of 3 methods. 28% of the respondents wore PM2.5 masks, 26.5% of the respondents used air purifiers and 27.2% of the respondents spent more time at home. However, 41.83% of the sample group did not apply the above behaviors.

The averting cost assessment from January to April 2021 for a period of 120 days showed that the average costs of using PM2.5 masks, using air purifiers and staying home longer was 586.02 Baht, 526.50 Baht and 597.94 Baht per person, respectively.

Applying these results to a population of 1,763,742 people in Chiang Mai (National Statistical Office, 2020), we find that the population who protect themselves by wearing PM2.5 dust masks, using air purifiers, and spending more time at home are 493,848 people, 467,392 people, and 479,738 people, respectively, accounted for 289 million Baht, 246 million Baht, and 287 million Baht, respectively. Therefore, the total averting cost is about 822 million Baht in 2021. This figure is far lower than Attavanich's (2019) estimate of the total cost of damages resulting from willingness to pay for PM10 reduction. He estimated that the cost of air pollution reduction in Chiang Mai was 1,855 million baht per year. There are 2 possible explanations for this difference. First, it could be because our study only considered 3 averting methods. There are some other averting methods such as installing water sprinklers or renovating buildings. Second, the limitation of the abatement cost method is that it was assumed that abatement behavior can perfectly restore environmental quality. When this assumption is not true, the abatement cost method provides only a lower bound on the environmental value.

Table 4 shows the estimation result of SURE model. The perception of air quality was found to significantly increase all averting costs. Samples with a bachelor's degree or higher also had higher pollution prevention costs for all items. In addition, income had a positive effect on the cost of using air purifiers only. This is due to the fact that air purifiers were more expensive than other measures. Generation Y respondents had significantly lower expenditures for staying indoors than Generation X respondents. Gender and the number of family members with respiratory disease did not significantly affect the averting cost of pollution. It is possible that these variables indirectly influence the cost through AQP.

The results of this study are consistent with Um et al (2002) and Abrahams et al (2000). People with higher incomes, who are younger and have a good perception about environmental quality, pay more attention to protective behavior and the level of education is not a significant factor. However, it does not agree with Whitehead (1998). He found that individuals with a bachelor's degree and above increased the use of water filters and purchase of bottled water to protect themselves from contaminated water.

Table 2 Summary statistics of variables

Variable	Description	Mean	S.D
Socioeconomic/demographic characteristics			
Female	Gender dummy variables (=1 if female only, =0 otherwise)	0.665	0.472
Age	Age of respondents	37.330	7.890
GenX	Generation X dummy variables (=1 if generation X only, =0 otherwise)	0.393	0.489
	Age of generation X group (years old)	45.542	2.891
GenY	Generation Y dummy variables (=1 if generation Y only, =0 otherwise)	0.607	0.489
	Age of generation Y group (years old)	32.011	5.010
Bachelor and higher	Education dummy variables (=1 if Bachelor's degree or higher only, =0 otherwise)	0.443	0.497
Public health related occupation	Occupation dummy variables (=1 if occupation related to public health only, =0 otherwise)	0.048	0.215
Sick member	Number of family members with respiratory diseases (persons)	0.137	0.438
Income	Monthly personal income (Bath)	12,768.38	9,497.31
PM2.5	PM2.5 concentration dummy variables (=1 if living in an area with the average of PM2.5 concentration above the standard, =0 otherwise)	0.528	0.500
Knowledge	Respondents' knowledge level about PM2.5	8.305	1.800
Perception of air quality			
Perception level	Respondents' perception level (0 = no perception and 1 = perfect perception)	0.399	0.141
	▪ Very low perception (0 – 0.200)	0.055	0.228
	▪ Low perception (0.201 – 0.400)	0.483	0.500
	▪ Moderate perception (0.401 – 0.600)	0.377	0.485
	▪ High perception (0.601 – 0.800)	0.075	0.264
	▪ Very high perception (0.801 – 1)	0.010	0.100
Averting costs (Bath/per person/4 months)			
PM2.5mask	Respondents wearing a PM2.5 mask[a] (%)	28.0	-
	Cost of wearing a PM2.5 mask[b]	586.02	808.07
Air purifier	Respondents using an air purifier[a] (%)	26.5	-
	Cost of using an air purifier[b]	526.50	754.84
Stay home	Respondents spending more time indoors[a] (%)	27.2	-
	Cost of spending more time indoors[b]	597.94	826.98
None	Respondents without averting behavior (%)	41.83	-

Note: Data from baseline survey, one observation for each of the 600 respondents.

[a] Multiple answer possible

[b] Only those with positive value

Table 3 Robust regression on AQP

Perception	Robust Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Constant	0.2701	0.0251	10.78	0.000	0.2208	0.3193
GenX	**-0.0201***	0.0116	-1.73	0.084	-0.0428	0.0027
Female	**0.0263****	0.0111	2.38	0.018	0.0046	0.0481
Bachelor and higher	**0.0690*****	0.0119	5.80	0.000	0.0456	0.0923
Sick member	**0.0487*****	0.0108	4.49	0.000	0.0274	0.0700
PM2.5	**0.0399*****	0.0108	3.69	0.000	0.0187	0.0611
Knowledge	**0.0074****	0.0028	2.59	0.010	0.0018	0.0129
R-squared	0.1420					
N	600					

*, **, and *** represent statistical significance of variables at the 10%, 5%, and 1% levels

Table 4 Seemingly Unrelated Regression on air pollution averting costs

Equation	Obs	Parms	RMSE	R-sq	chi2	P
ln(PM2.5mask)	600	7	2.1042	0.0410	25.68	0.0006
ln(Air purifier)	600	7	2.3095	0.2045	154.22	0.0000
ln(Stay home)	600	7	2.5649	0.0770	50.03	0.0000

Averting costs	PM2.5 mask		Air purifier		Stay home	
	Coef.	p-value	Coef.	p-value	Coef.	p-value
Constant	-0.9986	0.469	-8.2024	0.000	-2.9867	0.076
GenX	0.1242	0.495	-0.1383	0.489	**0.3661***	0.099
Female	-0.0457	0.806	0.1164	0.570	0.2193	0.335
Bachelor and higher	**0.3984***	0.055	**0.4781****	0.036	**0.6533****	0.010
Sick member	0.0140	0.944	0.2435	0.265	-0.0778	0.748
Public health related occupation	0.5448	0.177	0.5598	0.206	0.6749	0.170
ln(Income)	0.0926	0.536	**0.7904*****	0.000	0.2838	0.120
Perception	**2.1050****	0.001	**5.3355*****	0.000	**3.3058*****	0.000

*, **, and *** represent statistical significance of variables at the 10%, 5%, and 1% levels

4. Conclusions

Perceptions of air quality are related to socioeconomic characteristics such as age, gender, and education level, as well as family characteristics such as the health status of family members. Since air pollution is noticeable, people's perceptions increase when PM2.5 concentration in the living area is above the standard. We estimated that the cost of averting air pollution would be 822 million baht in 2021. Perception of air quality is an important factor that determines avoidance behavior. According to our study, people with high perception of air quality spend more averting costs. However, the impacts of other characteristics on avoidance costs vary depending on the averting methods.

Exposure to air pollution can cause respiratory problems. Self-protection can significantly reduce adverse health effects. As self-protective behavior increases with perception of air quality, information on the health risk associated with PM2.5 should be made available to all. This result found that if we increase AQP, information on the health risk associated with PM2.5 may reduce the number of illnesses from air pollution. Therefore, this research will promote SDGs 3.9, which it has a strong focus on reducing environmental pollution (UN, 2015).

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An Analysis of Local Food Adoption in Business Events: A Transaction Cost Economics Approach

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Abstract

This article addresses the specific issue of antecedents of local food adoption in business events in the academic levels in Thailand. It aims to investigate antecedents of local food adoption business events, particularly in Thailand. This study applies the model of Structural Equation Model (SEM) together with the tools of questionnaire to make a quantitative research of local food adoption behavior with the theories background of Transaction Costs Economics (TCE) and Theory of Planned Behavior (TPB), with measurement items being originated from both TCE and TPB. In the process of analyzing data, both Confirmatory Factor Analysis (CFA)and Structural Equation Modeling (SEM) are used to validate the reliability, validity of the study. The regression results suggest that Transaction Costs (TC) of local food adoption behavior have significant negative correlation in academics' Behavioral Intention (BI) of local food Adoption Behavior (AB), among which information cost is found to be the most significant influencer. Therefore, it is suggested that stakeholders or policy makers should reduce the transaction costs of local food adoption and facilitate the information channels of local food, thus alleviating the local food searching information costs and encouraging the local food adoption behavior.

Keywords: local food adoption; business events; Theory of Planned Behavior (TPB); Trans-action Costs Economics (TCE); Behavioral Intention (BI); Transaction Costs (TC); Confirmatory Factor Analysis (CFA); Structural Equation Modeling (SEM)

*JEL Classification Codes:*C51; C42; D 23

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1. Introduction

Business Events. By the definition of the International Congress and Convention Association (ICCA) in 2007, Business Events also call MICE, referred to Meetings, Incentive Travels, Conventions and Exhibitions that is one type of tourism in which the event planners planned in advance and bring event attendees together for a specific theme or topic that is targeting at professionals, schools, academics, trade organizations or other interest groups. This study focuses on one type of MICE, meetings, for the fact that event organizers have high probability to serve the event participants local food with time and efforts constraints.

Local food adoption has become an increasingly popular phenomenon in business events to catch up consumers' increasing demand of local food and open the niche market by differentiation and maintain their competitiveness by serving authentic local food in many developed countries and some business venues [0] (pp.147–158). In this sense, local food is used as their competitiveness tool to differentiate themselves among the fierce venue competition with an environmentally sustainable commitment and corporate social responsibility.

Local Food Adoption. Adoption is defined as a goods, service or idea that is perceived and used by potential individuals or organizations as new though it has existed in the market for times and have not decided to become a regular user of a product [0]. Food adoption expresses individuals' consumption pattern which shifts from traditional food products to new innovative food products [0]. In this study, local food adoption can be comprehended as souring behavior shift from conventionally sourcing of food to locally souring of food, such as using local food ingredients, sourcing local food from local suppliers, using local cuisines. The yes or no dichotomous responses approach is commonly recognized as a measurement in previous studies of adoption behavior [0] (p.26-33), which will be used afterwards in questionnaire requesting respondents to rate their adoption or rejection behavior of local food. In details, respondents are supposed to rate their general yes or no dichotomous responses of local food adoption, after those respondents are requested to rate their local food adoption behavior by using numerical 5-Likert Scale (where, 1=Aware, 2=Interest, 3=Evaluation, 4=Trial, 5=Adoption) [0] (pp.453-486).

However, local food options, as one of the top-3 determinants in business events have gained increasing concerns from both event organizers and event attendees in Thailand [0] (pp.147–158). While so far, the studies of local food use in the meeting industry are taken from the attendee's perspective There is not any research studying antecedents of local food adoption in business events from the Transaction Cost Economics approach or providing transaction costs implications of the local food adoption. This study addresses the specific issue of antecedents of local food adoption in business events, especially in Thailand.

Taking the significance of the MICE industry in Thailand and the potential existing gap into consideration, this study employs the Structural Equation Modeling (SEM) to investigate antecedents of local food adoption in business events within the theoretical framework of Theory of Planned Behavior (TPB) and Transaction Cost Economics

(TCE). The empirical findings of the research are supposed to provide some managerial implications to business event industry, reducing the economic and environmental impacts brought by business events related activities, generating the long-term economic, social, and environmental sustainability between both local communities, and business events industry and further fill in the gap of local food studies in the field of meetings industry.

The structure of the paper is as follows: firstly, a brief literature review is provided, which leads to the development of the proposed conceptual model. Then, materials and methods are described, followed by the presentation and interpretations of the results. The paper ends with conclusions, limitations, implications, and future research suggestions.

2. Literature Review

As previous research reveals that with more health-concerned issues, healthy eating has gained its trend in the consumption of local food and related studies of local food have been popular in developed countries, which can bring direct and indirect benefits to the host communities [0] (pp.97-112), leading to economic, social and environmental sustainability.

Firstly, locally sourced food will thrive the local economic sustainability by promoting local production and generating revenues in the economies [0]. Adoption of local food can help hotel and business event organizers reduce the economic costs caused by purchasing long-distance conventional food. Secondly, local food helps enhance the environmental sustainability by reducing the carbon footprint, reducing gas permission and energy consumption. Furthermore, implementation of the local food practices shows business event organizers' social responsibility and reliability in response to the global sustainability concerns, which in return benefits to their client loyalty and bring long-term reliable cooperative reputation. Attendees are increasingly concerned about the food sustainability in business events and increasingly demand for ethical products and services, which drives businesses to adopt responsible behaviors [0] (pp.45-60).

To catch up the dynamic trend of local food in business events, business event stakeholders have adopted sustainable food practices initiated by World Health Organization at both regional and national level, such as purchasing local source of food with a lower Carbon footprint and food miles, offering local and seasonal fruit, vegetables so as to acquire a sustainability image. Pressure from the competitors and society, more and more event-related organizers begin to integrate the local sourced food into their sustainable menus in their organizing process to meet the MICE Food Safety Management and food sustainability. Furthermore, the local food as one of determinants of events venue selection, has become a trending option to attract business tourists and maintain their differentiated competitiveness.

While providing the local food in business events has become the hot trend, some business event organizers are reluctant to adopt the local food practices because of some "perceived barriers" [0] (pp.45-60).

Curtis and Cowee [0] pointed out that lack of awareness, lack of available authority to distinguish the originality and sourcing of local sourced food, inconsistent quality and substantial supply quantity discourage hospitality to purchase the local food. Additionally, lacking well-established networks of suppliers and buyers is another factor influencing hospitality industry's willingness to adopt local food into their menu.

Hall and Roy [0] revealed that though event organizers have gained recognition of the high value of local food, 12 identified the barriers to use local food, which included a lack of reliable and consistent year around supply, poor local and regional governance structures, poor information, food quality issues, refund policies, real-time delivery, product cost, package size and standard, payment procedure, labor time to prepare, order method and uncooperative relationships between local food producers and buyers make it not so cost-effective to purchase small scale local food when compared with purchase wholesaled food from big corporates, thus constraining their willingness to buy local food.

Strohbehn and Gregoire [0] (pp.1-7) indicated local suppliers can offset these sourcing barriers and inconvenience by offering timely information in terms of the product availability, delivery and payment flexibility to convince buyers and gain competitive advantages.

To build the SEM measurement model and the structure model for local food adoption analysis, this study applies an integrated Theory of Planned Behavior and Transaction Cost Economics approach to predict the relationship between behavioral intention and local food adoption behavior of local food. TPB builds the overall theoretical framework of the study to examine organizers' perception of local food adoption, by analyzing the Attitude, subjective Norms, Perceived Behavioral Control and Behavioral Intention.

TPB was developed from the Fishbein and Ajzen's [0,0] (pp.2222-2247). Theory of Reasoned Action (TRA), a group of psychosocial theories of human social behavior. Now, TPB has been listed in the domain of Behavioral Economics which studies how the psychological, cognitive, emotional, cultural and social factors affect the economic decisions of economic agents [0]. According to TPB and TRA, Behavioral Intention (BI) is the most significant antecedent of an Actual Behavior. Previous studies have further revealed that there exists a significant correlation of Attitudes and Subjective Norms to Behavioral Intention, and it will subsequently lead to Actual Behavior [0]. Many researchers have employed this TPB to examine the high correlation between planned behavior and local food purchasing behavior [0].

In response to some limitations of TPB in strongly explaining the economic and environmental issues, some researchers have taken the extended TPB which uses some constructs from the TPB and adds other economic variables from economic theory to make TPB generate higher predictive validity of behavioral intentions [0] (pp.2222-2247). So, apart from Theory of Planned Behavior, this study also uses Transaction Cost Economics (TCE) in conjunction with TPB to investigate antecedents of local food

adoption in the context of meetings to improve the predictability of TPB in explaining behaviors relating to economic behaviors.

TCE has been widely applied in economics, especially in the new organization theory [0] (p.1-33). In previous studies, TCE have been widely applied to explain the local food networks and local food purchasing from consumers' perspective. This study adopts Williamson's [0] (pp.1-33) measurement of Transaction Costs due to the fact that his definition is approachable to measure the Transaction Costs in different stages of organizers' local food adoption behavior, including arranging a contract before signing, monitoring, and enforcing. Williamson's measurement of Transaction Costs will be used in the SEM in the construct of Transaction Costs of local food adoption to investigate the correlationship among TCE and TPB in explaining organizers' local food adoption behavior in the context of meetings.

3. Development of the Empirical Model

As previous studies of local food suggested, the Theory of Planned Behavior can serve as a satisfactory model framework to explain the behavior relating to local food, consisting of Attitudes, Subjective Norms, Perceived Behavioral Control and Behavioral Intentions. This study recognizes the limited predictive ability of TPB in explaining the economic and environmental issues, therefore, the constructs of Transaction Costs from TCE is extended into the TPB to improve the predictive validity of behavioral intentions. The role of TCE in the theoretical framework of TPB will be further examined. For better proceedings of following hypotheses constructs. This part handles with antecedents of local food adoption in the context of hospitality industry within the theoretical framework of TCE and TPB.

Williamson [0] (pp.1-33) mention that information asymmetry and specific asset investment contributed to uncertainty and further increased Transaction Costs from the transactional condition perspective. From the opportunistic condition perspective, opportunism is influenced by the "feeling for the entity," representing one's favorable or unfavorable evaluations of the specific transaction partner, the group or the organization [0] (pp.1-33). This interpretation was in line with Ajzen and Fishbein's [0]Theory of Reasoned Action, the originality of TPB. Eagly and Chaiken [0] suggested that a negative feeling for the entity would increase opportunism which increase Transaction Costs.

North et al., [0] mention that ideological attitudes and perceptions, one of the components of Transaction Costs that encapsulate each individual's set of values influence their interpretation of the world. Previous research also indicated that Transaction Costs lead to consumer's perceived value of adoption behavior [0] (pp.2768–2776). In this sense, Transaction Costs are affected by one's overall evaluation or attitudes toward the adoption process. Taking the bounded rationality and limited information processing capability into account, consumers can only process the available limited economic of information, thus considerable efforts are required to search reliable information before making decisions to adopt the products. After being offered access to reliable information associated with knowledge and brand, time and money saving effort will increase the perceived value of products and bolster the

adoption intention of the products [0, 0] (p.2768–2776). Similarly, based on this premise, we hypothesize that:

Hypothesis 1 (H1). Transaction Costs of local food adoption are negatively affected by organizers' Attitudes toward local food adoption.

Transaction Costs have been proved as a predictor of behavioral intention in previous studies of the adoption behavior of service, technology and products, with a positive relationship among Transaction Costs and adoption intention being found [0,0] (pp.2768–2776).

Hypothesis 2 (H2). Transaction Costs of local food significantly negatively affect organizers' Behavioral Intentions of local food adoptions.

Attitudes express one's overall evaluation of conducting a specific behavior, constituted with cognitions, emotions, belief and knowledge. Previous studies have proved that attitude acts as important antecedent of behavioral intention which expresses the overall evaluation of a given behavior. Ajzen [0] (pp.129-144) emphasized that a positive attitude toward a specific behavior strengthens the Behavioral Intentions to perform the behavior. In view of this premise, it is hypothesized that:

Hypothesis 3 (H3). Positive Attitudes toward local food adoption in business events positively affect organizers' Behavioral Intentions to implement local food adoption.

Subjective Norms are referred as the perceived pressures of whether to perform a given behaviors or not [0] (pp.2768–2776). Subjective Norms are also interpreted one's perceptions or assumptions about significant others' expectations of certain behaviors that one will or will not perform [0,0,0] (pp.2768–2776). Previous studies have confirmed that Subjective Norms are considered to affect the Behavioral Intention independently [0] which have served as powerful predictors of Behavioral Intentions. Subjective Norms have been extensively analyzed in the study field of adoption of environmentally sustainable food in the hotel industry and have indicated a positive and significant relationship between Behavioral Intentions to implement the sustainable food practices [0]. To adjust to the context of business decision making, especially the adoption decision-making models used in the hospitality and tourism, TPB has incorporate the variables derived from previous research of organizational responsible behavior of sustainable practices adoption result from pressures brought he organization's internal stakeholders' pressure from employees, owners and managers, and the external stakeholders' pressure from government, suppliers, customers, shareholders, creditors and society [0, 0]. Based on the review of previous studies, it is hypothesized that:

Hypothesis 4 (H4). Subjective Norms toward local food adoption in business events positively affects organizers' Behavioral Intention to implement local food adoption.

Perceived Behavioral Control reflecting one's belief concerning the access of resources, is considered as the perceived ease or difficulty to conduct a given behavior [0]. Ajzen [0] further mentioned that Perceived Behavioral Control whose measurement are one's perception toward resources, knowledge and ability to perform the behavior in conjunction with Behavioral Intention is the strongest antecedent of a behavior. Present studies of local food purchasing behavior in the hospitality industry show that companies' likelihood of behavior depends on the extent of accessibility and availability as well as the possibility of favorable prospects of if perform given manners. Perceived Behavioral Control has been associated with the purchase or adoption intention of sustainable food in green hotels [0]. A study conducted by Kang [0] indicated that Perceived Behavioral Control was shown to be the strongest predictor of hotels decision makers' purchasing intention of local food in Lowa countries, pointing that all factors of behavioral control mainly are constituted by internal factor such as knowledge, ability and external factor such as availability of resource.

Previous studies of the local food souring state that the hospitality industry faces the challenges of the consistent availability of sufficiently variety and quantity of local food especially in the off-season, which in conjunction with the knowledge and ability may influence restaurant chef's willingness to purchase local ingredients from the small-scale farmers. From previous studies, it is hypothesized that:

Hypothesis 5 (H5). Perceived Behavioral Control toward local food adoption in business events positively affects organizers' Behavioral Intention to implement local food adoption.

Even though Subjective Norms were found to be the weakest predictor of Behavioral Intention from previous researchers in their meta-analyses [0, 0] (pp.325–343, pp.471-499). Consequently, the Subjective Norms were not taken into the account of the analysis of the TPB. While many recent empirical studies point out that the Subjective Norms have been found to still have a positive mediating effect on ones' attitudes to a certain kind of behaviors and still consider the Subjective Norms as the key variable in the TPB model [0,0] (pp. 20-828). Han [0] confirmed that Attitudes toward a green hotel is positively correlated with his Subjective Norms. Previous research suggest that Subjective Norms may influence the Behavioral Intentions indirectly via another variable, thus it is still of great necessity to incorporate the studies of Subjective Norms into the full model to improve the over-all predictive power of TPB. The influence of significant others on attitude confirmed that researcher should not ignore the linkage between subjective norms and attitude which further may directly influence the Behavioral Intention of a given behavior [0]. Therefore, we hypothesize that:

Hypothesis 6 (H6). Subjective Norms toward local food adoption in business events affects Attitudes toward local food adoption in business events.

Ajzen [0] (pp.129-144) mentioned that there exists a correlation between Subjective Norms and Perceived Behavioral Control in the full model of TPB. Even though previous research seldom investigates the correlation between these two constructs, this study can also test the correlation between Subjective Norms and Perceived Behavioral

Control to maintain the complexity and high predictive power of TPB. Based on this rationale, the hypothesis is postulated as follows:

Hypothesis 7 (H7). Subjective Norms toward local food adoption in business events affects Perceived Behavioral Control toward local food adoption.

Previous studies have tested the strong relationship between Perceived Behavioral Control and Attitudes of a given behavior [0,0,0] (p.98). They confirmed that Attitudes have the mediating effect on the Perceived Behavioral Control. Based on this premise, we propose the hypothesis that:

Hypothesis 8 (H8). Perceived Behavioral Control toward local food adoption in business events exerts positive effects on Attitudes toward local food adoption.

Generally, Behavioral Intentions are commonly defined as the readiness or likelihood to perform a given behavior [0,0,0]. In the hospitality context, Behavioral Intentions are referred as an affirmed likelihood of performing a purchasing behavior [0]. Behavior can be resulted from Behavioral Intentions with considerable accuracy [0] (pp.129-144). Many previous researches have investigated and confirmed the relationship between behavioral intention and actual behavior and demonstrated that Behavioral Intention has been assumed to be a strong predictor of actual behavior in previous studies, with a high degree of correlation between Behavioral Intention and actual behavior with [0, 0, 0]. A significantly positive relation between purchasing behavior of organic food and purchasing intention was found a study [0]. Based on foregoing review, it is hypothesized that:

Hypothesis 9 (H9). Behavioral Intention toward local food adoption in business events affect the Actual Behavior of local food adoption.

According to Ajzen [0], Perceived Behavioral Control can have direct impacts on actual behavior without the anticipation of Behavioral Intentions on the conditions that some conformity (such as skills, knowledge, money, etc.) was made. It makes sense that Perceived Behavioral Control is a determinant of both Behavioral Intention and the Actual Behavior [0]. Even though Perceived Behavioral Control can be the direct and most significant indicator of actual behavior, while due to the asymmetric or the insufficient information that one or an organization known about the behavior, or changes on available resources or requirements, Perceived Behavioral Control sometimes cannot fully predict the behavior and subsequently function as the moderator of the Behavioral Intentions [0]. Having assumed the indirect correlations between Perceived Behavioral Control and Behavioral Intentions of local food adoption in the hypothesis 3, this study also further apply the full model of TPB to investigate the correlations between Perceived Behavioral Control toward local food adoption in business events and Actual Behavior for local food adoption in business events to improve the predictive reliability and power. Consequently, we hypothesize that:

Hypothesis 10 (H10). Perceived Behavioral Control toward local food adoption hotels affect Actual Behavior for local food adoption in hotels.

The proposed conceptual model presented in Figure 1 is based on theoretical framework:

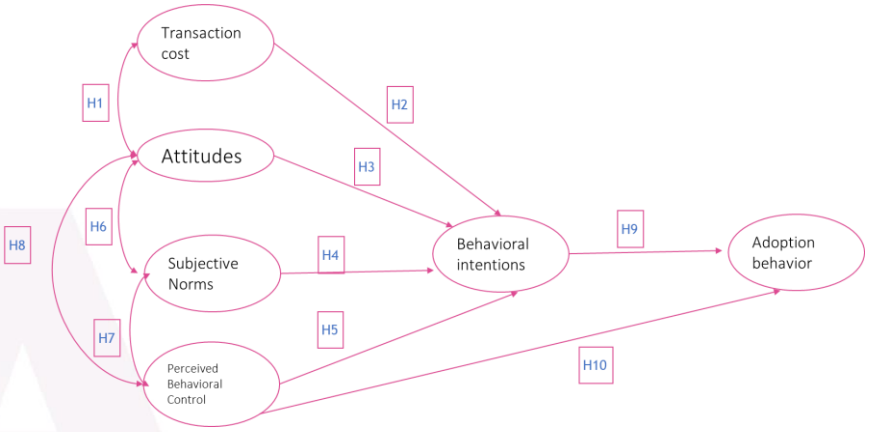

Figure 1. Proposed model of local food adoption in business events

4. Materials and Method

To achieve objectives of the study, this section discusses the methodology of quantitative research. Previous researchers have widely applied the quantitative approach to investigate the complex phenomena of local food. In order to gain an in-dept insight into whether event organizers' have the behavioral intention to adopt local food when organizing business events, this study applies the quantitative research which collects and analyzes data in a single study or series of studies [0]. Therefore, the rationale of selecting the quantitative research in this study is mainly because that quantitative research can provide numeric data to further test postulated hypotheses in social sciences [0]. Therefore, questionnaire was applied as the study instrument to get the design of the empirical research for a comprehensive understanding about event organizers' perception toward local food adoption in meetings industry in Thailand. The details of the study methodology and research designs are described as follow:

4.1.Research Design

Survey and questionnaire are widely used to collect data that reflects the characteristics, actions, or opinions of a population [0,0]. Phillimore and Goodson [0] mentioned that the "appropriateness of generalizing data from one specific context can be generalized across the entire social world. Therefore, a reliable questionnaire can generate information about people's behavior, expectation, and knowledge given that all the questionnaires are designed, sampled, and administered properly and scientifically [0, 0]. Large sample size generally improves the reliability of the results and can represent a population [0].

To achieve the research objectives, the questionnaire was developed and adapted on the basis of the previous studies from journals, papers and government documentation. To get reliable data that can generate good face validity, reliability and validity, this study used the cross-sectional data collected by survey. Research methods adopted for primary data collection in this study are three-fold: an expert review, a pilot

survey, and a questionnaire survey. The following are the measurement items for laten variables.

•Sustainability. According to 1987 Brundtland Report [0] (pp. 25-29), sustainability is viewed as the humanity's target goal of human-ecosystem equilibrium with the process of sustainable development that can "meet the needs of present without compromising the ability of the future generations to meet their own needs".

•Competitive Advantage. Competitive advantage is defined as an attribute that allows for a company or country to produce a goods or service of equal value at lower prices and achieve superior margins [0] (p.47-48). In the context of business, competitive advantage is an attribute which allows a company to outperform its competitors either by cost advantage or differentiation advantage [0,0] (p.47-48).

•Environmental concern is the evaluation or attitude toward one's behavior with subsequent action strategies in response to environmental issues [0] (p.2222-2247). Consumer's positive environmental concern has a positive impact on green product purchasing and decision of adoption behavior [0] (p.2222-2247). Previous research revealed that facing highly competitive market environment, corporate environmental and social performance will act as a strategic source of differentiation [0, 0] (p.628-652, p.463-469).

•Perceived Value. Perceived value is the overall evaluation of a product based on the consideration of service quality, customer satisfaction and client commitment [0] (p.22-28). Slater and Narver [0] (p.63-74) indicated that customer value creation is a prerequisite to create the competitive advantage. Wägeli et al [0] suggested that local food products are usually associated with differentiation, niche market and value-added products that can live up to consumers and supply chain actors' added value expectation of food supply chain in terms of transparency.

•Perceived Risk. Perceived risk is considered as the uncertainty that consumers have before purchase any good or service, consisting of functional risk, performance risk, physical risk, social risk, and time risk [0] (p.163-195). A reduction in perceived risks contribute to the probability of increase purchasing of a goods or a service [0, 0] (p.4-17). Abatekassa., Peterson [0] indicated that selecting new local food producers would increase unnecessary risk and additional costs brought by additional time and money inputs until establish contracts with suppliers who are in line with company philosophy.

•Trust. Trust, by definition, is the willingness to rely on partner who has confidences, and it exists when one party has confidence in partner's reliability and integrity [0]. Trust plays key role in a long-term supply chain relationship, which reduces details of monitoring of a contract and reduce Transaction Costs and transaction-related risk [0, 0,0] (p.619-652, p.6-18, p.243-268). Supplier reliability bas been regarded as the significant factor to the decision of sourcing local foods. Accordingly, degree of trust held by producers, suppliers, and regulators will affect buyer's risk perception and influence purchase intention. Perceived risks associated

with local food would expose extra Transaction Costs and logistics costs on buyers when suppliers cannot meet the in-time supply and consistent quality which leads to money and trust losses.

•Perceived Knowledge. Perceived knowledge refers to one's perception toward certain attributes and products [0] (p.581-588), which is a driving factor in building 'trust' for purchasing decisions [0] (p.1066-1081).

•Perceived access is defined as one's perception of resource presence, measured by accessibility, affordability, acceptability, accommodation [0] (p.127-140). Availability refers to adequacy of the supply of resource on a consistent basis. Accessibility refers to the location of food supply and ease of getting to that location, with measurement of travel time and distance. Affordability refers to food prices and one's perceptions of worth relative to costs.

•Accommodation measures how resources accept and adapt to one's needs [0]. Previous research suggested that perceived access, especially perceived availability plays key role in organizational buying decision-making process [0, 0, 0].

•Perceived Ability. Perceived ability refers to one's self-perception of the ability to perform given behavior [0] (p.328-346). Low perceived ability entails with low motivation to perform given behavior [0] (p.139-161). Previous research indicated that buyers perceived local suppliers have limited capability to offer valid and reliable information on price, quality, supply and delivery arrangements and to establish and maintain an effective relationship with their local suppliers.

In the first stage, prior to the formal distribution of questionnaire, questionnaires along with the measure model and construct model be sent to some academicians and experts who have reputations in the field of MICE industry to assess and evaluate components of the questionnaire, thus gaining some basic profiles of local food adoption reality in business events and results from interview will be further discussed in afterwards empirical analysis. The expert review contributes to confirming face validity of the study. The experts are constituted by a panel of three academicians from Chiangmai University, including Lect. Dr. Pairach Piboonrungroj, Asst. Prof. Dr. Chukiat Chaiboonsri and Asst. Prof. Dr. Warattaya Chinnakam.

In the second stage, prior to the finalized questionnaire survey, the pilot test questionnaires will select 30 event organizers in Thailand for checking the ease of understandability of the draft questionnaire so as to remove the redundant words, phrases or too technical terms for respondents [0]. Based on the feedbacks from respondents, some questions will be revised or reorder for better understandability, in this regard, the content validity and reliability were greatly improved.

There are two different languages involved in this study: English and Thai. The original questionnaire was designed in English and then translated into Thai version for Thai speaking respondents by two graduate native speakers of Thai in Chiangmai University. One academician from Chiangmai University checked the validity of

translation so as to meet the requirements of "translation equivalence", modifications were made based on the comparison between the original English version and the translated Thai version. Therefore, this process improved the accuracy of the survey instrument.

The third part is the main body of the questionnaire which requests respondents to rate their opinions of antecedents of their local food adoption behavior from constructs of Transaction Costs, Attitudes, Subjective Norms, Perceived Behavioral Control and Behavioral Intentions by using the Five-point Likert-scale (where 1=Strongly Disagree, 2= Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree). The Five-point Likert-scale is adopted in this study because it is sensitive to differentiate the measurement when guarantee the consistency [0] (p.23-32), which satisfies the reliability and validity requirements and results in stronger correlations with t-test results. It is worth pointing out that although a 7-point Likert scale was suggested by previous researchers in the local food studies [0, 0] (p.308-324, p.301-322), mentioning that 7-point Likert scale affords more precision on respondents' perceived level of importance of the asked questions than a 5-point Likert scale [0] (p.1-494). However, in reality, respondents are less likely to rate the options precisely and may response casually with too many discriminations, resulting in inaccuracy of the study findings.

4.1.1 Demographic Information

Q1: Region in Thailand

Q2: Type of university /college

Q3: Are you in responsible for food procurement process in business events?

Q4: Has your organization ever implemented local food adoption in business events?

4.1.2 Perceived Importance toward of Local food adoption in business events

Respondent are supposed to indicate their degree of opinions on the following variables based on a 5 Likert scale.

Q 5-8: Indicating Perceived Transaction Costs of Local food adoption.

Q9-13: Indicating Attitudes toward Local food adoption.

Q14-19: Indicating Perceived Subjective Norms toward Local food adoption.

Q20-23: Indicating Perceived Behavioral Control toward Local food adoption.

Q24-26: Indicating Perceived Behavioral Intentions toward Local food adoption.

4.1.3 Local Food Adoption Behaviors in Business Events

Q27-38: Indicating Perceived Behavioral Intentions toward Local food adoption.

In part 3, respondents' preferences of serving local food categories, frequency of serving local food categories and proportion of serving local food are evaluated based on 5 degrees, in accordance with the above items, generating relatively consistent results.

4.2 Data Collection and Processing

After collecting the data in beforementioned three stages, the collected data was entered into the Microsoft Excel worksheet before being exported to SPSS (version 24)

and R program for analysis. This study follows the Neuman [0] to deal with the collected data, including coding data, data cleaning, and data entry.

In the first stage, coding procedure was performed by pre-coding all measurement items with numerical values before carrying out the survey. In the second stage, unstable questionnaires were discarded in the data cleaning process. The researcher modifies questionnaires which may cause any omission or ambiguity of the respondents. Unanswered measurement items by respondents were remained blank in the Excel sheet. In the final stage, the data set followed Kline [0] by analyzing the descriptive statistics (means, standard deviations, etc.) and frequency distribution. Also, the Excel worksheet was imported into SPSS (version 24) and R program (Lavaan package) to further analyze the variance and covariance among the six constructs.

This research online uses convenience sampling method to collect information from faculty, department, unit in any university in Thailand. A total of 1027 questionnaires were administered by online email and data were collected over 6-month duration from July 2020 to January 2021.

5. Results

This section reveals the findings derived from data analysis of the questionnaire survey with regard to local food adoption in business events in universities and colleges level in Thailand. Following the structure of the questionnaire, the first section describes the questionnaire design, response rates, followed by demographic profiles of respondent in the second section. In the third section, the respondents' antecedents of local food adoption are analyzed from several perspectives, including Transaction Costs, Attitudes, Subjective Norms, Perceived Behavioral Control and Behavioral Intentions. Throughout this chapter, the findings are analyzed with reference to previous research findings and the relevant literature, comparisons are made when there are different research findings compared with previous studies.

5.1 Demographic profile

The final data collection resulted in 323 completed questionnaires, which contributed to a 31.45% overall response rate. Demographic characteristics of respondents are summarized in detail below.

Table 1. Demographic profile results (regions in Thailand)

Regions in Thailand	Frequency	Percent
Eastern Thailand	22	6.8%
Western Thailand	38	11.8%
Northern Thailand	82	25.4%
Southern Thailand	71	22%
Northeast Thailand	46	14.2%
Northwest Thailand	15	4.6%
Southeast Thailand	16	5%
Southwest Thailand	33	10.2%
Total	323	100%

Source: from data calculation

Region: Among the 323 valid samples, the region groups with the highest proportion are Northern Thailand and Southern Thailand, accounting for 25.4% and 22% respectively, followed by Northeast Thailand (14.2%) and Western Thailand (11.8%).

Table 2. Demographic profile results (type of university)

Type of university	Frequency	Percent
Public University/College	56	17.3%
Private University/College	152	47.1%
Autonomous Universities	48	14.9%
Rajamangala Universities of Technology	27	8.4%
Rajabhat Universities	17	5.3%
Military& Police Academies	0	0%
Education Agency&Institutes	23	7.1%
Total	323	100%

Source: from data calculation

Type of university /college: Based on 323 samples, the majority of respondent were from the Private University/College in Thailand with 47.1% respondent rate, followed by Public University/College in Thailand (17.3%) and Autonomous Universities in Thailand (14.9%). There was no respondent from Military & Police Academies, and Intergovernmental Institute with 0% respondent rate respectively.

Table 3. Demographic profile results (type of university)

Are you in responsible for food procurement process in business events?	Frequency	Percent
Yes	102	31.6%
No	221	68.4%
Total	323	100%

Source: from data calculation

Responsibility: The majority of respondent were not responsible for food procurement in business events in their organizations with 68.4%, which is more than twice than those who are responsible for food procurement.

Table 4. Demographic profile results (experience of local food adoption in business events)

Has your organization ever implemented local food adoption in business events?	Frequency	Percent

Yes	215	66.6%
No	106	33.4%
Total	323	100%

Source: from data calculation

Experience: it was found that the majority of respondents have ever implemented local food adoption in business events with 66.6%, with only 33.4% have not adopted the local food in business events.

To Sum up, it is obviously seen that samples collected were basically in compliance with business events profile in Thailand, which demonstrated a certain degree of reliability. In order to obtain the reliability and stability of scale, the reliability test of the questionnaire is tested.

5.2 The Reliability Test

An exploratory factor analysis is used to verify the structural validity of all factors. In this process, the KMO and Bartlett's Test are conducted. Table 4.5 shows that the KMO statistics of each factor is above 0.7, and Bartlett's Test significance P is significant at the level of 0.001, indicating that each factor is suitable for exploratory factor analysis to test the structural validity.

Table 5. Factors KMO and Bartlett's Test

Factors	**KMO**	**Bartlett's Test of Sphericity**		
		Approx. Chi-Square	**df**	**Significance level**
Transaction Costs	0.805	543.699	6	＜0.001
Attitudes	0.837	598.162	10	＜0.001
Subjective Norms	0.884	927.127	15	＜0.001
Perceived Behavioral Control	0.793	386.730	6	＜0.001
Behavioral Intention	0.718	353.890	3	＜0.001
Adoption Behavior	0.944	2383.416	66	＜0.001

Source: from data calculation

The analysis of exploratory factors and the results of the reliability test are shown in the Table 5, and the results show that the factor loading of each factor is above 0.6, and the variance explained rate is higher than 55 percent, indicating that each factor can represent the information of each measurement, and that each factor has a good structural efficiency. Moreover, it is obvious that the reliability coefficient of each factor is above 0.8, indicating that the reliability of each factor is ideal and conforms to the standard. So, the reliability is acceptable.

Table 6. Results of exploratory factor analysis and reliability test

Measurement Factors	**Measurement Items**	**Component**	**Eigenvalues**	**Variance Explained**	**Cronbach's α**
Transaction Costs	TC1	0.754	2.745	68.627	0.844

	TC2	0.842			
	TC3	0.836			
	TC4	0.877			
Attitudes	AT1	0.836	3.05	61.001	0.838
	AT2	0.792			
	AT3	0.732			
	AT4	0.769			
	AT5	0.773			
Subjective Norms	SN1	0.725	3.755	62.578	0.874
	SN2	0.753			
	SN3	0.769			
	SN4	0.883			
	SN5	0.834			
	SN6	0.772			
Perceived Behavioral Control	PBC1	0.756	2.511	62.778	0.801
	PBC2	0.820			
	PBC3	0.824			
	PBC4	0.766			
Behavioral Intention	BI1	0.863	2.225	74.167	0.825
	BI2	0.845			
	BI3	0.875			
Adoption Behavior	AB1	0.724	7.027	58.562	0.934
	AB2	0.719			
	AB3	0.785			
	AB4	0.715			
	AB5	0.804			
	AB6	0.720			
	AB7	0.847			
	AB8	0.833			
	AB9	0.732			
	AB10	0.718			
	AB11	0.823			
	AB12	0.745			

Source: from data calculation

5.3 The Validity Test

In the last section, the analysis of exploratory factors analysis and reliability test ensure that the scale factors used in this paper have a better reliability and stability. In this part, the measurement effect of the scale factor is verified and validated by the

Confirmatory Factor Analysis (CFA). And the Confirmatory Factor Analysis is carried out by the R software to build the Confirmatory Factor Analysis (CFA) model.

Both the Confirmatory Factor Analysis model and the Structural Equation Model are needed in order to evaluate the fit of the model to test whether the model is suitable for theχ^2 data. This study is tested by some adaptability indices: χ^2 /df (Chi-square Degree of Freedom Ratio), RMSEA (Approximate Error Mean Square Root), SRMR (Standardized Residual Mean Square Root), GFI (fit-To-Value Index); (Relative Fit Index), IFI (Incremental Fit Index).

5.3.1 The Validity test for Confirmatory Factor Analysis

Table7. Results of CFA model fit test

Fitness index	χ2	df	χ2/df	CFI	GFI	IFI	RMSEA	SRMR	PGFI
Fitting value	735.95	512	1.437	0.96	0.886	0.96	0.037	0.04	0.762
			＜3	＞0.9	＞0. 8	＞0.9	＜0.08	＜0.08	＞0.5

Source: from data calculation

First of all, the appropriate fit of the Confirmatory Factor Analysis model is tested, the results of the overall Good-of-fitness statistics for local food adoption in business events are shown in the Table 7.

1） The overall model Chi-square χ2 is 735.95 with 512 degrees of freedom. The p-value associated with this result is P=0.04 (P＜0.05). This p-value is significant using a type one error rate of 0.05.

2） For the normal Incremental Fit Indices (IFI), in the local food adoption model, CFI has a value of 0.96 with a RMSEA of 0.037, with the CFI value exceeding the guideline of 0.9 for a model of complexity and sample size and a low RMSEA value smaller than the guideline of 0.08 for a model with 34 measured variables and a sample size of 323.

3） For the Standardized Root Mean Square Residual (SRMR) with a value of 0.04, below the cutoff vale of 0.08.

4） For a normed Chi-square(χ2/df) which is the Chi-square value divided by the degrees of freedom =1.437. A normed Chi-square number smaller than 2 is considered to be very good, and between 2 and 5 is acceptable. Therefore, a normed Chi-square of 1.437 suggest an acceptable fit for the CFA model.

Looking Table 7 in detail, we can see that all of these measurements are within the range which is associated with good fit. Considering the values of each indicator are in line with the appropriateness criteria, it is suggested that the diagnostic provides

a good overall model fit. So, it is suitable to proceed to the further examination of the local food adoption model results.

The Confirmatory Factor Analysis model is mainly used to verify the structural validity of the factor measurement, in which the convergence validity and discriminant validity of the factor measurement is the main test content of the factor validity.

5.3.1.1 Convergence Validity Test

Convergence validity mainly measures whether the potential variables can better represent the obvious variables to which they belong. The convergence efficiency of the factors is mainly represented through the factor loading of the variable, the Average Variation and Construct Reliability (CR).

A higher factor loading denotes higher convergent validity. High loadings on a factor suggest that they will converge on the latent construct. A factor loading at least should be statistically significant. For construct validity, an individual standardized factor loading (regression weight) should be 0.5 or higher and ideally 0.7 or higher.

According to Table 4.8, we can see that all factor loadings are greater than 0.6. The lowest factor loading in this local food adoption model is 0.641, linking Attitudes Attitude (AT) to measurement item (AT3). Therefore, the convergence is confirmed and supported by the evidence.

In the Confirmatory Factor Analysis, apart from factor loadings, the variance extracted is also applied to evaluate the convergence. It is the square of a standardized factor loadings, which represents how much variation in a measurement item is explained by the latent variable.

Average Extraction AVE value is used to denote the discriminant validity, in which AVE calculates the mean variance extracted for the item loading on a construct. AVE is a summary indicator of convergence. An AVE of 0.5 or higher is a good rule of adequate convergence. However, if an AVE less than 0.5, it indicates that more error is remain on the in the items than the variance explained by the latent variables.

From Table 8, we can see that all AVE for all measurement factors is higher than 0.5 rules of thumb. Therefore, an adequate convergence is guarantee

Table 8. Results of convergent validity test

Source: from data calculation

Measurement Factors	Measurement Items	Factor Loading	Std.Err	Z-value	AVE	CR
Transaction Costs	TC1	0.647			0.589	0.849
	TC2	0.769	0.094	11.349***		
	TC3	0.777	0.093	11.436***		
	TC4	0.856	0.12	12.119***		
Attitudes	AT1	0.796			0.516	0.841
	AT2	0.728	0.063	12.925***		
	AT3	0.641	0.062	11.257***		
	AT4	0.697	0.066	12.333***		
	AT5	0.72	0.077	12.771***		
Subjective Norms	SN1	0.655			0.516	0.841
	SN2	0.695	0.087	10.868***		
	SN3	0.718	0.099	11.171***		
	SN4	0.876	0.083	12.983***		
	SN5	0.783	0.107	11.987***		
	SN6	0.725	0.11	11.261***		
Perceived Behavioral Control	PBC1	0.659			0.507	0.804
	PBC2	0.747	0.113	10.447***		
	PBC3	0.759	0.106	10.536***		
	PBC4	0.678	0.11	9.798***		
Behavioral Intention	BI1	0.761			0.613	0.826
	BI2	0.757	0.07	13.381***		
	BI3	0.829	0.08	14.64***		
Adoption Behavior	AB1	0.691			0.549	0.936
	AB2	0.686	0.077	11.682***		
	AB3	0.758	0.088	12.835***		
	AB4	0.684	0.102	11.645***		
	AB5	0.771	0.1	13.035***		
	AB6	0.688	0.1	11.711***		
	AB7	0.839	0.11	14.11***		
	AB8	0.826	0.105	13.899***		
	AB9	0.705	0.106	11.986***		
	AB10	0.681	0.099	11.598***		
	AB11	0.809	0.106	13.642***		
	AB12	0.727	0.113	12.337***		

Note: ***P＜0.001

As an indicator of convergent validity, construct reliability is computed from the square sum of factor loading for each construct and the sum of the error variance terms for a construct. Based on the rule of thumb, a CR value of 0.7 or higher indicates good reliability. And a CR between 0.6 and 0.7 may acceptable. High construct reliability denotes that there exists internal consistency and all the measurement items can well present the latent variable.

Referring back to Table 4.8, all construct reliability is greater than 0.8, with construct reliability ranging from 0.804 for the construct Perceived Behavioral Control (PBC), 0.826 for the construct Behavioral Intention (BI), 0.841 for the construct both Attitudes (AT) and Subjective Norms (SN), 0.849 for Transaction Costs (TC) to 0.936 for the construct Adoption Behavior (AB), denoting the internal consistency, adequate convergence and adequate reliability as well.

In conclusion, the local food adoption model is relatively well considering the fact that it meets the criteria of factor loading, AVE value and construction reliability. Therefore, adequate evidence of convergent reliability is provided.

5.3.1.2 Discriminant Validity Test

The discriminant is an extent to which a construct is truly distinct from the other constructs. A high discriminant validity indicates that a construct is different from others.

When conducting the discriminant validity test, we will compare The AVE value for any two constructs with the square of the correlation estimates between these two constructs. The AVE estimate should be greater than the square correlation estimate. Otherwise, if the correlation between factors exceeds the arithmetic square root of their measurement Average Extraction AVE value, then the difference between factors is less effective, and the factor measurement homogeneity is higher.

The results of the discriminant validity test are shown in the Table 9. It is clearly seen that all AVE estimates are greater than the corresponding inter-construct square correlation estimates (above the diagonal in bold font), which further indicates that each factor has a better degree of discriminant validity and there is no problem with discriminant for local food adoption model.

In terms of correlation results, some conclusions are reached below:

1) Transaction Costs have a significant negative correlation with Behavioral Intention with -0.569, not significantly related to Attitudes

2) There is a significant correlation with the Perceived Behavioral Control.

3) There is a significant positive correlation between the Perceived Behavioral Control and Behavioral Intention, Adoption Behavior.

4) There is a positive correlation between Behavioral Intention and Adoption Behavior, and the relationship between these two factors confirms the possibility that the model that we are studying is valid.

Table 9. Results of descriptive statistics, correlation analysis and discriminant validity test

	TC	AT	SN	PBC	BI	AB
TC	0.767					
AT	-0.111	0.718				
SN	0.007	0.315***	0.718			
PBC	-0.006	0.294***	0.185**	0.712		
BI	-0.569***	0.472***	0.170*	0.310***	0.783	
AB	-0.263***	0.381***	0.125*	0.295***	0.729***	0.741
M	3.890	3.816	3.551	3.673	3.812	3.495
SD	0.751	0.634	0.760	0.627	0.617	0.611

Source: from data calculation

Note: significance level: ***P＜0.001，**P＜0.01，*P＜0.05；The bold value is AVE square root；values below the diagonal are correlation estimates among constructs, diagonal elements are construct variance, and values above the diagonal are square correlations.

TC: Transaction Costs; AT: Attitudes; SN: Subjective Norms; PBC：Perceived Behavioral Control；BI: Behavioral Intention; AB: Adoption Behavior.

5.3.2.1.3 Validity Test for Structural Equation Model

After the CFA model pass all the validity test, we apply the same guideline that is used for CFA in previous section to evaluate the model fit of SEM. The influence relationship between the various factors will be studied through the Structural Equation Model.

In a SEM model, a comparison of the model fit of SEM and a model fit for CFA will be made as well as some examination diagnostics.

According to the influence relationship of various factors in the theoretical model, the initial Structural Equation Model is constructed by R software. The test results of the model fit are seen in the Table 10. Based on the model fit test, we can see that:

1）The overall model Chi-square $\chi 2$ is 659.627 with 512 degrees of freedom(P＜0.05). The p-value associated with this result is P=0.027 (P＜0.05). This p-value is significant using a type one error rate of 0.05. The $\Delta \chi 2$ between SEM ($\chi 2$= 659.627) and CFA ($\chi 2$=735.95) is 76.323. So, a lower $\chi 2$ in SEM suggests that a SEM model is overall fit and has been improved.

2）For the normal Incremental Fit Indices (IFI), in the local food adoption model, CFI has a value of 0.974 with a RMSEA of 0.030, with the CFI value exceeding the guideline of 0.9 for a model of complexity and sample size and a low RMSEA value

smaller than the guideline of 0.08 for a model with 34 measured variables and a sample size of 323. The Δ CFI between a CFA model (CFI=0.96) and SEM model (CFI=0.974) is 0.974 -0.96=0.014. Obviously. The SEM model CFI indices are improved, suggesting an improved model.

3）For the Standardized Root Mean Square Residual (SRMR) with a value of 0.044, below the cutoff vale of 0.08. The difference Δ SRMR in CFA (0.04) and SRMR in SEM (0.044,) is 0.004.

4）For a normed Chi-square(χ2/df) which is the Chi-square value divided by the degrees of freedom =1.288 (659.627/512=1.288). A normed Chi-square number smaller than 2 is considered to be very good, and between 2 and 5 is acceptable. Therefore, a normed Chi-square of 1.288 suggest an acceptable fit for the revised CFA model. The χ2/df for CFA is 1.437 and 1.288, the difference Δχ2/df is -0.149.

As a result, taking the overall model Chi-square χ2, IFI, Standardized Root Mean Square Residual (SRMR) and normed Chi-square(χ2/df) into consideration, the model is corrected appropriately, and the suitability of the model is improved. All the fit indicators are in line with the fit standard. Consequently, and the model research conclusion is reliable.

Table10. Results of revised model fit test

Fitness index	χ2	df	χ2/df	CFI	GFI	IFI	RMSEA	SRMR	PGFI
Fitting value	659.627	512	1.288	0.974	0.897	0.974	0.030	0.044	0.772
			＜2	＞0.9	＞0. 8	＞0.9	＜0.08	＜0.08	＞0.5

Source: from data calculation

5.4. Local Food Adoption Model

Given that the validity and reliability test is guaranteed, the final result of the model is the validation of a set of constructs that enable local food adoption model to study relations among 6 main constructs. Local food adoption model would like to understand what the antecedents of the local food adoption behavior in business events are. After the validity and reliability test, the fitted schematic of the local food adoption model in the Structural Equation Model is illustrated in Figure 2 as follows:

In the regression model, regression coefficients can be used to compute the predicted values for the dependent variables. In our local food adoption model, we can see that Subjective Norms doesn't cause Behavioral Intentions. If we take any observed values for Transaction Costs, Attitudes, Subjective Norms, Perceived Behavioral Control, we can estimate a value for Behavioral Intentions using the following equations:

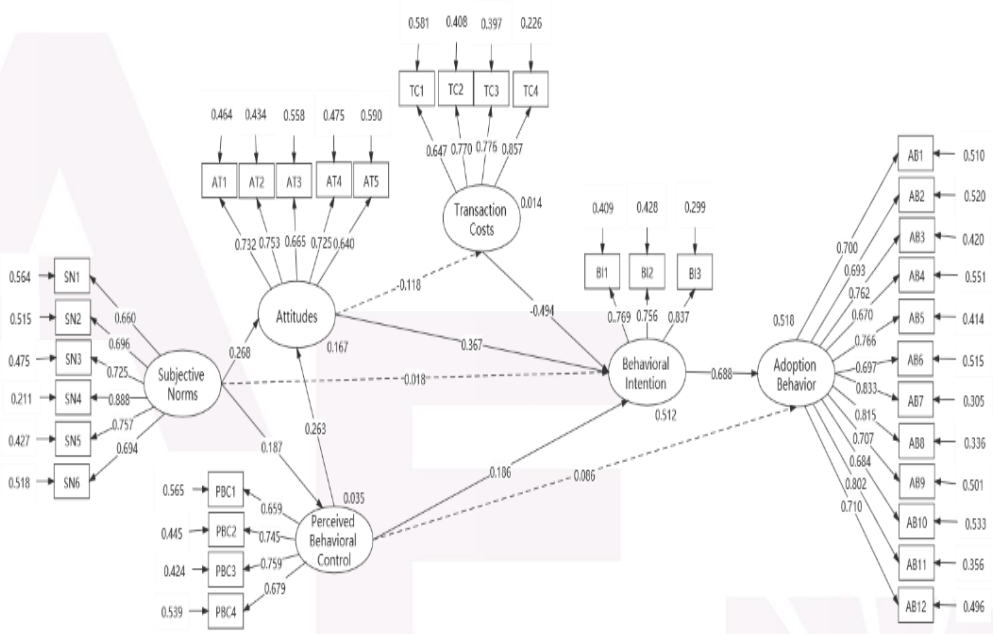

Figure 2. Fitted schematic of the local food adoption model in business events

In the regression model, regression coefficients can be used to compute the predicted values for the dependent variables. In our local food adoption model, we can see that Subjective Norms doesn't cause Behavioral Intentions. If we take any observed values for Transaction Costs, Attitudes, Subjective Norms, Perceived Behavioral Control, we can estimate a value for Behavioral Intentions using the following equations:

$$\hat{Y}_{BI} = \boldsymbol{\beta_1 AT + \beta_2 PBC + \beta_3 TC}$$
$$= \mathbf{0.367}\boldsymbol{AT} + \mathbf{0.186}\boldsymbol{PBC} - \mathbf{0.494}\boldsymbol{TC}$$

Similarly, predicted value for Adoption Behavior can be:

$$\hat{Y}_{AB} = \beta_4 BI$$
$$= 0.688BI \quad (2)$$

This will present a multiple equation prediction because Behavioral intention is also endogenous, substituting the equation for Behavioral Intentions into the Adoption Behavior model, we can get:

$$\hat{Y}_{AB} = \beta_4 BI$$
$$= \beta_4(\beta_1 AT + \beta_2 PBC + \beta_3 TC) \quad (3)$$

$$= 0.688\{\beta_1 AT + \beta_2 PBC + \beta_3 TC\}$$
$$=0.688\{0.367AT + 0.186PBC - 0.494TC\}$$
$$= 0.252AT + 0.128PBC - 0.34TC$$

5.5 Results of Hypotheses Testing

Several diagnostics measurements are available to use to evaluate the SEM model, ranging from fit indices to standardized residuals and modification indices. **Table 11** shows the fitting results of this paper, which mainly studies the relationship among the constructs.

Table 11. Fitting results

Hypotheses	Path	Estimate	Std.all	Std. Err	T-value	P	R^2
H1	AT→TC	-0.115	-0.118	0.064	-1.786	0.074	0.014
H6	SN→AT	0.257	0.268	0.064	4.041***	＜0.001	0.167
H8	PBC→AT	0.317	0.263	0.084	3.784***	＜0.001	
H7	SN→PBC	0.236	0.187	0.084	2.791**	0.005	0.035
H2	TC→BI	-0.447	-0.494	0.059	-7.537***	＜0.001	
H3	AT→BI	0.324	0.367	0.058	5.62***	＜0.001	0.512
H4	SN→BI	0.015	0.018	0.046	0.33	0.741	
H5	PBC→BI	0.198	0.186	0.064	3.112**	0.002	

Hypotheses	Path	Estimate	Std.all	Std. Err	T-value	P	R^2
H9	BI→AB	0.604	0.688	0.064	9.48***	＜0.001	0.518
H10	PBC→AB	0.08	0.086	0.051	1.58	0.114	

Source: from data calculation

Note: Significance level: ***P＜0.001，**P＜0.01，*P＜0.05；

TC: Transaction Costs; AT: Attitudes; SN: Subjective Norms; PBC： Perceived Behavioral Control；BI: Behavioral Intention; AB：Adoption Behavior.

Based on the Table 4.11, we can draw some conclusions that:

5.5.1 Testing of Attitudes to Transaction Costs

As shown in the **Table 11**, as for **H1** which postulates the AT-TC relation, the correlation coefficient is -0.115, p=0.074 s (P>0.05). So, Attitudes has no significant impact on Transaction Costs and does not cause Transactions Costs to change, so we **reject the Null Hypothesis that** Transaction Costs of local food adoption are negatively affected by attitudes towards local food adoption in business events. Therefore, it is confirmed that **H1 does not hold true.**

5.5.2 Testing of Transaction Costs to Behavioral Intentions

According to the **Table 11**, as for **H2** that postulates the TC-BI relation, we can see that Transaction Costs Negatively impact Behavioral Intentions, withβ=-0.494

，t=-7.537, P＜0.001. The estimate parameter between TC and BI is negatively significant. So, we **accept the Null hypothesis** that Transaction Costs of local food adoption affects Behavioral Intentions in local food adoption in business events. As a result, we confirm that **H2 holds true.**

5.5.3 Testing of Attitudes to Behavioral Intentions

Based on the **Table 11**, as for **H3 t**hat postulates the AT-BI relation, the estimate parameter between AT and BI is positively significant with**β**=0.367，t=5.62，P＜0.001. So, we accept the Null hypothesis that positive Attitudes toward local food adoption positively affect Behavioral Intentions to implement local food adoption in business events, So, we conclude that **H3 Established.**

5.5.4 Testing of Subjective Norms to Behavioral Intentions

According to **Table 11,** as for H4 which studies the SN-BI path, the impact of Subjective Norms to Behavioral Intentions is not significant (P>0.05), so we reject Null hypothesis that Subjective Norms toward local food adoption positively affects Behavioral Intentions to implement local food adoption in business events. As a consequence, we reach a conclusion that **H4 does hold true.**

5.5.5 Testing of Perceived Behavioral Control to Behavioral Intentions

Referring to **Table 11,** concerning the **H5** which studies the relation of PBC-BI Perceived Behavioral Control positively impacts Behavioral Intention, β=0.186，t=3.112，P＜0.01, so we accept the null hypothesis that Perceived Behavioral Control toward local food adoption in business events positively affects Behavioral Intentions to implement local food adoption. Therefore, it is confirmed that **H5 is true.**

5.5.6 Testing of Subjective Norms to Attitudes

Looking at **Table 11,** for SN-AT relation, we can see that Subjective Norms positively impact Attitudes, β=0.268，t=4.041，P＜0.001, so we accept the null hypothesis that Subjective Norms toward local food adoption in business events positively affects Attitudes toward local food adoption in business events. As a result, we can conclude that **H6 is true.**

5.5.7 Testing of Subjective Norms to Perceived Behavioral Control

As illustrated in **Table 11**, about H7 which studies the SN-PBC relation, it is found that Subjective Norms can positively predict Perceived Behavioral Control, **β**=0.187，t=2.791，P＜0.01, thus, we accept the null hypothesis that Subjective Norms toward local food adoption in business events affects Perceived Behavioral Control toward local food adoption in business. So, it is supposed that **H7 was founded.**

5.5.8 Testing of Perceived Behavioral Control to Attitudes

As displayed in **Table 11,** as for H8 that studies on the relation of PBC-AT, it is found that Perceived Behavioral Control positively impact Attitudes, β=0.263，t=3.784，P＜0.001, so we accept the null hypothesis that Perceived Behavioral Control

toward local food adoption in business events positively affects Attitudes toward local food adoption in business events, so it is concluded that H8 was founded**.**

5.5.9 Testing of Behavioral Intention to Adoption Behavior

As illustrated **Table 11**, about H9 that assumes the relation about BI-AB, we can find that Behavioral Intentions positively impact Adoption Behavior, β=0.688，t=9.48，P＜0.001. So, we accept the null hypothesis that Behavioral Intentions toward local food adoption in business events affect the local food adoption behavior. Therefore, it is supposed **H9 is true.**

5.5.10 Testing of Perceived Behavioral Control to Adoption Behavior

As illustrated **Table 11, H10 studies the** PBC-AB relation, it is clear that the impact of Perceived Behavioral Control on Adoption Behavior is not significant (P>0.05), so we reject the null hypothesis that Perceived Behavioral Control toward local food adoption in business events in business events affect adoption behavior of local food. So, it is assumed that **H10 doesn't hold true.**

5.5.11 Conclusions of Hypotheses Testing

Through the hypotheses testing, we can find that only H2, H3, H5, H7, H8, H9 hold true. Among above true hypotheses, the lower level of Transaction Costs is, the higher level of Attitudes and Perceived Behavioral Control.

Transaction Costs, Attitudes, Subjective Norms and Perceived Behavioral Control can interpret the Behavioral Intentions with 51.2%. Transaction Costs have the highest influence on Behavioral Intentions, followed by Attitudes, Perceived Behavioral Control.

Behavioral Intention and Perceived Behavioral Control can interpret the Adoption Behavior with 51.8%. Behavioral Intentions have a stronger influence on Adoption Behavior.

The higher level of Subjective Norms, the higher level of Perceived Behavioral Control. However, the coefficient of Perceived Behavioral Control is 3.5%. The coefficient should be less than 0.3, so the impact of Perceived Behavioral Control is less significant.

6. Conclusions and Research Recommendation

This dissertation aims to investigate antecedents of local food adoption business events, particularly in Thailand. In this study, the role of Transaction Cost Economics (TCE) will be examined in the theoretical framework of Theory of Planned Behavior (TPB) by identifying how Transaction Costs affect universities and colleges' Attitudes, Subjective Norms, Perceived Behavior Control and Behavioral Intentions toward local food adoption in business events and further influence universities and colleges' Actual Behavior of local food adoption behavior in meetings. By doing so, research objectives of the study are to:

Firstly, this study investigates antecedents of local food adoption in universities and colleges in Thailand. This study employs questionnaire as the instrument tool to get universities and colleges' perception of local food adoption. This study applies the Structural Equation Modeling (SEM), consisting of Confirmatory Factor Analysis and Path analysis to validate the measurement model and structure model respectively. The results of the study reveal that the Transaction Costs have strong influences on local food Adoption Behavior, Behavioral Intentions, followed by Attitudes, Perceived Behavioral Control.

Secondly, this study uses the econometric technique to estimate universities and colleges' local food adoption behavior. The regression results suggest that only focused on the pure Theory of Planned Behavior cannot improve the predictability of economic agents' decision-making behavior. In contrast, the additional economic construct, namely Transaction Costs of local food adoption behavior have significant correlation in Event organizers' Behavioral Intention of local food Adoption Behavior, among which information cost is found to be the most significant influence on the local food adoption behavior in universities and colleges' business events in Thailand. Therefore, it is suggested that stakeholders or policy makers should facilitate the information channels of local food, thus alleviating the local food searching information costs and encouraging the local food adoption behavior.

Empirical findings of this study are beneficial for providing managerial implications for local food adoption in business events.

6.1 Policy Implications

6.1.1 Lowering the Transactions Costs

From the result analysis of CFA and SEM analysis, we can find that Transaction Costs affects both the Behavioral Intentions and Adoption Behavior of local food. Through the factor loading analysis of TC construct, we can see that among four measurements of Transaction Costs of local food adoption, all factor loadings are higher than 0.647, in details TC1(Search and Information Costs) account for 0.647, TC2 (Monitoring Costs) 0.770, TC3 (Negotiating Costs) 0.776, TC4(Policing Negotiating) 0.857. So, in order to raise the possibility of Behavioral Intentions and Adoption Behavior of local food in business events, business events should try to minimize the Transaction Costs of local food adoption by lowering Transactions Costs by four dimensions.

6.1.2 Suggestions Based on Attitudes

From the result analysis of CFA and SEM analysis, we can see that Positive Attitudes toward local food adoption in business events positively affect Behavioral Intentions to implement local food adoption with β=0.367. There are five measurement items can explain the attitudes with factor loadings of AT1=0.732 (Perceived Advantage), AT 2=0.753 (Perceived Value), AT 3=0.665 (Perceived Risk), AT 4=0.725 (Trust) and AT 5=0.640 (Environmental Concern). Based on the results, the following proposals are made, including catering to Environmental Concerns of Local

Food, increasing the Perceived Advantage of Local Food, increasing the Perceived Value of Local Food

It is tested that Perceived value of local food can represent the attitudes of local food adoption and. So, business events-related parties should firstly, provide some valued local food with characteristics of safety, freshness and distinctiveness in order to meet event attendees' local food catering preferences, gain the differentiate advantage and then further adopt the local food in business events. Secondly, business event organizers should cooperate with stable suppliers to reduce the uncertainty that event organizers have before purchasing. A reduction in perceived risks contribute to the probability of increase purchasing of a goods or a service.

Thirdly, organizers should enhance the trust among suppliers and local food adopter in order to which reduces details of monitoring of a contract and reduce transaction costs and transaction-related risks and then lead to the decision of sourcing local foods. Fourthly, organizers should improve the Environmental sustainability of local food so in order to improve the local food adoption willingness.

6.1.3 Suggestions Based on Perceived Behavioral Control

As depicted in the SEM model, Perceived Behavioral Control proves to be the third largest in the explanation of local food adoption behavior in business events, withβ=0.186. Even though the role of Perceived Behavioral Control in local food adoption model is not as significant as Transaction Costs and Attitudes, it still positively affects the Behavioral Intentions of local food adoption. Therefore, suggestions will be given based on the measurement items of PBC(Perceived Behavioral Control), including PBC 1 (Perceived Access), PBC 2 (Perceived Knowledge), PBC 3 (Perceived Ability), PBC 4 (Perceived Barriers).

First of all, since suppliers should provide more Accesses to Local Food. The factor loading of PBC1 1is 0.659, denoting that event organizers feel it difficult to identify the source and originality of local food information, holding the concept that it takes much time to seek the information. So, local food suppliers should contact the event organizers actively and provide the local food information and certification of the originality of local food, which would encourage the event organizers' Behavioral Intentions adopt local food.

Secondly, the factor loading of PBC 2 is 0.745, implying that events organizers' willingness to cooperate with the local community to boost the local food serving in business events. So, the local community can unify as an integrated and provide the valuable local food to event organizers, so as to seek the common growth.

Thirdly, the factor loading of PBC 3is 0.759, suggesting that event organizers' confidence on improving customer's loyalty and satisfaction in business events by serving high-valued local food. Therefore, high-quality local food suppliers are suggested to present their high-end local food to event organizers.

Finally, the factor loading of PBC 4 1is 0.679, giving a hint that event organizers plan to improve their event competitive advantage by serving the differential local food and retain event customers. So, some local food suppliers should provide the differential local food to event organizers.

6.1.4 Suggestions Based on Behavioral Intentions

As presented in the local food adoption model, Behavioral Intentions of local food adoption also significantly leads to the local food adoption behavior withβ=0.688. Consequently, related suggestions should be provided from the measurement items of BI， including BI 1(Behavioral Plan), BI 2 (Behavioral Willingness) and BI 3 (Behavioral Expectation).

Firstly, the event organizers should make a behavioral plan to implement local food adoption. The factor loading of BI 1is 0.769 and is capable in representing BI. So, Event organizers would adopt local food in business events when local food suppliers are responsive to supply reliable local food as demanded. Therefore, the local food suppliers are suggested to provide and update their latest local food option and criteria to event organizer in order to increase evet organizer's Behavioral Intentions of local food adoption as well as the local food adoption behavior.

Secondly, the factor loading of BI 2 is 0.756 and is able to represent the BI. Moreover, event organizers are willing to cooperate with the local community to boost the adoption of the local food in business events when the criteria of quality controlling, seasoning advancing planning and delivery channels building. So, the local food suppliers should take initiative to provide the requested food with require standard, thus facilitating the local food adoption behavior in business events.

Thirdly, the factor loading of BI 3 is 0.837 and has the highest ability in explaining BI. Event organizers should try to demonstrate the benefits of local food adoption in business events and get supports from the organizations.

6.1.5 Suggestions for Local Food Adoption in Business Events

The local food adoption behavior is manifested by 12 measurement items in terms of preferences on Local Food Categories, frequency of Local Food Categories and proportion of Local Food. Results show that event organizers have preferences over dairy product and fresh produced food, have high frequency of serving dairy products and value-added products and serve a large proportion of dairy products and value-added products. Based on these findings, it is suggested that local food suppliers increase the supply of Fresh produced food, dairy product and value-added products in business events.

6.2 Research Limitation and Recommendations for Future Research

However, there exist some limitations of this study which offers the possibility of proposing future studies. On the one hand, this paper mainly uses the theoretical framework of TPB basis to explain local food adoption behavior in business events in Thailand. However, obviously, this theory also employs TCE to explain the adoption behavior. There may exist some conflicts when explaining the local food Adoption

Behavior. Therefore, the future research should mainly focus on the influence of transaction costs of local food on local food adoption behavior in business events.

On the other hand, this study is conducted in the scope of Thailand universities and colleges only, thus it is of great potential for further study across the country even in the ASEAN countries in order to attain a much more comprehensively generalized conclusion. The researcher could add more potential independent variables such as accessibility, pricing, packaging into the further study so as to get a better insight on business events holders' perception toward the local food adoption of business events.

The further study is believed to generate conductive results to guide the Thailand MICE develop in a more sustainable way and to maintain its long-run competitive advantage within the MICE industry. Moreover, due to the time limit, this study only chooses the academic level, one of the business organizers in business events to analyze local food adoption behavior, future research can involve more business event organizers in order to obtain a more generalized conclusion.

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Appendix A:

This contains the independent variables and measurement items used in this study. There are five independent variables used in this study, consisting of Transaction Costs of local food adoption in business events, Attitudes toward local food adoption in business events, Subjective Norms toward local food adoption in business events, Perceive Behavioral Control toward local food adoption in business events and Behavioral Intentions toward local food adoption in business events. Independent variables are based on the theoretical justification of Theory of Planned Behavior (TPB), and Transaction Costs Economics (TCE). Independent variables and related measurement items used in this study are adapted from previous research from journals, publications and theories.

Independent Variable	Definition	Measurement item	Notation	Theory	Adapted Source
Transaction Costs of local food adoption (TC)	refers to costs associated with the time and effort to search, negotiate, contract, and maintain a relationship with local food suppliers	Information & Searching Costs	TC1	TCE	Williamson (1985)
		Negotiating Costs	TC2		
		Monitoring Costs	TC3		
		Policing & Enforcing Costs	TC4		
Attitude toward local food adoption (AT)	refers to one's overall evaluation of local food adoption behavior, constituted with cognitions, emotions, belief and knowledge.	Perceived Advantage	AT1	TPB	Ajzen (1991)
		Perceived Value	AT2		
		Perceived Risk	AT3		
		Trust	AT4		
		Environmental Concern	AT5		
Subjective Norms toward local food adoption (SN)	refers to the perceived pressures from either social pressure or significant others about whether to adopt local food.	Authority Pressure	SN1	TPB	Ajzen (1991)
		Supplier Pressure	SN2		
		Competitor Pressure	SN3		
		Customer Pressure	SN4		
		Owner & Manager Pressure	SN5		
		Employee Pressure	SN6		

Independent Variable	Definition	Measurement item	Notation	Theory	Adapted Source
Perceived Behavioral Control of local food adoption (PBC)	refers to the perceived degree of ease or difficulty to adopt local food, measured by the perception of the resources, knowledge and ability to perform the given behavioral.	Perceived Access	PBC1	TPB	Ajzen (1991)
		Perceived Knowledge	PBC2		
		Perceived Ability	PBC3		
		Perceived Barriers	PBC4		
Behavioral Intentions of local food adoption (BI)	refers to the amount of effort one is willing and planning to exert to adopt local food.	Behavioral Plan	BI1	TPB	Ajzen (1991)
		Behavioral Willingness	BI2		
		Behavioral Expectation	BI3		

Appendix B:

This contains the dependent variables and measurement items used in this study. In this study, there are two dependent variables, including Behavioral Intentions and Adoption Behavior. As analyzed previously in TPB, Behavioral Intentions can be the dependent variable of AT, SN, PBC, as well as the independent variable of Adoption Behavior from Ajzen (1991) in Theory of Planned Behavior. Table 6 shows the definition and measurements of Dependent variables in this study. The local food adoption behavior, as a dichotomous variable, will be measure by Five-point Likert scale. Respondents are supposed to be measured by their frequency of adoption, ratio of local food serving in business events, ingredients of local food and category of local food serving in the business events,

Independent Variable	Definition	Measurement item	Notation	Theory	Adapted Source
Behavioral Intentions of local food adoption (BI)	refers to the amount of effort one is willing and planning to exert to adopt local food.	Behavioral Plan	BI1	TPB	Ajzen (1991)
		Behavioral Willingness	BI2		
		Behavioral Expectation	BI3		
Local Food Adoption Behavior (AB)	a behavioral shifting from conventionally sourcing of food to locally souring of food, such as using local food ingredients.	Purchasing Frequency	AB1-3	TPB	Roy (2016)
		Local Food Category	AB4-6		
		Local Food Ingredients	AB7-9		
		Local Food Ration	AB10-12		

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Technical Efficiency Analysis of Economic Development in Four Economic Regions of China Based on Infrastructure Construction

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Abstract

This study uses the stochastic frontier model and copula-based stochastic frontier model to analyze infrastructure construction technical efficiency of four economic regions in China covering 2001-2019. In terms of the endogenous variable for the stochastic frontier model, two variables of log (PAW) and log (EP) are significant, and another two of log (FAIHI) and log (LOC) are insignificant in this study while three variables of log (FAIHI), log (PAW) and log (EP) are significant, and only one variable log (LOC) is insignificant for the copula-based stochastic frontier model. Therefore, the copula-based stochastic frontier model is relatively efficient in using various inputs to fit the model when comparing with the stochastic frontier model.

The results of SFM show that the mean technical efficiency of four economic regions is 0.3940. Amid them, the technical efficiency in the Eastern region is 0.4211, the Central region 0.1429, the Western region 0.0854, and the Northeast region 0.9267. The results of CSFM display that the mean technical efficiency of four economic regions is 0.3067. Amid them, the technical efficiency in the Eastern region is 0.0787, the Central region 0.1016, the Western region 0.1988, and the Northeast region 0.8478. The Northeast region has the highest technical efficiency from the results of both models. Moreover, another three regions have comparatively lower technical efficiencies. The other three regions need to learn the experience from the Northeast region to reduce the regional disparities.

Keywords: Four economic regions; China; Infrastructure construction; Technical efficiency; Stochastic frontier; Copula-based stochastic frontier

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1. Introduction

Good infrastructure amenities are considered essential to achieve economic growth and improve the quality of people's life (Ingram & Kessides, 1994). In the past few decades, China has been the fastest-growing country in the world. And investment-led growth is one of the defining features of China's growth. Meanwhile, a substantial improvement of physical infrastructure has underpinned China's sustained high economic growth. (Sahoo, Dash & Nataraj, 2010)

1.1 Principle and Rationale of the Study

This study intends to estimate the technical efficiency of economic development among different economic regions in China based on infrastructure construction and provide helpful information for government to reduce regional disparities in terms of economic development.

1.1.1 Economic Development and Infrastructure Investment in China

The statistics from the National Bureau of Statistics of China show that in 2019, China's investment in infrastructure, consisting of transportation, telecommunications, the internet, water conservancy, environment, and public amenities, reached 17,000 billion yuan, which ranked the first in the world. (National Bureau of Statistics of China [NBSC], 2020)

However, in the early days of the People's Republic of China founding, the development of transportation, post, and telecommunications in China's infrastructure was still seriously lagging. It was developing at a relatively low speed. From 1953 to 1978, the average annual growth rate of China's infrastructure capital stock was 7.1 percent. From 1979 to 1989, the average annual growth rate of China's infrastructure capital stock was 6.9 percent. During this period, China began to take some short-term measures for infrastructure development, using limited funds to increase investment in crucial infrastructure and change weak infrastructure. (Yang, 2019)

During the period of 1990 to 2008, China's infrastructure capital stock raised from 1.19 trillion yuan to 1.92 trillion yuan, increasing over 16 times in 18 years. It was with an average annual growth rate of 16.7 percent. Better infrastructure conditions have lowered the costs of production and distribution in the manufacturing industry and improved the capability of Chinese products to open up markets and take part in the competition. (Yang, 2019)

In the 21st century, the role of China's infrastructure in promoting economic growth has become increasingly apparent. "If you want to get rich, build roads first." This is a famous common saying in China, which emphasizes the importance of transport infrastructure construction. "Let some people and some regions get rich first. Some areas develop faster and then drive most areas to make progress.

This is a shortcut to accelerate development and achieve common prosperity." Deng Xiaoping, previous Chairman of China, put forward in the 1980s. (News of the Communist of China, 2020) This policy has laid down the base for different economic regions to develop at a diverse speed.

1.1.2 Economic Development and Infrastructure Construction in Four Economic Regions of China

In the 1980s, to scientifically reflect different regions' social and economic development, China divided the country into four major economic regions according to economic growth across the country. These are now known as the Eastern, Central, Western, and Northeast regions. (NBSC, 2020)

From **Figure 1** and **Table 1**, it could be seen that the eastern part of China's mainland (excluding Macao, Hong Kong, and Taiwan) includes eight provinces and two municipalities, and the total area the Eastern region covers is 930,000 square kilometers, accounting for about 9.7 percent of the whole nation. The Central part includes six provinces with a land area of 1,028,000 square kilometers, approximately 10.7 percent of the entire country. The Western region is a large area with twelve provinces, one municipality, and five autonomous territories covering 6,870,000 square kilometers, which accounts for 71.4 percent of the country. The Northeastern region, with an area of 788,500 square kilometers, accounts for 8.2 percent of the entire country. (Provincial Statistical Bureaus of China [PSBC], 2019)

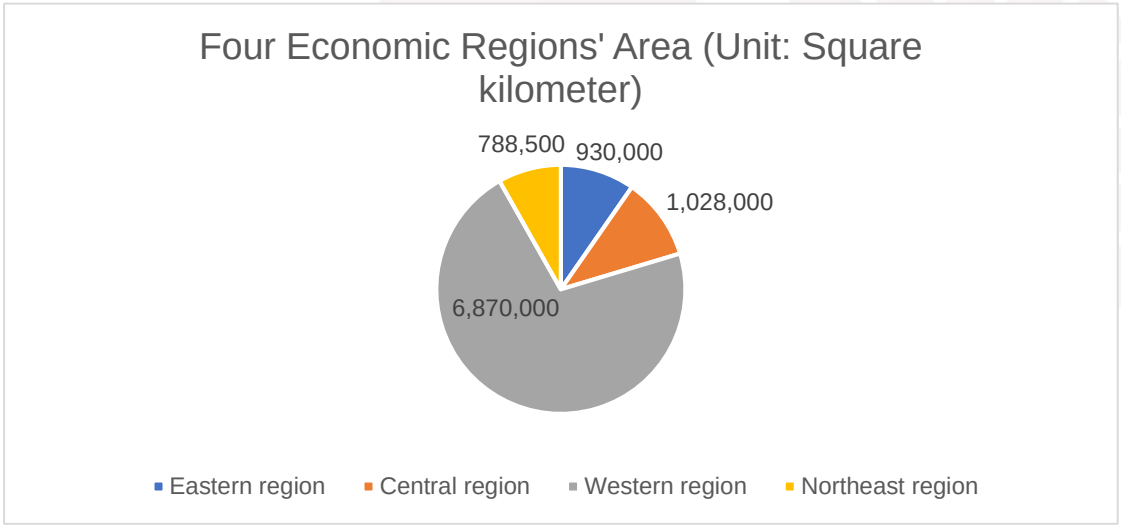

Figure 1 Four Economic Regions' Area
Source: Provincial Statistical Yearbooks of China 2019

Table 1. Provincial-level administrative region in China

Economic regions	Provincial-level administrative region
Eastern region	Beijing, Tianjin, Hebei, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong, Hainan, Macao, Hong Kong and Taiwan
Central region	Shanxi, Henan, Anhui, Hubei, Hunan, and Jiangxi
Western region	Chongqing, Sichuan, Guizhou, Guangxi, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang, and Inner Mongolia
Northeast region	Liaoning, Jilin, and Heilongjiang

Source: National Bureau of Statistics of China 2020

From **Figure 2**, it is evident that the Eastern region is the most economically developed in China from 1978 to 2019, whose GDP reached 51 trillion RMB in 2019, accounting for 42.1 percent of the total. (CEIC, 2020) This is partly owing to one of China's development strategies, the Eastern part should be a pioneer in the development, and the Central and the Western regions should provide support. After the Eastern part has developed, it should support the development of the Central and Western regions.

The Central region's GDP ranked second in 2019, which was 22 trillion RMB. It is located between the Eastern and Western regions. The Central region is at a medium level of economic development. And it ranks at the second echelon of China's economic development. It is also well-known as a large population area, transportation center, economic zone, and critical market in China, and it plays an essential role in the labor division in China.

Covering the largest area, the Western region has bountiful natural resources, has vast market potential, and occupies a vital strategic position. However, due to natural, geographic, historical, and other causes, the economic development of the Western region was far behind the other three economic regions. **Figure 2** demonstrates that the economic growth in the Western area of twelve provinces is quite close to the Central part of the six provinces. (CEIC, 2020)

The Northeast region was once China's old industrial base and the most economically developed part, which played an essential role in supporting the national economy. However, with the industrial center gradually diverting to the Eastern and Central areas, the Northeast region kept relatively slow and had a fluctuated development during the past decades. (CEIC, 2020)

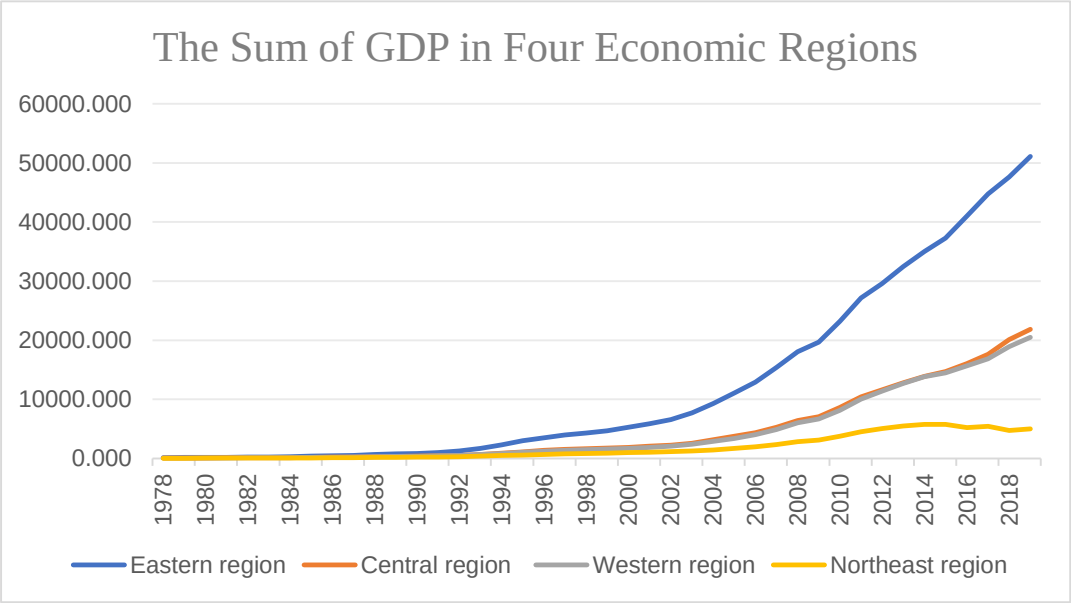

Figure 2 GDP Development in Four Economic Regions (1978-2019)
Source: CEIC Data

2. Methodology

2.1 Data Collection

The study uses annual data of China's infrastructure in four economic regions from 2001 to 2019. In detail, the data of the Eastern region are collected from ten provinces or municipalities. The data of the Central region are added by six provinces. The data of the Western and Northeast regions are also summed up from their subordinate provinces, with the number of twelve and three respectively.

Transport infrastructure comprises railway and road etc. Water Infrastructure refers to dams, water pipes, and so on, and in this study, it is indicated by the population with access to water. Electricity Infrastructure consists of the network of wires, towers, dams, and turbines, and it is measured by electricity production in the study. Telecommunication Infrastructure includes telephone wires, cables (containing submarine cables), satellites, microwaves, and mobile technology. The length of the optical cable will be studied here.

Therefore, in this study, the dependent variable is export, which is a statistical sign of the state of economics. The independent variables are transport infrastructure proxy by fixed-asset investment in highway industry, water infrastructure proxy by population with access to water, electricity infrastructure proxy by electricity production, and telecommunication infrastructure proxy by the length of optical cable.

Table 2. Data Description

Key factors	Indicators	Abbr.	Unit	Data source
State of economics	Export	EX	USD mn	CEIC database
Transport infrastructure	Fixed asset investment in highway industry	FAIHI	RMB mn	CEIC database
Water infrastructure	Population with access to water	PAW	Person th	CEIC database
Electricity infrastructure	Electricity production	EP	kWh bn	CEIC database
Telecommunication infrastructure	Length of optical cable	LOC	km th	CEIC database

2.2 Conceptual Framework

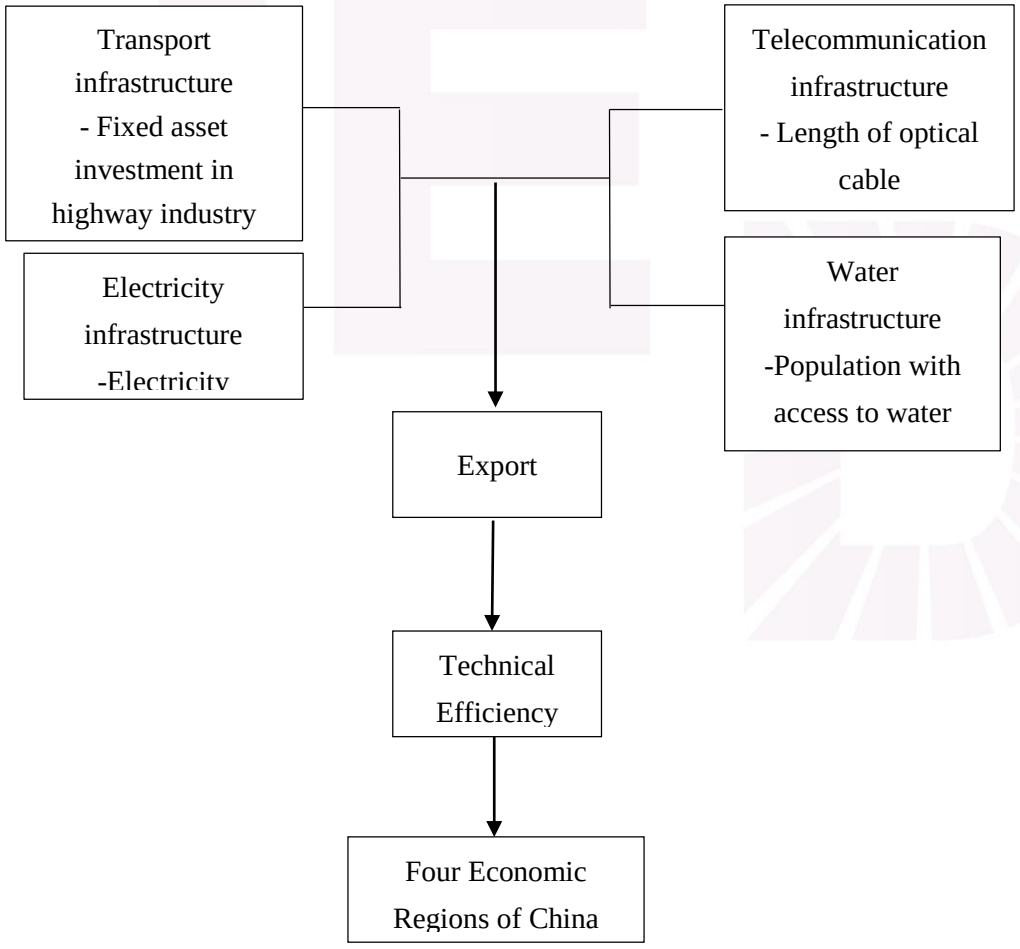

Figure 3 Conceptual Framework

2.3 Copulas and Dependence

The copula is a multivariate cumulative distribution function in which the marginal probability distribution of each variable is uniform. Copulas are applied to depict the dependence between random variables. A copula links a given number of the marginal distribution (one-dimensional distribution) with a joint (multivariate) distribution. (Kreinovich et al., 2018) If the collective distribution H is given, the system function C (.,.) can be expressed as

$$H = (X_1, X_2) = H\left(F_1^{-1}(u_1), F_2^{-1}(u_2)\right) = C_\alpha\left(F_1(x_1), F_2(x_2)\right), \quad (1)$$

where $u_1 = F_1(x_1)$ and $u_2 = F_2(x_2)$, α is a parameter vector of the copula, generally referred to as the dependence parameter vector. $F_1(...)$ and $F_2(...)$ are uniform distributions, and bivariate copulas have the features as below:

$$\mathrm{C(w,z) - C(w,v) - C(u,z) + C(u,v) \geq 0.} \quad (2)$$

Meanwhile, Sklar Theorem is the key to link copula functions and distribution functions together. Any multivariate probability distribution function can be signified by marginal distribution and a dependent structure, which is shown as below:

$$\begin{aligned} f(x_1, \dots x_n) &= \frac{\partial F(x_1, \dots x_n)}{\partial x_1 \dots \partial x_n} \\ &= \frac{\partial C(u_1 \dots u_n,)}{\partial u_1 \dots \partial u_n} \times \Pi \frac{\partial F x_i}{\partial x_i} \\ &= c(u_1 \dots u_n,) \times \Pi f_i(x_i) \end{aligned} \quad (3)$$

Therefore, a bivariate density function of x_1 and x_2 can be decomposed marginal densities and copula density as:

$$f(x_1, x_2) = c(u_1, u_2) \times f_1(x_1) \times f_2(x_2) \quad (4)$$

The most popular method for measuring dependence is Pearson's linear correlation, which does not have information for asymmetric distributions. Thus, the limitations of Pearson's linear correlation led the U.S. to use rank correlations that are Kendall's tau and Spearman's rho for measure nonlinear dependence. The expressions of Kendall's tau and Spearman's rho are shown as follows:

$$\tau_{x_1 x_2} = 4 \int \int_{[0,1]^2} C(u_1, u_2) - 1 = 4E[C(u_1, u_2) - 1$$

$$\begin{aligned} S_{\rho(x_1 x_2)} &= 12 \int \int_{[0,1]^2} u_1 u_2 d[C(u_1, u_2)] - 3 \\ &= 12 \int \int_{[0,1]^2} C(u_1, u_2) du_1 du_2 - 3 \\ &= 12E[(U_1, U_2)] \end{aligned} \quad (5)$$

A lot of copulas can capture dependence structures. However, few copulas can measure the full range of dependence structures, covering the field from the lower to the upper bounds. Some copulas can still be used, such as Gumbel, Clayton, and Joe copula, measuring either negative or positive dependence. (Kreinovich et al., 2018) The copulas related are listed as below:

1) The independent copula

The product copula means the copula is independent. The formula takes the form $C_{IN} = u_1 u_2$. So, once we use the independent copula, which means to assume that the two random variables are independent.

2) T-copula

The t copula could underlie the multivariate Student's t distribution. It has the form as below:

$$C_{v,C}^{t}(u_1, \dots, u_n) = t_{v,C}(t_v^{-1}(u_1), \dots, t_v^{-1}(u_2)) \quad (6)$$

Where $t_v^{-1}(x)$ is the inverse student's t function and $t_{v,C}$ is the cumulative distribution function of the multivariate student's t distribution with arbitrary mean and matrix generator.

3) The Gaussian copula

This copula takes the form

$$C_{Gau}((u_1, u_2, \rho) = \int_{-\infty}^{\phi^{-1(u_1)}} \int_{-\infty}^{\phi^{-1(u_2)}} \frac{1}{2\pi\sqrt{1-\rho^2}} \exp\left(-\frac{x_1^2 - 2\rho x_1 x_2 + x_1^2}{2(1-\rho^2)}\right) dx_1 x_2 \quad (7)$$

where $-1 \le \rho \le 1$, represents the standard normal distribution function. The Gaussian copula is such a copula of a bivariate normal distribution with standard normal marginal and Pearson linear correlation coefficient ρ. The parameter ρ is related to Kendall's tau τ and Spearman's rho S_ρ for measure rank dependence.

4) Clayton copula

This copula can reflect the lower tail dependence for $\alpha > 0$ and has the following formula:

$$C_{Clay}((u_1, u_2|\alpha) = (u_1^{\alpha} + u_2^{\alpha} - 1)^{-1/\alpha} \quad (8)$$

The copula above only can capture a strong lower tail and positive dependence, but the Clayton copula can be rotated and applied to capture negative support or display strong upper tail dependence.

5) Frank copula

Although the Archimedean class of copulas is popular in empirical applications, the Frank copula in Archimedean copulas is the only one who can gain both lower and upper bounds, thus permitting positive and negative dependence. The relating

copula function is given by:

$$C_{Fra}((u_1, u_2, \alpha) = -\frac{1}{\alpha}\ln\left(1 + \frac{(\exp(-\alpha u_1) - 1)(\exp(-\alpha u_2) - 1)}{\exp(-\alpha) - 1}\right) \quad (9)$$

where $\alpha \in (-\infty, +\infty)/\{0\}$; if $\alpha > 0$, it indicates that the random variables u_1, u_2 are positively correlated; when $\alpha \to 0$ it means that the random variables u_1, u_2 are independent; when $\alpha < 0$, it shows that the random variables u_1, u_2 are negatively correlated.

6) Gumbel copula

The bivariate Gumbel copula is given by

$$C_{Gum}((u_1,u_2|\alpha) = \exp\left(-\left((-lnu_1)^{\frac{1}{\alpha}} + (-lnu_1)^{\frac{1}{\alpha}}\right)^{\alpha}\right), \alpha \in (1,+\infty) \quad (10)$$

The Gumbel copula is similar to the Clayton copula. It belongs to an asymmetric copula of the Archimedean family, which permits strong upper tail dependence. The Gumbel copula can also be rotated to capture negative reliance.

7) Joe copula

The Joe copula had the definition as follows:

$$C_{Joe}((u_1,u_2|\alpha) = 1 - [(1-u_1)^{\alpha} + (1-u_2)^{\alpha} - (1-u_1)^{\alpha}(1-u_2)^{\alpha}]^{1/\alpha} \quad (11)$$

Where $\alpha \geq 1$. This copula is akin to Gumbel copula. It can reflect the stronger upper tail dependence than Gumbel copula and $\lambda_U = 2 - 2^{1/\alpha}$.

In conclusion, different copula has different features regarding upper tail dependence, lower dependence, comprehensive dependence, etc. Therefore, selecting a suitable copula to capture the proper dependence between two random variables is also important. (Wiboonpongse, A. et al., 2015)

2.4 Model Selection

Akaike information criterion (AIC), Bayesian information criterion (BIC) are two selection criteria to select a model that is to make all variables fit the model at the best level.

AIC is defined for a large class of models fitted by using maximum likelihood:

$$AIC = -2logL + 2 * k \quad (12)$$

where L is the maximum likelihood function for the estimated model.

The BIC value is well-defined as:

$$BIC = \frac{1}{n}(RSS + \log(n)\, k\hat{\sigma}^2) \quad (13)$$

For the results of AIC and BIC, the lowest values are preferred.

2.5 Copula-Based Stochastic Frontier Model (CSFM)

The following model is the stochastic frontier model (SFM):

$$y_t = x_t{}'\beta + \varepsilon_t \quad (14)$$

$$\varepsilon_t = v_t - u_t \quad (15)$$

where $t = 1, 2, \ldots, N$, y_t is the dependent variable that is taken logarithm, x_t is a $k \times 1$ vector of independent variables, β is a $k \times 1$ vector of unknown parameters, v_t is a random error, and u_t is a non-negative unobservable random variable that represents technical inefficiency, and u_t and v_t are independent. (Kreinovich et al., 2018) The technical efficiency TE_t can be computed by

$$TE_t = \frac{\exp(x'\beta + v_t - u_t)}{\exp(x'\beta + v_t)} = \exp(-u_t) \quad (16)$$

The stochastic frontier model assumes that v_t and u_t are independent. Copula can make the optimum use of the stochastic frontier model. The copula-based stochastic frontier model sufficiently regards dependence structure between u and v, with independence between u and v using product copula. First, the joint density of $f(u,v)$ can be transformed into $f(u,\varepsilon)$ following Smith.

$$f(u,v) = f(u,u+\varepsilon) = f_u(u) + f_v(u+\varepsilon) \times c_\alpha\big(f_u(u), f_v(u+\varepsilon)\big) \quad (17)$$

Then, the probability density function of ε can be expressed by:

$$f_\alpha(\varepsilon) = E_U[f_v(U+\varepsilon)c_\alpha\big(F_U(U), F_V(U+\varepsilon)\big)] \quad (18)$$

Where $E_U[\dots]$ denotes the expected value of the distribution of technical inefficiency U. It is assumed to be time-series observations of i individuals or firms, then log maximum likelihood is used to estimate the CSFM:

$$L(\beta, \sigma_u, \sigma_v, \alpha) = \prod_{t=1}^{n} f_\alpha(\varepsilon_t) = \prod_{t=1}^{n} f_\alpha(y_t - \beta_0 - x'_t\beta_t) \quad (19)$$

Where y_t is the logarithm form of output at time t, x_t is the independent variable vector, σ_u and σ_v are from marginal distributions of U and V respectively. It is shown that very few density functions of ε exist closed-form solution. Then, the maximum simulated likelihood method is adopted to estimate the unknown parameters in CSFM. (Kreinovich et al., 2018) The density function of ε can be transformed as below:

$$f(\varepsilon) = \int_0^\infty f_U(u) \times f_V(u+\varepsilon) \times c_\alpha\big(F_U(u), F_V(u+\varepsilon)\big)du$$

$$= \int_0^\infty \frac{2\exp(-\frac{u^2}{2\sigma_u^2})}{\sqrt{2\pi}\sigma_u} \times f_V(u+\varepsilon) \times c_\alpha\big(F_U(u), F_V(u+\varepsilon)\big)du$$

$$= \int_0^\infty \frac{2\exp(-(\sigma_u u_0)^2/2\sigma_u^2)}{\sqrt{2\pi}\sigma_u} \times f_V((\sigma_u u_0+\varepsilon) \times c_\alpha\big(F_U(\sigma_u u_0), F_V(\sigma_u u_0+\varepsilon)\big)d\sigma_u u_0$$

$$= \int_0^\infty \frac{2\exp(-{u_0}^2/2)}{\sqrt{2\pi}} \times f_V((\sigma_u u_0+\varepsilon) \times c_\alpha\big(F_U(\sigma_u u_0), F_V(\sigma_u u_0+\varepsilon)\big)du_0$$

$$\approx \frac{1}{R}\sum_{r=1}^{R} f_V\,(\sigma_u u_{0,r}+\varepsilon) \times c_\alpha\left(F_U\big(\sigma_u u_{0,r}\big), F_V\big(\sigma_u u_{0,r}+\varepsilon\big)\right) \quad (20)$$

Where u_0 is a sequence of R random. The simulated log-likelihood of the copula-based stochastic frontier approach can be shown as below:

$$L_s(\beta, \sigma_u, \sigma_v, \alpha) \approx \sum_{t=1}^{N} \log\{\frac{1}{R}\sum_{r=1}^{R} f_V\big((\sigma_u u_{0,tr}+\varepsilon_t) \times c_\alpha\left(F_U\big(\sigma_u u_{0,r}\big), F_V\big(\sigma_u u_{0,r}+\varepsilon\big)\right)\} \quad (21)$$

Where $\varepsilon_t = y_t - \beta' x_t$. Besides, the relevant parameters, λ, γ and σ^2, can be defined by $\lambda = \sigma_u/\sigma_v$, $\gamma = {\sigma_u}^2/({\sigma_u}^2 + {\sigma_v}^2)$, and $\sigma^2 = {\sigma_u}^2 + {\sigma_v}^2$. Note that the standard errors of these parameters can be estimated by applying the invariance property.

The technical efficiency for copula-based stochastic frontier model can be analyzed as follows:

$$TE_\alpha = E[\exp(-U)\,|\xi = \varepsilon]$$

$$= \frac{1}{f_\alpha(\varepsilon)} \int_{R_+} \exp(-u)\, f(u,\varepsilon) du$$

$$= \frac{E_U\left[\exp(-U) f_V(U+\varepsilon) C_\alpha\left(F_U(U), F_V(U+\varepsilon)\right)\right]}{E_U\left[f_V(U+\varepsilon) C_\alpha\left(F_U(U), F_V(U+\varepsilon)\right)\right)}$$

$$\approx \frac{\frac{1}{R}\sum_{r=1}^{R} \exp(-\sigma_u u_{0,tr}) \times f_V\left((\sigma_u u_{0,tr} + \varepsilon_t) \times C_\alpha\left(F_U\left((\sigma_u u_{0,tr}\right), F_V\left((\sigma_u u_{0,tr} + \varepsilon\right)\right)\right.\right.}{\frac{1}{R}\sum_{r=1}^{R} f_V\left((\sigma_u u_{0,tr} + \varepsilon_t) \times C_\alpha\left(F_U\left((\sigma_u u_{0,tr}\right), F_V\left((\sigma_u u_{0,tr} + \varepsilon\right)\right)\right.\right.} \quad (22)$$

3. Result

3.1 Data Analysis

EX, FAIHI, PAW, EP and LOC respectively stand for Export, Fixed-Asset Investment in Highway Industry, Population with Access to Water, Electricity Production, and the Length of Optical Cable, which are displayed in **Table 3**.

Table 3. Data description: average values from 2001 to 2019

Region	EX (USD mn)	FAIHI (RMB mn)	PAW (Person th)	EP (kWh bn)	LOC (km th)
Eastern	1300080	1758324	186117	1566	192
Central	89530	1177265	79065	836	164
Western	86101	2440956	76908	1204	361
Northeast	49856	216830	42585	245	83

Source: CEIC 2020

The data from **Table 3** is evidently shown that the Eastern region had the highest yield of export, which is the statistical sign of economic status here. Besides, the population with access to water in the Eastern region ranked first. The Western region invested the most in the highway industry during the past two decades, and had the longest length of cable. The economic status and the infrastructure items of the Central region were all in the middle place. As for the Northeast region, it got the lowest mean values of all variables.

3.2 Copula-based Stochastic Frontier Model (CSFM)

For the estimation of the stochastic frontier model, the following linear translog production model is considered:

$$\ln(\mathrm{EX})_{it} = ln\beta_0 + \beta_1 ln(\mathrm{FAIHI})_{it} + \beta_2 ln(\mathrm{PAW})_{it} + \beta_3 ln(\mathrm{EP})_{it} + \beta_4 ln(\mathrm{LOC}\ )_{it} + V_{it} - U_{it} \quad (23)$$

Where i represents different individuals of four economic regions in China, t is the year from 2001 to 2019. EX, FAIHI, PAW, EP, and LOC refer to exports, fixed asset investment in highway industry, population with access to water, length of optical

cable, respectively. And there are two error terms, V_{it} being regarded as noise terms and U_{it} inefficiency terms.

3.2.1 Stochastic Frontier Model

The empirical case of error components frontier (Battese et al., 1992) showed that in a production function, inefficiency reduces the number of endogenous variables. Logged with the dependent variable, iterative maximum likelihood estimation is terminated after 28 iterations. There are values of log-likelihood and parameters of two successive iterations within the tolerance limit. In this study, panel data are shown as 4 cross-sections, 19 periods, 76 observations. Thus, all observations are in the panel. Final maximum likelihood estimates are shown in **Table 4**.

Table 4. Stochastic Frontier Model

	Estimate	Std. Error	z value	Pr(>|z|)
Intercept	-7.4779515	2.7881547	-2.6820	0.007317 **
log (FAIHI)	-0.1394908	0.1116239	-1.2497	0.211427
log (PAW)	1.0661925	0.3609286	2.9540	0.003137 **
log (EP)	1.3646296	0.2010320	6.7881	1.136e-11 ***
log (LOC)	0.2593066	0.2565203	1.0109	0.312083
sigma Sq.	2.6834406	1.9073457	1.4069	0.159458
gamma	0.9881569	0.0086873	113.7479	< 2.2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
log likelihood value: 11.14248

If the p-value is in the scope of [0, 0.001], it has a significant code of ***. If the p-value is in the scope of (0.001, 0.01], it has a substantial code of **. If the p-value is in the scope of (0.01, 0.05], it has a significant code of *. If the p-value is in the scope of (0.1, 1], it has no considerable code. **Table 4** clearly demonstrates how inputs are significant to the output in the stochastic frontier production function. Under the significant level of 10%, a p-value of 0.211427 shows that log (FAIHI) is insignificant. The p-value of 0.0031 means log (PAW) is significant. log (EP) is also significant, while log (LOC) is insignificant. In this way, two variables are significant, and two are insignificant.

3.2.2 Copula of V_{it} and U_{it} for Stochastic Frontier Model Based on Copula

In the conventional stochastic frontier model, it is assumed that V_{it} and U_{it} are not correlated to each other, as is shown the same as an independent copula

$C_{IN} = u_1 u_2$. To further understand the discrepancy, Normal (Gaussian) copula, T-copula, Clayton Copula, Frank copula, Gumbel copula, and Joe copula are used to estimate parameters. These copulas are assumed that V_{it} and U_{it} are correlated with each other. The Copula enables the optimal application of stochastic frontier models.

Table 5. Correlation Coefficient of Copula

Copula	Rho.1/Alpha	Maximized loglikelihood
Normal copula	-0.51	9.955
T-copula	-0.5101	9.955
Clayton Copula	0.497	3.966
Frank copula	-2.69	6.741
Gumbel copula	1.00	-6.528e-07
Joe copula	1.00	-3.613e-07

The results from **Table 5** of the normal copula, t-copula, and Frank copula means two error terms U_{it} and V_{it} have negative correlations with each other for four economic regions in China. The maximized loglikelihood reflects the likelihood that U_{it} and V_{it} have correlations. For normal copula and Frank copula, in terms of Maximized loglikelihood, the value of normal copula is 9.955, larger than the value of Frank copula 6.741, which means the parameter of normal copula to be -0.51 is more likely to happen while comparing the parameter of Frank copula to be -2.69.

3.2.3 Model Selection for the Best-fit Copula Model for Copula-based Stochastic Frontier Model

Akaike information criterion (AIC), Bayesian information criterion (BIC) are estimators to measure the quality of the model. The lowest values of AIC and BIC are much preferred to choose the best model.

Table 6. Results of AIC and BIC

Copula	AIC	BIC
Normal copula	-5.93148225462293	-3.6007489143366
T-copula	-15.9090239717599	-11.2475572911872
Clayton copula	-5.93148225462293	-3.6007489143366
Frank copula	-11.4817100493799	-9.15097670909356
Gumbel copula	2.00000130561	4.33073464589633
Joe copula	2.00000072250034	4.33073406278667

It is only necessary to find out the lowest values of AIC and BIC. It is clearly shown in **Table 6** that t-copula has the lowest values of AIC and BIC, which are -15.909 and -11.248 respectively. Therefore, the best-fitted copula model for the stochastic frontier model here is the t-copula.

3.2.4 Stochastic Frontier Model Based on Copula Model

The empirical case of error components frontier (Battese et al., 1992) showed that in a production function, inefficiency reduces the number of endogenous variables. Logged with the dependent variable, iterative maximum likelihood estimation is terminated after 31 iterations. There are values of log-likelihood and parameters of two successive iterations within the tolerance limit. In this study, panel data are shown as 4 cross-sections, 19 periods, 76 observations. Thus, all observations are in the panel.

Table 7. Copula-based Stochastic Frontier Model

	Estimate	Std. Error	Z value	Pr(>|Z|)
Intercept	-17.204807	8.728033	-1.9712	0.04870 *
log (FAIHI)	-0.629654	0.346586	-1.8167	0.06926
log (PAW)	2.574625	1.123036	2.2926	0.02187 *
log (EP)	2.393556	0.586187	4.0833	4.441e-05 ***
log (LOC)	-1.103842	0.740884	-1.4899	0.13625
sigma Sq.	3.892871	3.156104	1.2334	0.21741
gamma	0.929747	0.058688	15.8421	< 2.2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

log likelihood value: -67.11617

If the p-value is in the scope of [0, 0.001], it has a significant code of ***. If the p-value is in the scope of (0.001, 0.01], it has a significant code of **. If the p-value is in the scope of (0.01, 0.05], it has a significant code of *. If the p-value is in the scope of (0.1, 1], it has no significant code. Under the significant level of 10%, **Table 7** clearly illustrates the p-value of 0.06926 shows that log (FAIHI) is significant. The p-value of 0.02187 means log (PAW) is significant. Log (EP) is also significant, while the p-value of 0.13625 says that log (LOC) is insignificant. In this way, three variables are significant, and only one is insignificant.

In terms of the endogenous variable for the stochastic frontier model, two variables are significant, and another two are insignificant while three variables are significant, and only one is insignificant for the copula-based stochastic frontier model.

Therefore, to conclude, the copula-based stochastic frontier model is relatively efficient in using various inputs to fit the model when comparing with the stochastic frontier model.

3.2.5 Results of Technical Efficiencies

The stochastic frontier model assumes that v_t and u_t are independent. The technical efficiency TE_t can be calculated by

$$TE_t = \frac{\exp(x'\beta+v_t-u_t)}{\exp(x'\beta+v_t)} = \exp(-u_t) \tag{24}$$

The results of SFM could be shown that the mean efficiency of four economic regions is 0.3940395. Amid them, the efficiency in the Eastern region is 0.42113276, the Central region 0.14286421, the Western region 0.08544203, and the Northeast region 0.92671909.

The technical efficiency for the copula-based stochastic frontier model can be calculated as follows:

$$\begin{aligned} TE_\alpha &= E[\exp(-U)\,|\xi = \varepsilon] \\ &= \frac{1}{f_\alpha(\varepsilon)} \int_{R_+} \exp(-u)\, f(u,\varepsilon) du \\ &= \frac{E_U[\exp(-U) f_V(U+\varepsilon) C_\alpha(F_U(U), F_V(U+\varepsilon))]}{E_U[f_V(U+\varepsilon) C_\alpha(F_U(U), F_V(U+\varepsilon))} \\ &\approx \frac{\frac{1}{R}\sum_{r=1}^{R} \exp(-\sigma_u u_{0,tr}) \times f_V((\sigma_u u_{0,tr}+\varepsilon_t) \times C_\alpha(F_U((\sigma_u u_{0,tr}), F_V((\sigma_u u_{0,tr}+\varepsilon))}{\frac{1}{R}\sum_{r=1}^{R} f_V((\sigma_u u_{0,tr}+\varepsilon_t) \times C_\alpha(F_U((\sigma_u u_{0,tr}), F_V((\sigma_u u_{0,tr}+\varepsilon))} \end{aligned} \tag{25}$$

The results of CSFM show that the mean efficiency in four economic regions is 0.3067181. Amid them, the efficiency in the Eastern region is 0.07867134, the Central region 0.10160992, the Western region 0.19876288, and the Northeast region 0.84782813.

Table 8 demonstrates different technical efficiencies between SFM and CSFM of four economic regions. Overall, the mean technical efficiency of CSFM 0.306718 is lower than the SFM of 0.3940395. The value in the Eastern region differs greatly among the four economic regions, with SFM of 0.42113276 and CSFM of 0.07867134. In contrast, the technical efficiencies in the Central region of the two models have only a slight difference. The technical efficiencies in the Western and Northeast regions of SFM and CSFM fluctuate around 0.15.

Table 8. Technical Efficiencies between SFM and CSFM

	SFM	CSFM
Eastern	0.42113276	0.07867134
Central	0.14286421	0.10160992
Western	0.08544203	0.19876288
Northeast	0.92671909	0.84782813
Mean	0.3940395	0.3067181

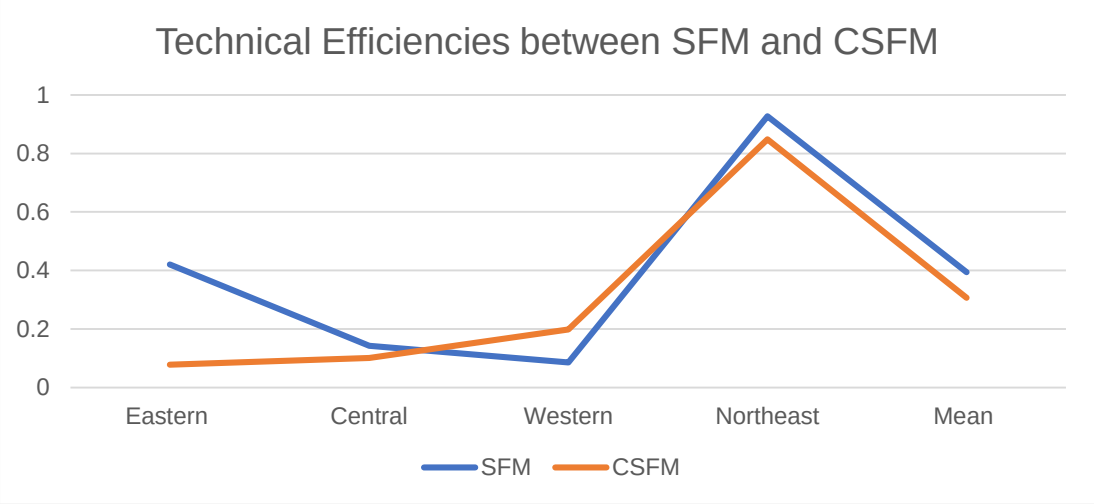

Figure 4. Technical Efficiencies between SFM and CSFM

From **Figure 4**, it is also clearly illustrated that CSFM has a lower value of technical efficiency in the Eastern region, the Central region and the Northeast region. Only the Western region has a higher value of technical efficiency than the Western region. The lowest value is from the Eastern region of CSFM and the highest value is from the Northeast region of SFM. It is obviously shown from both models of SFM and CSFM that the Northeast region has the highest technical efficiency.

4. Discussion

Since good infrastructure facilities are essential to achieving economic growth and improving people's quality of life, it is necessary to develop infrastructure in an appropriate way. China was relatively backward at the early stage but has grown fast in the past few decades. One of the reasons is the massive development of physical infrastructure, which has underpinned China's sustained high economic growth and enabled innumerable Chinese people to live a better life. It is essential to find out more about China's infrastructure situation and may provide examples for the developing countries that would like to improve their economics. We need to verify the significance

between inputs and output and figure out the technical efficiency of economic growth in different economic regions of China.

First, some literature was studied. About the stochastic frontier model (SFM), it was first proposed by Aigner et al. (1977). It was popular to be used in the agricultural field to estimate technical efficiency. Battese and Coelli (1992), Ruggiero (1996), Bravo-Ureta (2007), and Wiboonpongse et al. (2015) all did some researches on agriculture. To distinguish the previous study, the research gap of this study would be a supplementary material of technical efficiency measurements combining the topic of infrastructure construction.

Then it comes to the technical part of this study, which mainly focuses on the significance of the models for infrastructure variables and technical efficiencies of four economic regions of China. Firstly, according to the four infrastructure inputs for three different production functions here, figuring out which model could offer a better result of significance. The three models would be the stochastic frontier model, the copula-based stochastic frontier model, and the copula-based meta-stochastic frontier model.

Furthermore, this paper focuses on finding out the technical efficiencies of four economic regions of China based on infrastructure construction and gives some useful advice for the government to reduce regional disparities in terms of economic development.

From the results mentioned above, the stochastic frontier model based on copula is relatively efficient in using various inputs to fit the model compared with the stochastic frontier model. Though it is hard to say which model is more efficient in getting the result of the technical efficiency owing to the small sample, it offers the information that both models obviously show that the Northeast region has the highest technical efficiency. This is an important result because it is commonly thought the Eastern region had the highest technical efficiency.

As we all know, the Northeastern region was once China's old industrial base and the most economically developed region, which played an essential role in supporting the national economy. And now, the Northeast region has stepped into the relatively saturated condition in infrastructure construction. As for another three regions, the Eastern region, though being the most developed region in China, still has room for further development. The Western part has had a robust advance in infrastructure construction these years, but considering its natural, geographic, historical, and other reasons, the Western region still needs more development. The development of the Central region in infrastructure construction also requires more planning and strategy.

5. Conclusion and Recommendation

This study proposes to estimate the technical efficiency of economic growth among different economic regions in China based on infrastructure construction and provide

helpful information for government to reduce regional disparities in terms of economic development.

In terms of the endogenous variable for the stochastic frontier model, two variables of log (PAW) and log (EP) are significant, and another two of log (FAIHI) and log (LOC) are insignificant in this study while three variables of log (FAIHI), log (PAW) and log (EP) are significant, and only one variable log (LOC) is insignificant for the copula-based stochastic frontier model. Therefore, to conclude, the copula-based stochastic frontier model is relatively efficient in using various inputs to fit the model when comparing with the stochastic frontier model.

The results of SFM show that the mean efficiency of four economic regions is 0.3940395. Amid them, the technical efficiency of the Eastern region is 0.42113276, the Central region 0.14286421, the Western region 0.08544203, and the Northeast region 0.92671909. The results of CSFM display that the mean efficiency of four economic regions is 0.3067181. Amid them, the efficiency in the Eastern region is 0.07867134, the Central region 0.10160992, the Western region 0.19876288, and the Northeast region 0.84782813.

Overall, the results show that the Northeast region has the highest technical efficiency from both models. However, it is surprising that the Eastern region has a much lower technical efficiency in the copula-based model. Though the Central region and the Northeast region also have a smaller value of technical efficiency, they have been reduced slightly. Only the Western region has a higher value of technical efficiency in the second model. In this way, the reason could be dated back to the use of variables. The variable log (LOC) is insignificant in the copula-based model, and to some degree, it has affected the results of technical efficiencies in both the Eastern and Western regions. It would be better to use the density of optical cable instead of the length of optical cable.

To reduce the regional disparities, some suggestions are being put forward:

First, the Northeast region needs to keep the current situation of infrastructure construction and continue to make full use of the infrastructure to develop economics. Moreover, another three regions have comparatively lower technical efficiencies. And it is important for other three regions to learn the experience from the Northeast region. From the data of the Western region, we could also see that it had the highest investment in the highway industry and had extended the length of the cable double or triple comparing to the other regions. However, its technical efficiency is the lowest of SFM. It is much better in CSFM, with technical efficiency raking the second, but compared to the Northeast region it is a still relatively low value. It is essential to make use of various infrastructures in these three regions fully to develop economics. When investing more to develop infrastructure construction in these three regions, it is imperative to make a long-term plan and make the construction project more efficient, especially in some relatively backward regions.

Finally, it is always stressed that sustainable development and reducing regional disparities are necessary. China has also implemented many different policies to achieve this goal. And there is a great number of measurements to development infrastructure, but as we summarized above, for the Northeast region, maintaining the current technical efficiency is the most important, and for the other three economic regions, considering how to improve technical efficiency and make the most of the input is more crucial.

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I dedicate this paper to my grandma, who has always expected me to be industrious. My grandma has spent all her life in a small village and has seen many changes in China in the past eighty years. She always mentioned one of the significant changes in our town was infrastructure construction. Therefore, this paper aims to find out more about infrastructure in China. Simultaneously, this work has been done thanks to specialized assistance, warm encouragement, and adequate supervision from many people.

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Forecasting and Nowcasting of China's Demand for Electricity

Hexing Liu[1], Chukiat Chaiboonsri[2], Anuphak Saosaovaphak[3]

Abstract

This study is aim to test the feasibility of using nowcasting method on China's electricity consumption and comparing different method of prediction result using the data from 2000-2020. The traditional methodology on electricity consumption prediction are regression models of forecasting method. This study used ARMAX model to forecast electricity consumption as the reference of traditional forecasting to compare with the new nowcasting method BSTS model's result of prediction. The result proved the feasibility of using nowcasting method on electricity consumption and the superiority of nowcasting method BSTS model rather than traditional forecasting method ARMAX model for electricity consumption prediction.

Keyword: Electricity consumption, China, Forecasting, ARMAX model, Nowcasting, BSTS model

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1. Introduction

As China is under the process of economic structural transformation and rapid development, electricity consumption in the richest provinces has stabilized. Policy makers and power industry planners need to carefully reassess the demand for electricity generation to prevent Over-skewed resources that could lead to over-supply or stranded generator. Having a better technique to predict the electricity consumption is essential for power systems planning.

1.1 Principle and Rationale of the Study

This study is aim to test the feasibility of using nowcasting method on electricity consumption and comparing different method of prediction. The traditional methodology on electricity consumption prediction are regression models of forecasting method. (Fazil Kaytez, et.al.2015). This study would use ARMA(p,q,X) / ARIMAX model to forecast electricity consumption as the reference of traditional forecasting to compare with the new nowcasting method BSTS model's result of prediction.

1.1.1 Electricity Consumption of China

Over the last 30 years, China's economy growth is fast, on average, 10 percent per year. Therefore, China's power industry has grown from 60 Giga Watt (GW) in 1980 to 7,325,300 GW, and electricity consumption has increased from 295 Tera Watt hour (TWh) in 1980 to 7225 TWh in 2019 (CEC, 2020). **Figure 1** shows the electricity consumption of China in the last ten years (Statista, 2020).

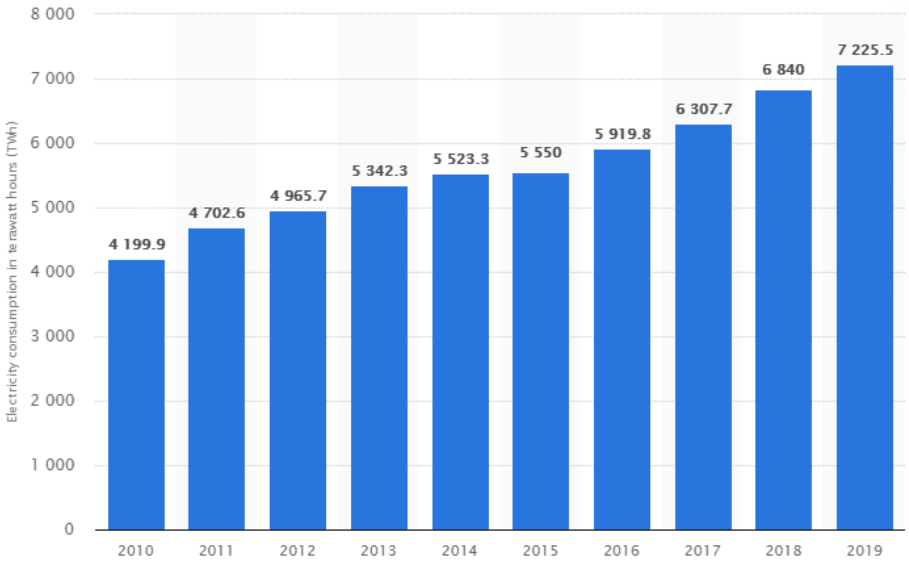


Figure 1 Electricity Consumption in China between 2010 and 2019
Source: Statista (2020)

Electricity is the most direct form which can refer to a nation's industrial

development by electricity consumption data. Therefore, electricity consumption, especially in the industry could near tell the level of economic development (Chi Zhang et al., 2017). Therefore, having a proper technique to predict the electricity consumption is essential for power systems planning, a predictive analysis based on the rapport of economic development and electricity consumption is essential, as China is under the process of economic structural transformation and rapid development (Gang et al.,2016).

1.1.2 Nowcasting

The word "nowcasting" comes from the term Now + Forecasting. Forecasting is usually used to use data from previous periods to forecast Economic Indicators in the next period, but Nowcasting uses data in the current period to forecast economics indicator at the same time by Choi and Varian (2012), describing it as "Prediction of Present".

In the modern 21st century, with the development of technology, daily life has been changed dramatically. The Internet has entered people's life. It can connect each other with a high speed, and users can access or save data on the Internet.In order to get information from the Internet users could use a type of website called "Search Engine" by using the **Keyword** or **Query**. The search engine is a website which users can search for required information. To do so, users type the desired **Keyword** into the search field. Then search engines use its index to find relevant websites and display them in a list. The Search Engine has many service providers, such as Google, Baidu, and Bing. Baidu has the largest population of users in China. Recent updates of stats in August 2020 show Baidu has the largest market share of Search Engine, which is 71.13 percent compared to 3.42 percent of Google in China (Statcounter,2020).

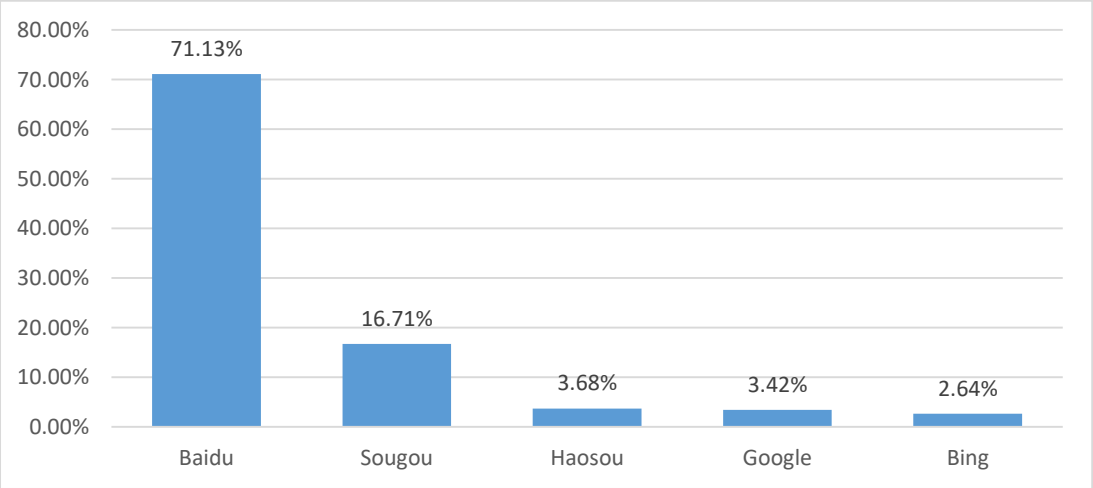


Figure 2 Top 5 Search Engine in China
Source: Statcounter,2020

Baidu Index is a data collection platform based on Baidu search engine

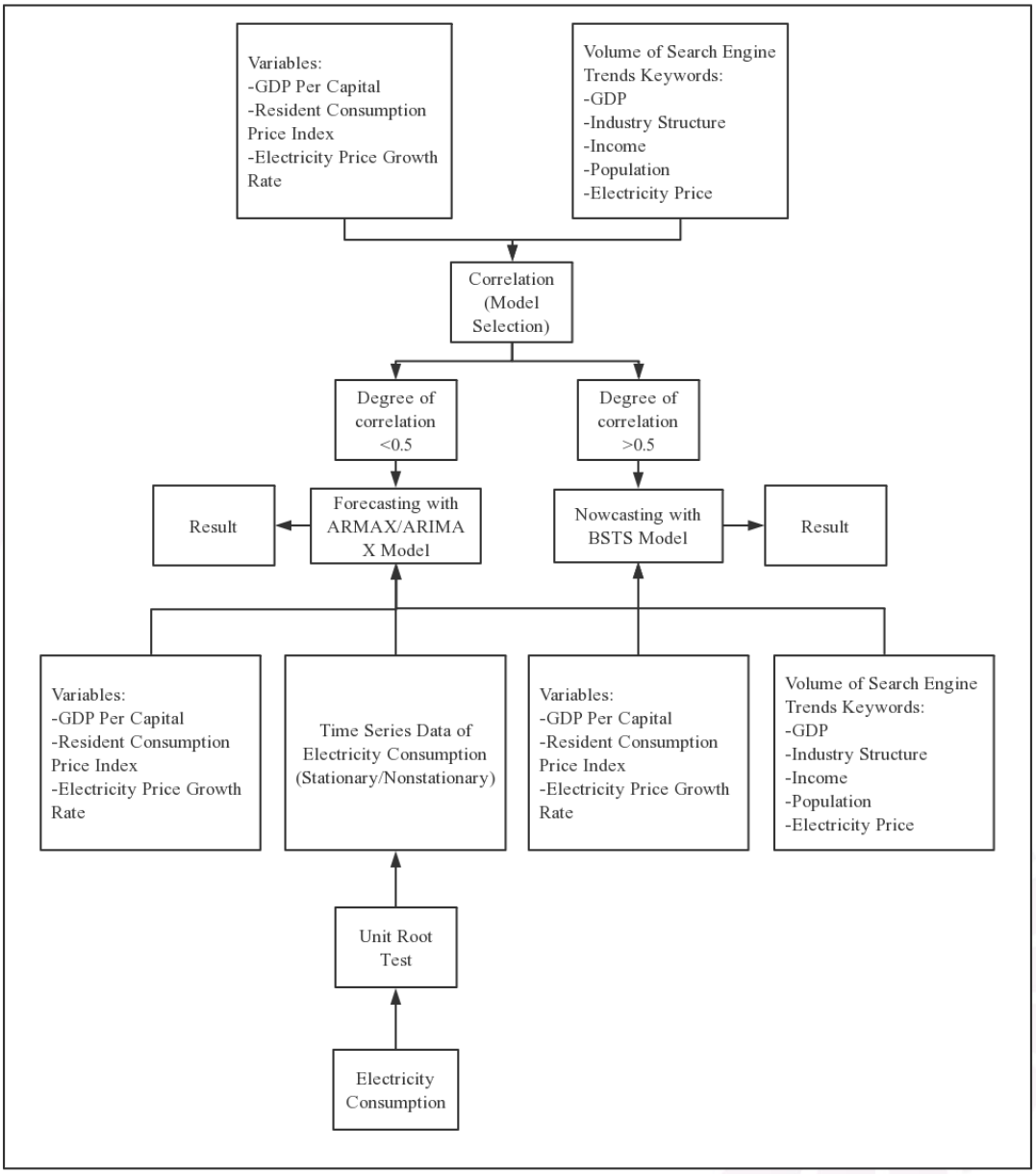
users' retrieval behavior data. The Baidu Index depends on the user's active search behavior record. Every user's search behavior in the Baidu search engine is a display of enthusiastic willingness. Every search behavior may become an expression of the consumer's desire to consume. The demand map of the Baidu Index is based on the semantic mining technology to present the user with the hidden focus and consumption desire of keywords (Baidu Index,2020).

Now many types of research are using the data from search engine trends to help with the analysis. The main attraction of search engine trend data to the economic outlook is that they can be mobilized faster and more frequently than most traditional economic series. The traditional method of statistic and forecasting always comes with an irreducible delay. However, for decision making, it is crucial to have access to real-time information to understand the current situation. That is why people developed several efficient forecasting tools, summarized as real-time forecasting (or nowcasting).

This study will test and verify the feasibility of using nowcasting method on electricity consumption and predict the electricity consumption by using forecasting/nowcasting method. Since previous study of electricity consumption prediction is based on the traditional methodology and studies of now-casting haven't relate to the electricity consumption prediction, this paper would conducts comprehensive approaches on verifying the feasibility of using search engine volume to now-cast the electricity consumption of China.Hence, this paper attempt to fill the gap in literature on now-casting electricity consumption. Besides, this study would have two parts of contribution. First is for the industry planer and investor.if the hypothesis of relationship between search terms and electricity consumption stand, they could use this method to support their decision making of investment. Second is for government policy maker, this study attempt to provide a prediction method of electricity demand analysis, which could be helpful to make the real-time adjustment of policies such as electricity price(set by government) and subsidy policy to the industry.

2. Methodology

2.1 Process Framework



2.2 Data collection

This paper collect annual data of China's electricity consumption from 2000 to 2020. The time series data is electricity consumption of China. The variables are GDP per capital, resident consumption price index and electricity price growth rate. The control variable is search engine volume by Baidu Index. The high frequency search engine data would be summarized into the same frequency as others.

The selected keywords for electricity consumption are GDP, industry structure, income, population, and electricity price. Each of the keywords represent one of the key factors which would affect the electricity consumption according to the study from Huang(2014).

Table 1. Data collection

Key factor	Indicators	Measurement	Data source
State of economics	GDP Per Capital	Yuan	World Bank
Resident Consumption Price	Resident Consumption Price Index		World Bank
Electricity Price	Electricity Price Growth Rate		National Bureau of Statistic
Electricity Demand	Electricity Consumption	GWh	National Bureau of Statistic
Search Engine Volume	Baidu Index Trends		Baidu Index

2.3 Panel Unit Root Test

The ADF-Test (equation (1)) produces a parametric correction for high-order correlation by assuming that Y_t series follows an AR(p) process and adds p lagged difference terms of dependent variable Y_t to the right-hand side of the test regression:

$$\Delta Y_t = \alpha y_{t-1} + x_t' \delta + \beta_1 \Delta Y_{t-1} + \beta_2 \Delta Y_{t-2} + \ldots + \beta_p \Delta Y_{t-p} + \varepsilon_t \quad (1)$$

Defined that:

-Y_t: time series data of the electricity consumption(EC)

-ε_t: a stochastic (non-systematic) and iid (Independent and identically distributed with mean=0 and variance=σ^2, assumed to be white noise)

-x_t': exogenous regressors (constant, constant and trend)

-α, δ: parameters to be estimated

Equation (1) will be used to test unit root of Y_t(Electricity Consumption) in types of ADF-Test approach. This test provided the null hypothesis and alternative hypothesis below that:

H_0: $\alpha = 0$ (Y_t has unit root or Y_t is non-stationary time series)

H_1: $\alpha < 0$ (Y_t does not have a unit root or Y_t is stationary time series)

According to the null hypotheses and alternative hypotheses already mentioned above to evaluate by t-ratio for α, if t-computed greater than the critical value at 5% level of t-statistics table, then the null hypothesis is rejected.

2.4 Forecasting Model

1) ARMA Model

Auto-regressive Moving Average Model (p,q) model is the forecasting method of stationary time series data. The simple AR(1) model can be represented by equation(2)

$$y_t = \chi_t'\beta + \mu_t, u_t = \rho u_{t-1} + \varepsilon_t \quad (2)$$

The simple AR(1) model identified that this model has only the first order term, and that p is represented by the number of order in AR model. In this case, the AR(1) model has only p equal to 1. Furthermore, if AR(p) model has more than the first-order term, we can say that AR(p) model has higher-order AR terms(p>1). An auto-regressive model of q, AR(p) could be represented by equation (3) as follow:

$$y_t = \chi_t'\beta + \mu_t, u_t = \rho u_{t-1} + \rho u_{t-2} + ... + \rho_p u_{t-p} + \varepsilon_t \quad (3)$$

For moving average term, MA(q) model is one part of ARMA(p,q) model. MA(q) model has the form (equation 4)

$$u_t = \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + ... + \theta_q \varepsilon_{t-q} \quad (4)$$

Therefore, ARMA (p,q) model can be presented fully by equation (5)

$$u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + ... + \rho_p u_{t-p} + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + ... + \theta_q \varepsilon_{t-q} \quad (5)$$

From the equation (5), the terms of $\rho_1 u_{t-1} + \rho_2 u_{t-2} + \cdots + \rho_p u_{t-q}$ represented auto-regressive terms. Finally, ρ_p is a coefficient of AR(p) terms and θ_q is a coefficient of MA(q) terms.

Model selection

- Akaike Information Criterion (AIC)

AIC was developed by Hirotsugu Akaike in 1971 and proposed in Akaike(1974). This is a method of the wellness of fit of an estimated statistical model. To understand for AIC is a statistics tool for model selection. The AIC criterion of the model selection for best model is by giving the lowest of AIC compared with other models. In general, the AIC can be written by equation (6)

$$AIC = 2k - 2\ln(L) \quad (6)$$

- Schwarz Information Criterion(BIC)

The Schwarz Information Criterion(BIC) was developed by Gideon E.Schwarz, who used an adopted Bayesian approach applied for arguments. It's very similar with the Akaike information criterion. In statistics concept, the Bayesian information criterion(BIC) or Schwarz Criterion is a model selection among a class of parametric models with different numbers of parameters. The BIC can be written by equation (7)

$$BIC = n\ln(\frac{RSS}{n}) + k\ln(n) \quad (7)$$

Where RSS is the residual sum of squares from the estimated model. Note that the term for BIC in equation(7) needs to understand behind this criterion that

disturbances or error terms are normally distributed. The minimized BIC should be the best model to select.

- Hannan-Quinn Information Criterion(HQC)

One another statistics tool for model selection is the HQC. The HQC is an option to AIC and BIC. It is given as

$$HQC = n\ln(\frac{RSS}{n}) + 2k\ln\ln(n) \tag{8}$$

Where k is the number of parameters, n is the number of observations, and RSS is the fitted residual sum of squares of a minimum that results from linear regression or from non-linear global optimization.

Forecast Evaluation

The Mean Absolute Error(MAE)

In statistics, the Mean Absolute Error(MAE) is a quantity used to measure how close forecasts or predictions are to the eventual outcomes. The mean absolute error(MAE) is presented by equation(9)

$$MAE = \frac{1}{n}\sum_{i=1}^{n}|f_i - y_i| = \frac{1}{n}\sum_{i=1}^{n}|e_i| \tag{9}$$

The Mean absolute error is an average of the absolute error$e_i = f_i - y_i$, where f_i is the prediction and $y_i$is the true value. Note that alternative formulations may include relative frequencies as weight factors. The mean absolute error is a common measure of forecast error in time series analysis.

The Mean Absolute Percentage Error(MAPE)

In statistics, the Mean Absolute Error(MAE) is measure of accuracy in fitted time series value in statistics, specifically trending. It usually has been expressed accurately by a percentage and the formula of MAPE to present in equation(11)

$$MAPE = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{A_t - F_t}{A_t}\right| \tag{10}$$

Where A_t is the actual value and F_t is the forecast value. The difference between A_t and F_t is divided by the actual value A_t again. The absolute value of this calculation is summed for every fitted or forecast point in time and divided again by the number of fitted points of n. This makes it a percentage error so one can compare the error of fitted time series that differ in level.

Root Mean Squared Error(RMSE)

The RMSE is a forecast evaluation approach calculated from actual value and forecasted value in a specified period. The accuracy model to predict the time series data should be responded by minimized value of RMSE. The RMSE denoted the formula in equation(11)

$$RMSE = \sqrt{\sum_{t=T+1}^{T+h} (\hat{y}_t - y_t)^2 / h} \quad (11)$$

Where $(\hat{y}_t - y_t)$ represented the discrepancy value between forecast value and actual value in period t, respectively. The smaller the error is the better forecasting ability of that model according to RMSE of forecast evaluation approach.

Theil Inequality Coefficient

The forecast evaluation approach TIC(Theil Inequality Coefficient) computed by equation(12)

$$TIC = \frac{\sqrt{\sum_{t=T+1}^{T+h} (\hat{y}_t - y_t)^2 / h}}{\sqrt{\sum_{t=T+1}^{T+h} \hat{y}_t^{\,2} / h} + \sqrt{\sum_{t=T+1}^{T+h} y_t^{\,2} / h}}$$, h= period ahead (12)

Where $(\hat{y}_t - y_t)$ is represented by the difference value between actual value and forecasted value in period t, respectively. Once again, the less the error is the better forecasting of that model based on TIC of forecast evaluation approach.

Furthermore, the special technics can be carried out to evaluate the prediction model by BP , VP , and CP .

Bias Proportion(BP), Variance Proportion(VP), and Covariance Proportion(CP)

If the forecasting model is “good”, the bias and VP should be small so that most of the bias goes to the CP.

$$\text{Bias Proportion (BP)} = \frac{\left(\left(\sum_{i=T+1}^{T+h} \hat{y}_t / h\right) - \bar{y}\right)^2}{\sum_{i=T+1}^{T+h} (\hat{y}_t - y_t)^2 / h} \quad (13)$$

$$\text{Variance Proportion(VP)} = \frac{\left(S_{\bar{y}} - S_y\right)^2}{\sum_{i=T+1}^{T+h} (\hat{y}_t - y_t)^2 / h} \quad (14)$$

$$\text{Covariance Proportion (CV)} = \frac{2(1-r)S_{\bar{y}}S_y}{\sum_{i=T+1}^{T+h} (\hat{y}_t - y_t)^2 / h} \quad (15)$$

In detail, the bias proportions describe the distance between the mean of forecasting value and the mean of actual series. The variance proportion describes the distance between the variation of forecasting value and the variation of actual series.Covariance proportion was used to measure the remaining forecasting errors.

Two types of forecasting methods were applied to predict the time series data of both dynamic forecast method and static forecast method. The dynamic

forecast method is presented by equation(16). Moreover, the static forecasting method is shown in equation(17), respectively.

$$\hat{y}_s = \hat{c}(1) + \hat{c}(2)x_s + \hat{c}(3)z_s + \hat{c}(4)y_{s-1} \quad (16)$$

$$\hat{y}_{s+k} = \hat{c}(1) + \hat{c}(2)x_{s+k} + \hat{c}(3)z_{s+k} + \hat{c}(4)y_{s+k-1} \quad (17)$$

In terms of equation(17), the $\hat{y}_s$ is the initial observation in the prediction sample. And y_{s-1} is the actual series of lagged.

Moreover, both $\hat{c}(1)\hat{c}(2)$ are parameters from forecasted model and both x_s, z_s are the reoressors of forecasted model. From (17) represented the static forecast method and the difference between dynamics forecast method and static forecast method under prediction by using EViews. The actual series or transformed series were used to forecast.

If the time series data is predicted by dynamic forecast method, time series data would be transformed. But if the time series data is predicted by static forecast method, actual series would be preferred to forecast.

ARMA(p,q,X) model

The Auto-Regressive Moving Average(ARMA) model is the one suitable for the stationary time series data without both trend and seasonality. And the ARMA(X) model is a ARMA(p,q) model included with exogenous variables(X). The form of the ARMAX model is denoted by equation(18)

$$\Phi(B)y_t = \Xi(B)x_{t-\alpha} + \Theta(B)\varepsilon_t \quad (18)$$

And defined that:

y_t = Output variable

$x_{t-\alpha}$ = An external input variable

ε_t = White noise

$\Phi(B) = 1 + \phi_1 B + \phi_2 B^2 + \ldots + \phi_{n\phi} B^{m\phi}$ (The Auto Regressive terms(AR(p) model)

$\Xi(B) = 1 + \xi_1 B + \xi_2 B^2 + \ldots + \phi_{n\xi} B^{m\xi}$ (The Moving Average terms(MA(q) model)

$\Theta(B) + 1 + \theta_1 B + \theta_2 B^2 + \ldots + \phi_{n\theta} B^{m\theta}$ (The coefficients of exogenous variables(X))

(Hannan, Edward James,1970)

2.5 Nowcasting Model

BSTS model

Bayesian Structure Time Series Model is a statistical technique used for feature selection, time series forecasting, now-casting, inferring causal impact and

other applications. Let y_t (Electricity Consumption) denote observation t in a real-valued time series with three state components: a trend μ_t, a seasonal pattern τ_t and a regression component $\beta^T X_t$. The model is:

$$y_t = \mu_t + \tau_t + \beta^T X_t + \epsilon_t$$
$$\mu_{t+1} = \mu_t + \delta_t + \eta_{0t}$$
$$\delta_{t+1} = \delta_t + \eta_{1t} \quad (33)$$
$$\tau_{t+1} = -\sum_{S=1}^{S-1} \tau_t + \eta_{2t}$$

The current level of the trend is μ_t, the current "slope" of the trend is δ_t. Slopes normally multiply some X variables, in this study they are GDP per capital, resident consumption price index and electricity price growth rate. The seasonal component τ_t could be thought as a set of S dummy variables with dynamic coefficients constrained to have zero expectation over a full cycle of S seasons.This study described the annual cycle in the quarterly initial claims data using a seasonal state component with S=4. The seasonal state model takes the latter approach, but the constraint is that the SS most recent seasonal effects must sum to zero in expectation. This allows the seasonal pattern to slowly evolve.

3. Result

3.1 ADF Unit Root Test

The unit root test are found at level I(0) and the first difference level I(1) in trend and intercept. After ADF test the results of probability were determined at the significance level between 0.0000 and 0.01000 which is apply to the significance level of 1%, 5%, and 10% of variables which noted as ***,** and *. If the test statistics are greater than the critical value, it is insignificant and it will reject the null hypothesis, if the test statistics are less than the critical value, it is significant and it will accept the hypothesis.

Table 2. The Result of ADF Unit Root Test

Variables	Test	Level	ADF Test		Remark
			T-Statistics	Prob	
Electricity Consumption	Trend and Intercept	I(0)	-3.559998**	0.0613	Stationary
		I(1)	-3.843090**	0.0381	Stationary
GDP Per Capital	Trend and Intercept	I(0)	-3.919934**	0.0364	Stationary
		I(1)	-2.706838	0.2452	Non-Stationary
Resident Consumption Price Index	Trend and Intercept	I(0)	-3.581158**	0.0590	Stationary
		I(1)	-8.143707***	0.0000	Stationary
Electricity Price Growth Rate	Trend and Intercept	I(0)	-3.715040**	0.0450	Stationary
		I(1)	-5.262334***	0.0028	Stationary

Source: Calculation by using Eview10 Software Application
Note: *,**and *** represent significant at 10%, 5%, and 1% respectively

Table 2 presents the ADF unit root test result of the time series data and variables. If the critical value is smaller than t-statistic, it determined as stationary, however critical value is greater than t-statistic, it determined as non-stationary. This study shows the result of stationary and non-stationary both by using the calculation of Eview10 Application Software.

3.2 Forecasting Method

3.2.1 Multiple Regression

The multiple regression test is to check if all the variables could be used together to explain the dependent variable which is electricity consumption. The result of least squares multiple regression are present in **Table 3**.

Table 3. The result of LS multiple regression

Dependent Variable	Method	R-squared	Prob(F-statistic)
Electricity Consumption	Least Squares	0.988840	0.000000

Source: Calculation by using Eview10 Software Application

From the result of Least Squares above, The R-squared value is more than 0.98 which means the model good and stable. The Prob(F-statistic) is 0.00000 smaller than 0.05 which implies the set of all variables can explain the dependent variable electricity consumption. Since the ADF unit root test result shows both electricity consumption and its variables are stationary at level I(0), therefore electricity consumption could be forecast using ARMA model with the set of all variable above.

3.2.2 ARMA(p,q,x) Model Result

Since electricity consumption and all the variables are stationary, for forecasting purpose, the ARMAX Model could be used to predict the electricity consumption. ARMAX(1,1,X) Model, ARMA(2,1,X) Model, ARMAX(2,0,X) and ARMAX(1,0,X) Model are selected to be compared and pick the most suitable model for electricity consumption forecasting.To select the proper model for the ARMA forecasting method, the AIC, BIC and HQC would be checked.

Table 4. ARMAX model selection

Model	AIC	BIC	HQC
ARMAX(1,1,X)	26.36674	26.66517	26.43151
ARMAX(2,1,X)	26.04381	26.39198	26.11937
ARMAX(2,0,X)	26.28854	26.58697	26.35331
ARMAX(1,0,X)	26.36990	26.61859	26.42387

Source: Calculation by using Eview10 Software Application

The best model to forecast is ARMAX(2,1,X) model because the value of AIC, BIC and the HQC of this model are less than others.

Use ARMAX(2,1,X) model to forecast, the result are shown in **Table 5.**

Table 5 Forecasting by Dynamics Method

Model	RMSE	MAE	MAPE	BP	VP	CP
ARMAX(2,1,X)	91100.13	72890.56	1.593655	0.000221	0.068896	0.930883

Source: Calculation by using Eview10 Software Application

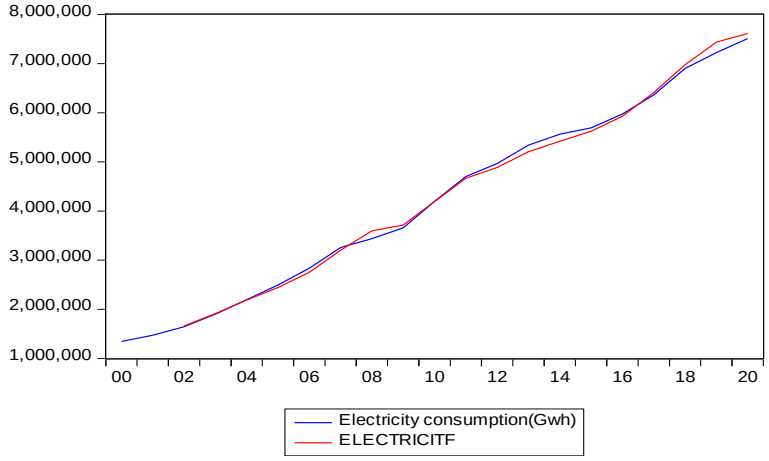


Table 6. Forecasting by Static Method

Model	RMSE	MAE	MAPE	BP	VP	CP
ARMAX(2,1,X)	71207.53	52269.88	1.255112	0.003235	0.001106	0.995658

Source: Calculation by using Eview10 Software Application

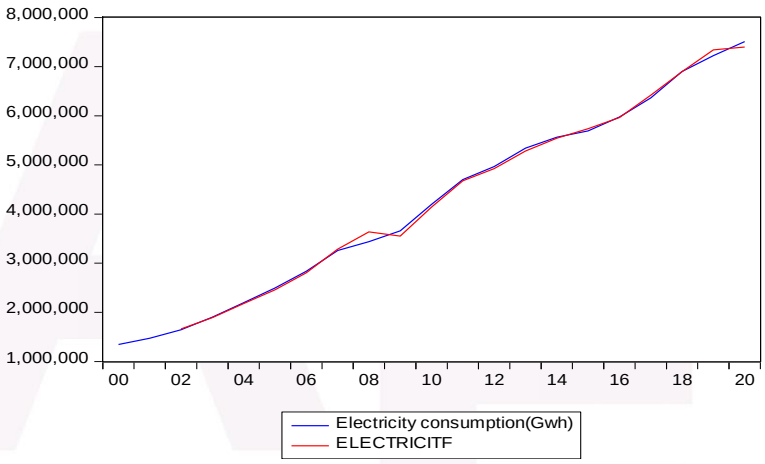


Figure 3 Graph of forecasting value and actual value by dynamics/static method
Source: Calculation by using Eview10 Software Application

From the result above, all the error related RMSE,MAE and MAPE are small, BP and VP are very small so that most of the bias goes to the CP. The prediction value are round the actual value along the time series. Therefore, the forecast is appropriate by Dynamics Method.

3.3 Nowcasting Method

3.3.1 Keywords Selection

The selected keywords for electricity consumption are GDP, industry structure, income, population, and electricity price. Each of the keywords represent one of the key factors which would affect the electricity consumption according to the study from Huang(2014).

3.3.1 Multiple Regression

The multiple regression test is to check if all the variables could be used together to explain the dependent variable which is electricity consumption. All the search engine trends volume data has been summarized from daily into yearly to fit the frequency of EC and other variables.The result of least squares multiple regression are summarized in **Table 7**.

Table 7. The result of LS multiple regression for nowcasting

Dependent Variable	Method	R-squared	Prob(F-statistic)
Electricity Consumption	Least Squares	0.999856	0.026219

Source: Calculation by using Eview10 Software Application

From the result of Least Squares above, The R-squared value is more than 0.99 which means the model good and stable. The Prob(F-statistic) is 0.026219 smaller than 0.05 which imply the set of all variables together with the search engine volume can explain the dependent variable electricity consumption.

3.3.2 BSTS Model Result

From the result of multiple regression, since the set of all variables together with the search engine volume can explain the dependent variable electricity consumption, the nowcasting method is appropriate for electricity consumption prediction. The nowcasting result is shown as follow:

Table 8 Nowcasting by BSTS Model

Model	RMSE	MAPE
BSTS	158.3212	0.03836706

Source: Calculation by using R Software Application

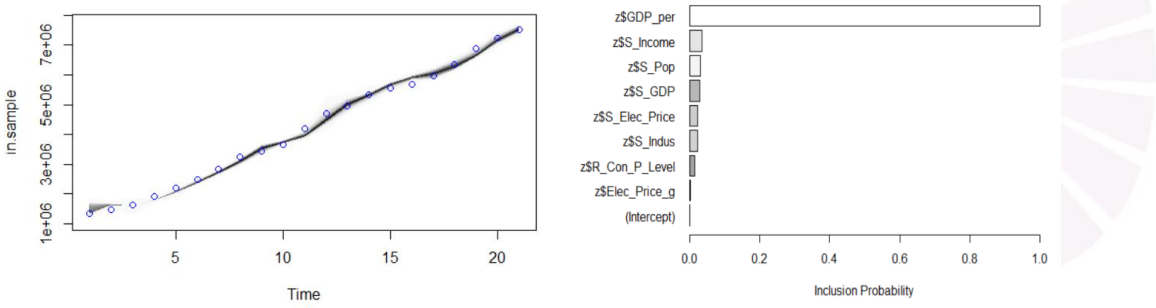


Figure 4 (Left) Graph of nowcasting value and blue point of actual value
(Right) Inclusion Probability for predictor in nowcasting

From the result of BSTS model, RMSE and MAPE are small and the actual value point are close to the graph of nowcasting value which means the nowcast is appropriate by BSTS model. The inclusion probability for predictor shows that beside the main variables the search engine volume data is effective as well. After the appropriateness of nowcasting result is tested, the BSTS model could be used to nowcast, the result is shown as follow:

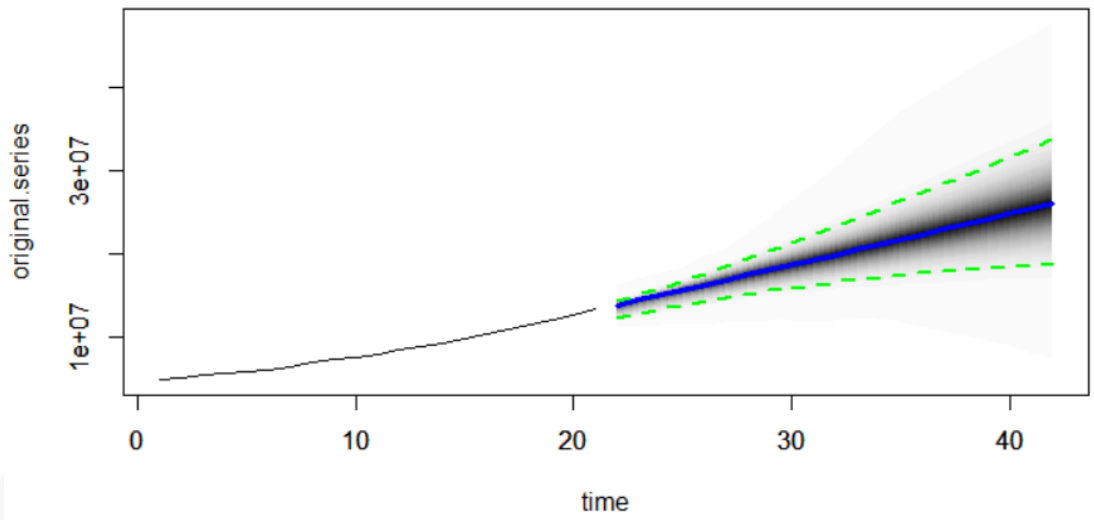


Figure 5 The nowcasting result of electricity consumption from 2020-2040

4. Discussion

This study is aim to test the feasibility of using nowcasting method on electricity consumption and comparing different method of prediction. The traditional methodology on electricity consumption prediction are regression models of forecasting method. (Fazil Kaytez, et.al.2015). This study used ARMAX model to forecast electricity consumption as the reference of traditional forecasting to compare with the new nowcasting method BSTS model's result of prediction.

From the multiple regression result of nowcasting predictors, the R-squared value is more than 0.99 which means the model good and stable. The Prob(F-statistic) is 0.026219 smaller than 0.05 which imply the set of all variables together with the search engine volume can explain the dependent variable electricity consumption. Thus, it is feasible to use BSTS model on electricity consumption nowcasting.

To compare the different method of prediction, could check the RMSE and MAPE from each method's prediction result, the result is shown in **Table 9**. These results revealed that the BSTS model produced more accurate prediction as compare to those under ARMAX model. Another advantage of using nowcasting method to do the prediction is the prediction value could be update in high frequency, just need to add new high frequency search engine volume data into the sum of previous data set.

Table 9. Nowcasting and Forecasting Result

Model	RMSE	MAPE
BSTS	158.3212	0.03836706
ARMAX(2,1,X)	91100.13	1.593655

5. Conclusion and Recommendation

This study has proved the feasibility of using nowcasting method on electricity consumption and the superiority of nowcasting method BSTS model rather than traditional forecasting method ARMAX model for electricity consumption prediction.

This study focus on explore the feasibility of using nowcasting method on electricity consumption and comparing different method of prediction. According to the study, the nowcasting method BSTS model is more accurate than traditional forecasting method. When energy industry planner needs to plan for generator construction or making generation short-term planning, the updatable nowcasting method could be consider as a reference method of electricity consumption prediction to prevent Over-skewed resources that could lead to over-supply or stranded generator.

From the result of nowcasting prediction of China's electricity consumption, we could see it is a positive trend of growth in the future, to match the demand the government needs to keep investing on the electricity industry construction. Meanwhile, the industry structure on the supply side needs to make adjustment under the background of growing demand of electricity consumption. Now the main material to generate power is still coal in China, government should not only consider of matching the demand of electricity but also the environmental and efficient generation. Therefore, the policymaker should make policies to push the electricity industry's transition while keep increasing investment on electricity generator construction.The government should increase investment on new energy resources development and make the preferential policy for new clean energy industry construction such as long-term low-interest loan for the related company.

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The inspiration of doing this study of electricity consumption prediction is from my father who devote himself to China's hydro industry all his life. Been raised in such family give me the interest of the electricity industry. This paper would never been done with the specialized assistance warm encouragement, and effective supervision from those who care about my graduation.

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An Analysis of Determinants of Foreign Direct Investment in Banking Industry from Taiwan to the nine ASEAN countries with Gravity Model

Hsiao-I, Pan[1], Komsan Suriya[2], Pathairat Pastpipatkul[3]

Abstract

This paper examined the choice of FDI location of Taiwanese banks' FDI with a particular on a sample of the nine Association of Southeast Asian Nations (ASEAN) member states. The pattern and the determinants of Taiwanese banks' FDI in ASEAN are investigated with gravity model framework and examined by panel data analysis from 2000 to 2019. It was found that Taiwanese banks generally preferred to directly invest in countries that had large market size, high economic freedom, closer geographical proximity, larger value of bilateral trade, and large amount of Taiwanese outward direct investment. Unlike previous studies, the results confirm that interest rate spread had relatively insignificant effects on the location choice of Taiwanese banks in ASEAN. Additionally, control of corruption in host countries seemed to have significantly negative effect on location choice of Taiwanese banks. The insights presented in this paper could offer useful suggestions for both governments and investors.

Keywords: ASEAN countries; Financial FDI; gravity model; Internationalization; location choice; Taiwanese banks

JEL Classification Codes: G11, G21

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1. Introduction

Foreign direct investment and international trade affect substantially not only emerging markets but also the whole structure of the world economy (Koepke, 2018). According to the annual report from UNCTAD (2018), foreign direct investment (FDI) flows have increasing extraordinarily from US$330 billion to US$1.43 trillion in the recent decades. This growth is partially resulted from the considerable expansion in international capital flows in the services sector, especially from the banking industry (UNCTAD, 2008). Banks all over the world have played a vital role in keeping the global economy moving for a long history and also during the Coronavirus pandemic. The rapid increase in international trade activities, financial innovation, and recent developments in international financial markets have spurred economists to research the factors that affect location choice of overseas expansion in the banking sector and the possible influences on the global banking industry. Among service sectors, internationalization of the banking industry started to grow in importance in the 1970s (Grubel, 1977). Literatures show that performance of multinational firms is better than that of domestic firms due to inventory utilization and internationalization of investments (Shah, Said & Anwar, Jamil & Hasnu, SAF, 2018). Internationalization is considered as one of the ways for firms to be more competitive (Delios and Beamish, 1999).

Internationalization of banks started few centuries ago and is still developing continuously (Lothian ,2002). When expanding internationally, a bank must determine which foreign market to enter. Generally, overseas expansion may allow Taiwanese banks to address the domestic difficulty which is caused by excessive competition (overbanking) in the domestic market. This paper examines the effects of determinants on FDI location choice of Taiwanese banks especially in ASEAN nations. FDI in banking industry has witnessed impressive upsurge in most ASEAN nations. Many European and American banks have established branches in the Southeast Asia region for many years. By contrast, Taiwanese banks were relatively late to do overseas expansion in Southeast Asia region. Internationalization of banks refers to the process of increasing involvement and providing loan, asset and liability management to foreign counterparts in the global market. Several theories and literatures suggest that transnational banks follow their corporate and non-corporate customers to go abroad (Esperanca and Gulamhussen, 2001). Internationalization enables enterprises to acquire foreign advanced technology and knowledge of management via multinational networks (Dunning, 1988). Additionally, multinational enterprises (MNEs) may gain additional profits and improve operating efficiency by utilizing their remaining resources in overseas market expansion and operating.

In terms of the importance of FDI for both private sector development and government policies, research analyzing the factors affecting FDI location choices gained prominence in the international business literature. In this research, the main aims are to examine the development and determinants of FDI location choice of the Taiwanese banking industry in ASEAN nations and identify the impact of determinants which will benefit for the policymakers to construct the policies efficiently. In 2019, mor than 35% of total FDI inflows of ASEAN was contributed by FDI inflows in financial and insurance sector. It's very clear that financial and insurance sector in ASEAN have attracted major ratio of FDI inflows from other countries. (see figure 1) Therefore, understanding Taiwanese OFDI determinants in banking industry in the nine

major ASEAN member states can lead to meaningful policy implications for the ASEAN host countries.

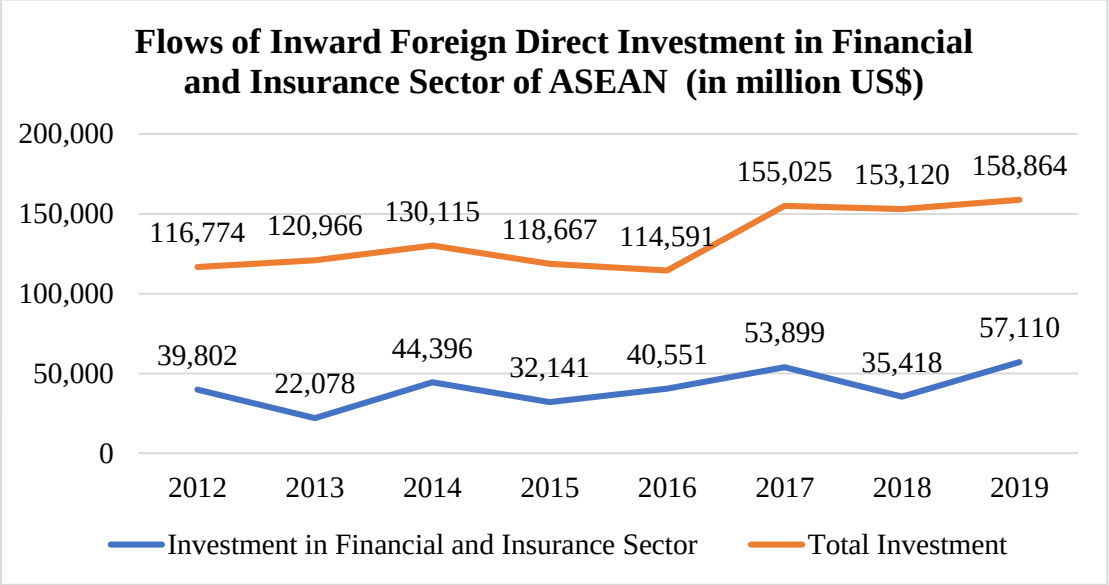

Figure 1 FDI Inflows in Financial and Insurance Sector of ASEAN (2012-2020)
Source: Author, using Banking Bureau, R.O.C. (Taiwan) online data.

Although, there is only a few little studies researched the determinants of location choice for Taiwanese banks. Also, to study the determinants of FDI location choice of the Taiwanese banking industry will give a broader overview of FDI from high-income countries to developing countries during the crisis and recovery period. Conducting a more complete framework than previous literature is the purpose of this study. By investigating internationalization of Taiwanese banking industry, this study will answer the question of "What factors affect the outward FDI location choice of Taiwanese banks to AMS?", focusing on the possible relation between the determinants and location choice of overseas expansion and "How are the FDI location choice influenced by the determining factors ?" detect whether the international behaviour of banks has changed with the passing of time. Emphasis is put on the phenomena of "customer following" and "market seeking".

In terms of internationalization of Taiwanese banks, previous studies focused on the relationship between internationalization and operating performance or risk of Taiwanese banks. Most of the literature on Taiwanese outward direct investment in banking industry in Southeast Asian region was based on the pros and cons of the research, and there were few empirical studies on the factors affecting Taiwan's banking industry's investment in Southeast Asia. This paper is a multi-country study which will conduct comprehensive approaches on investigating the relationship between several determinants and FDI location choice of Taiwanese banks from 2000 to 2019. Hence, this paper attempts to partially fill the gap in the literature on implementing a new methodology with a dynamic gravity model and serve as a valuable reference to policymakers.

2. Literature review

One of the earliest FDI theories was the work of Dunning which formed the

conventional theory of FDI. Dunning (1988) proposed the concept of the eclectic theory and OLI paradigm model to account for the transnational activities of enterprises with three types of interrelated advantages. Dunning and Lundan (2008) developed the theory answering the question "why do companies invest abroad," and stated "OLI" paradigm. According to this theory, FDI is observed if ownership-specific advantages ("O"), such as proprietary technology, exist with locational advantages ("L"), such as low factor costs, and potential benefit from internationalization ("I") of production process abroad. Academic literature have broadly studied and reviewed the major determinants of Foreign Direct Investment (FDI) from both theoretical and practical aspects. Due to the relatively more complicated nature of FDI and the two distinct motivations for FDI: horizontal FDI and vertical FDI, developing a general equilibrium model and framework for FDI is quite a complex and difficult task (Blonigen, 2005). In the words of Eicher et al. (2012), the FDI determinants can be categorized in factors relevant to the attractiveness of the economic performance, and the quality of host countries' economic policies. The economic literature on FDI determinants are notably various in terms of competing theories and empirical results.

Location is determined by certain factors that make a specific location or country more or less attractive for foreign direct capital inflows (Kurtović et al., 2014). Blonigen and Piger (2014) utilized Bayesian statistical techniques and mentioned that the variables with little support for inclusion probabilities are multilateral trade openness, host country business costs, host country infrastructure, and institutions. In contrast, the variables with constantly high inclusion are conventional gravity variables, cultural distance factors, parent-country per capita GDP, relative labor endowments, and regional trade agreements. Hymer (1976), and Buckley and Casson (1976), the core concepts of these works are that multinational firms explore foreign investment opportunities as to arbitrage from market imperfections across jurisdictions and thus maximize returns (Coase 1937). In seeking such benefits, MNEs would locate optimally as to pursue cost-efficient locations (Buckley and Casson 1976).

There are many classical literatures that have explored the process and the determinants of the internationalization of firms. Internationalization is a complicated process and has numerous aspects. The definition of internationalization has been discussed in European and American countries for a long time, but scholars still do not generate a universal definition of it. Over the last two decades, direct investment in the banking sectors of emerging markets has become a popular topic for scholars. Johanson and Vahlne (1977) suggested that the internationalization of enterprises is the process in which the companies increase their international participation gradually by integration, acquisition, and use of knowledge about the global markets and business.

Since the 1960s, the number of cross-border economic activities has surged dramatically, and multinational enterprises have expanded their business quickly. Following this global trend, international banks or multinational banks also have thrived for a long period of time. In the past, economists did not have a benchmark of bank internationalization. Literature on the internationalization of banks generally concentrates on the effect of internationalization on banks and the determinants of the cross-border expansions of banks, and several factors have been identified to explain why banks go internationalization and enter the specific foreign markets. (Yamori, 1998; Berger, 2007; Buch and Lipponer, 2007). Casson (1990) defined an international bank as a bank that owns or controls entities in two or more countries. Scholtens (1991)

defined an international bank as a bank that participates in cross-border currency activities or other financial transfer. Multinational banks have different meanings in two aspects, one of them refers to attracting and anchoring foreign inward investment, establishing branches in home countries, and forming strategic alliances. In terms of the other meaning, it indicates to overseas expansion of physical entities abroad and the internationalization of banks' business. Grubel (1977) listed out the three types of multinational bank: multinational retail banking, multinational service banking, and multinational wholesale banking.

The internationalization of manufacturers and internationalization of banks have the same operating philosophy: pursuing profits, markets, customers, etc. However, because the financial industry is under government monitoring and management, and the internationalization of banks is affected by the financial environment and regulations of various host countries, and its cross-border operations, there are many incentives for internationalization of banks that are different from the theories of internationalization of firms. Slager (2006) integrates the incentives for bank internationalization proposed in the past and clarified the incentives into 11 incentives (net interest margin, new market, cluster, customers, etc). The internationalization of its financial system started in the 1980s but has only in the 2000s reached its peak. Therefore, studying the effect of internationalization on Taiwan's economic performance provides a good sample for developing countries. Banks follow customers from home countries to foreign markets to avoid losing client relationships. Banks can also investigate growth opportunities for domestic customers and assist customers to invest overseas. Moreover, internationalization provide opportunities for banks to diversify outward foreign investments in different countries or regions to reduce market uncertainty and control the risk. Closer geographical distance between home and host countries, the common language, the administrative system, and the similar culture can be the supportive boost for banks to penetrate the foreign market. (Slager, 2006).

3. Introduction of Taiwanese banks and the investments outside Taiwan

In the third edition of the 'World's Best Banks' list which proposed by Forbes magazine and Statista, ten Taiwanese banks can be found in the list, which are most private banks, only two state-owned banks were selected. According to the statistics of the Financial Supervisory Commission, the interest rate spread had been decreasing in recent years, from 1.36% in 2010 to 1.23% in the third quarter of 2021. However, the most important source of profit for the banking industry is the revenue from the interest rate spread of deposits and loans. In summary, banks' profits mainly consist of interest income, fee revenue, and profit from investment. Because of the low interest rate environment and low ROE and ROA, overseas expansion is the beneficial way for Taiwanese banks to improve their profitability.

In the past two decades, the Taiwanese financial industry has witnessed several structural changes. To pursue economies of scale and enhance profitability, financial holding corporations combine banks, insurance companies, and other financial institutions by mergers and acquisitions. Until the end of 2020, the total number of financial institutions branches, including both Taiwanese and foreign banks, trust companies, credit cooperatives, was up to 5407 branches in Taiwan. In average, one financial institution serves about 3,000 people, while one financial institution serves more than 5000 people in Singapore or Japan.

Following with the growth of the number of branches, domestic competition among banks has become progressively severe. Among the top ten banks in Taiwan, only Bank of Taiwan had a market share about 9%. The total market share of the top three banks was even less than 25%, indicating the low concentration of the domestic market. Due to the similar products and services provided by banks, domestic banks face serious competition and engage in a price war which cause decreasing profits.

3.1 Development of Taiwanese banks in Asia

According to the World Economic Outlook Database of the IMF, Taiwan was ranked as the 17th richest country out of 191 countries in 2019. However, it is considered that Taiwan has now on the mature market stage. The pace of economic growth is slowing down, and the demand of domestic market is getting relatively smaller. By contrast, ASEAN economies have developing rapidly and have been very active in bilateral relations with other countries around the world. Foreign enterprises, including banks, have benefited from ASEAN countries' developing infrastructure, high demographic dividends, massive domestic market, and interest rate spread. Liang, Cheng, and Lin (2018) figured out that local banks in Taiwan have suffered from great difficulties of narrowing interest rate spread and deteriorating asset quality since the 1990s. The main cause is the problem of excessive competition (overbanking) in the domestic market which is already saturated and unable to provide enough room for local banks to grow.

Generally, overseas expansion may allow Taiwanese banks to address the domestic difficulty. Following the upsurge in outward foreign direct investment (OFDI) by Taiwanese firms, Taiwanese banks have quickened their pace of internationalization. As of 2020, Taiwanese banks had 521 overseas affiliates, and 426 of them locate in Asian region. Of the 426 overseas branches and offices in Asia, the largest number are in the mainland China (90), followed by Hong Kong (70), and a total of 209 in the nine ASEAN countries. Specific and transferable advantages (scale, brand, technology, etc.) are necessary for banks to penetrate new markets (Fung, Bain, Onto and Harper, 2002). Taiwanese banks utilize the client relationships with Taiwanese multinational firms, and which have established in domestic market already as a basic resource when expanding overseas business.

Figure 2 presents the development and distribution of Taiwanese banks branches in ASEAN member states. Until 2020, The number of branches in Vietnam was the greatest out of the nine ASEAN nations, while there were only three branches in Lao PDR. Currently, most of overseas branches of Taiwanese banks locates in Singapore, Vietnam, Philippines, and Cambodia. However, due to the financial regulations and restrictions of Thailand, Malaysia, Indonesia, it is relatively difficult for foreign financial corporations to acquire branch licenses or a certificate prior to operating the business. At present, only CTBC Bank has subsidiary banks in Indonesia.

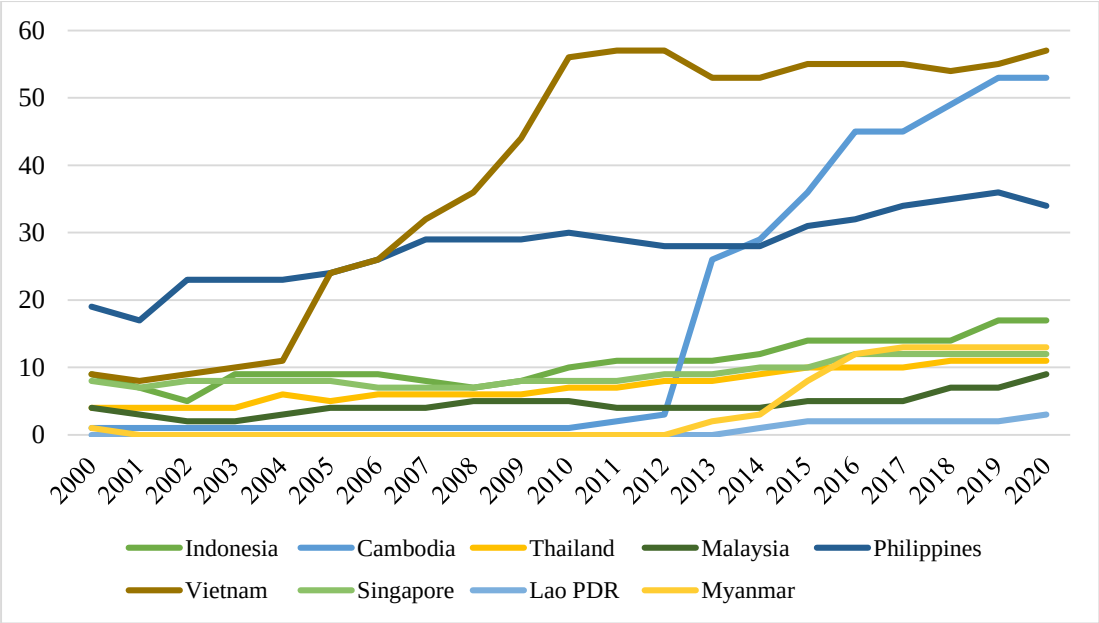

Figure 2 Distribution of Overseas Branches of Taiwanese Banks in ASEAN (from 2000 to 2020)
Source: Authors, using Banking Bureau, R.O.C. (Taiwan) online data.

Most of Taiwanese banks prefer to establish overseas branches (28%) and representative offices (10%) rather than subsidiary banks (3.8%) (see table 1). This phenomenon indicates that Taiwanese banks have different investment costs and expectations for the southeast Asian market. Moreover, Taiwanese banks didn't have sufficient knowledge and experience of doing business in the southeast Asian region. Consequently, banks were more likely to cooperate with the "New Southbound Policy" and establish branches and representative offices at lower investment costs to serve Taiwanese firms and collect market information first in southeast Asian nations.

Compared to other Asian countries like Japan and South Korea, ASEAN economies have relatively lower financial market saturation and penetration. Since 2016, the Taiwanese government has implemented the New Southbound Policy that encourages domestic firms and banks to directly invest in South-Asia nations. However, the economic developments, financial regulations, and other institutional conditions vary across ASEAN nations. Consequently, location choices and entry strategy are crucial issues for overseas expansion of Taiwanese banks. In the Taiwan Industry Reports: 2021 Banking Industry, although the COVID-19 pandemic caused a negative impact on the overseas business of Taiwanese banks, lots of data show that Taiwanese financial holding corporations have stable performance in ASEAN in the recent year.

Table 1. Number of Overseas Branches of Domestic Banks in Asian Area

Asian area	Total	Branches	Sub-Branches	Representative Offices	Subsidiary Banks	Others
Total	521	148	28	52	20	273
Subtotal	426	99	28	48	15	236
Mainland China	90	25	8	4	5	48
Japan	48	9	-	-	1	38
Indonesia	17	-	-	5	1	11
India	4	2	-	2	-	0
Cambodia	53	3	19	1	2	28
Hong Kong	70	20	1	2	1	46
Thailand	11	-	-	6	1	4
Malaysia	9	3	-	3	-	3
Philippines	34	6	-	1	2	25
Vietnam	57	12	-	12	1	32
Singapore	12	12	-	-	-	0
Lao PDR	3	3	-	-	-	0
Myanmar	13	1	-	12	-	0
Macau	3	3	-	-	-	0
Korea	2	-	-	-	1	1

Source: Author, using Banking Bureau, R.O.C. (Taiwan) online data.

In the Taiwan Industry Reports: 2021 Banking Industry, Taiwan Institute of Economic Research conducted the survey and found that approximately 60% of Taiwanese banks consider that there will be an upward trend in turnovers of overseas branches. In the year 2021, doing overseas business remains a vitally important objective for Taiwanese banks. Although the COVID-19 pandemic caused a serious negative impact on the overseas business of Taiwanese banks, engaging in an international syndicated loan, cross-border financing, and providing overseas financing and investment service for Taiwanese entrepreneurs would be a major business for Taiwanese banks. Besides, lots of data show that Taiwanese financial holding corporations have relatively stable performance in ASEAN member states (AMS) in the recent year even in this pandemic era. However, southeast Asian countries have implemented more strict financial regulations and increased the minimum registered capital for foreign banks to protect domestic financial institutions. Therefore, many Taiwanese banks are unable to get licenses for establishment of subsidiary banks.

Moreover, the China–United States trade war, COVID-19 pandemic and the severe debt issues for Chinese local government brought a substantial slowdown in China's economic growth and made Taiwanese banks worried about their overseas business and development in China. As the China Banking and Insurance Regulatory Commission has continued to relax restrictions on foreign investment and financial business in recent years, it is said that Taiwanese banks will expand business in China's market at a stable pace in 2021 and pay more attention to business stabilization and risk exposure management. Specific and transferable advantages (such as scale, brand, technology, management knowledge, credit disciplines, and so on) are necessary for service companies, including banks to penetrate new markets (Fung, Bain, Onto and Harper, 2002). Taiwanese banks can utilize the client relationships with Taiwanese multinational firms, and which have established in domestic market already as a basic resource when expanding overseas business. Further offer Taiwanese managers with various consumer financial services such as deposits and remittances service, wealth management in order to gain profits from providing financial services with lower credit-checking cost.

3.2 Development of Taiwanese banks in ASEAN member states

The location choices of internationalization of Taiwanese banks mostly follow those of the local corporations. In recent years, Taiwanese enterprises have gradually invested in the southeast Asian countries instead of mainland China due to increasing production costs, changes in investment regulation, political issues of mainland China. Since 2016, the Taiwanese government has implemented the "New Southbound Policy" that encourages domestic firms and banks to directly invest in South-Asia nations to do diversification of investment and lower the risk of high investment concentration in China. The Financial Supervisory Commission (F.S.C.) also support domestic banks to expand their regional footprints across Asia, especially in the Southeast Asian region where the financial market penetration rate is relatively lower. Furthermore, Taiwanese banks are aggressively seeking for business opportunities in foreign markets to reduce the pressure caused by excessive competition and deteriorating margins of the domestic market. Nevertheless, Taiwanese bank may not always be able to follow the footprints of Taiwanese firms because of financial regulations vary across countries.

Under the "New Southbound" policy, Taiwan is deepening ties across the board with the ten ASEAN member states, six South Asian countries, Australia and New Zealand. As for the trade war between the U.S. and China, it remains one of the reasons for Taiwanese enterprises to invest in ASEAN. Compared to other Asian countries like Japan and South Korea, ASEAN economies have relatively lower financial market saturation and penetration. In recent years, Southeast Asian nations have been regarded as an emerging market with the most potential and rapid growth. The demographic dividend, economic growth and trade agreements attract Taiwanese banks.

In terms of the profit before tax of overseas branches of Taiwanese Banks, roughly 85% of total profit came from Asian branches which reached to NT$ 63.3 billion in 2019. Additionally, overseas branches in ASEAN contributed more than 15% of total profit in Asian area, while roughly 60% of profit came from the branches in Hong Kong. However, ASEAN has enormous potential for economic development and huge market and population. In recent years, Taiwanese banks prefer to direct invest in ASEAN markets rather than in Hong Kong which is considered as a more saturated and highly

competitive international financial center. Additionally, political issues of Hong Kong also are factors that influence international strategies of Taiwanese banks.

4. Model

4.1 Model framework

This study adopts a gravity model framework and conducts a panel data model to examine which determinants affect the location choices of Taiwanese banks in ASEAN nations. The empirical results may offer businesses and government agencies guidance for making proper investment decisions. The accumulated amount of Taiwanese outward direct investment in financial industry is considered as the dependent variable in the extended gravity models with panel data analysis. The yearly data was collected from the database of The Investment Commission R.O.C. (Taiwan). Literature focus on FDI analysis frequently use panel regression (see, e.g., Onyeiwu and Shrestha, 2004; Jadhav, 2012; Ghazal and Zulkhibri, 2015). On methodological grounds, panel data estimations provide empirical implications of clear association between macroeconomic determinants and FDI inflows or location choices. Moreover, panel regression is considered as a more effective method over time series (Hsiao and Hsiao, 2006).

The gravity model was derived from the Law of Universal Gravitation by Sir Isaac Newton. Newton also inferred that the gravitation decreases with the increase in the square of the center-to-center distance of the two objects. The conventional gravity model began to develop in the 1960s. The concept of a gravity model emerged firstly in the field of economics was in 1889 when Ravenstein adopted it to examine migration patterns in the UK (Anderson, 2011). Tinbergen and Poyhonen were the first two pioneers who adopted Newton's Law of Universal Gravitation to interpret bilateral trade flows between countries as a function of national income, population, and distance of transportation. The concept of the estimation equation is the same as the above equation of the Law of Universal Gravitation, so it is called Gravity Model. In short, FDI gravity model remains a useful for explanation of FDI analysis under the eclectic paradigm and OLI framework (Hermannsdottir 2008; Dunning 1988). FDI gravity analysis generally focuses on the location-specific factors of the FDI inflows receiving nation. Moreover, numerous economists have successfully employed the gravity model to explain FDI flows and proposed the theoretical basis for the application of the conventional gravity variables model not only for trade investigation but also for FDI analysis (see, e.g., Blonigen and Piger, 2014; Belgibayeva A, Plekhanov A, 2015; Larch et al., 2017; Baier, 2020).

Some literature propose that there was a sizeable relationship between the size of extended markets and the stock of FDI. (see Levy-Yeyati, Stein, and Daude ,20 (1) The larger the extended market of the host country, the larger the amount of foreign direct investment. The larger the extended market of the home country, the smaller the amount of outward direct investment. Interestingly, the influence of distance was not significant and was not consistent with the expectation of the gravity model. This study adopts a gravity model framework to investigate the pattern and the determinants of Taiwanese banks' FDI in ASEAN by using static panel data analysis. Combining theories, the static model for determinants of FDI was investigated using the following basic specifications:

$$lnFDI_{ijt} = \alpha + \beta_1 lnMS_{jt} + \beta_2 EF_{jt} + \beta_3 lnBT_{ijt} + \beta_4 lnTDI_{jt} + \beta_5 Dist_{ij} + \beta_6 Cor_{jt} + \beta_7 Int_{jt} + \varepsilon_{ijt}$$

where the dependent variable (*FDI*) is the Taiwanese OFDI in financial industry, and *t* indicates time. α stands for the constant term. MS_{jt} refers to the market size of host countries. $Dist_{ij}$ indicates the geographical distance between host and home countries. EF_{jt}, BT_{ijt} and TDI_{jt} represent the economic freedom, the bilateral trade value, and Taiwanese OFDI, respectively. Cor_{jt} refers to control of corruption. Int_{jt} indicates the interest rate spread. STATA 13 computer packages was applied to conduct an empirical model and estimate the coefficients. With respect to the results of the F-test, and Hausman test, the optimal model was selected.

4.2 Variables and Hypothesis

Market Size (*MS*)

Market size is a key determinant affecting a country's FDI attractiveness and a crucial factor influencing internationalization of firms. (Brouwer et.al, 2004; UNCTAD, 2008). Empirically, the relation between the host country's economic and market size and FDI is the most tested hypothesis (see for example, Wheeler and Mody, 1992; Bevan and Estrin, 2004; Becker and Cieslik, 2020). Per capita income of host country is positively related to the number of overseas offices or branches of multinational banks in that nation (Goldberg and Johnson, 1990; Yamori ,1998). In this study, per capita GDP is used as the proxy for market size. The open-source data was gathered from the database of World Bank.

Hypothesis 1. The GDP per capita of a host country has positive influence on FDI of Taiwanese banks in a host country. The greater the GDP per capita of a host country, the greater the OFDI of Taiwanese banks in the host country.

Economic Freedom (EF)

Economic freedom is found to cause a consistently positive impact on FDI inflows (Sambharya and Rasheed, 2015 Economou, 2019). This indicator should be classified as the market-seeking variable. The index of economic freedom is graded on a scale of 0 to 100 and provided by The Heritage Foundation as yearly data. The lower the index, the more the restrictions in host countries are.

Hypothesis 2. The degree of economic freedom of a host country has positive influence on the FDI of Taiwanese banks in a host country. The higher the degree of economic freedom, the greater the OFDI of Taiwanese banks in the host country.

Bilateral Trade Value (*BT*)

Several literatures suggests that "customer following" and "market seekers" explain the pattern and trend of internationalization of service companies including financial firms. Banking industries internationalize to follow their customers (Miller and Parkhe ,1998). Location choices of the banking industry to establish branches abroad were positively influenced by the export volume from home country to host countries (Heinkel and Levi, 1992; Mutinelli and Piscitello, 2001; Buch and Lipponer, 2007). In this study, the bilateral trade value which equals the total value of imports plus the total value of exports between Taiwan and the host countries was employed. The Ministry of Finance, R.O.C. provides the essential annual data.

Hypothesis 3. The value of bilateral trade between Taiwan and a host country has positive influence on the FDI of Taiwanese banks in a host country. The greater the

value of bilateral trade between Taiwan and a host country, the greater the OFDI of Taiwanese banks in the host country.

Outward direct Investment from Taiwan (*TDI*)

In order to examine whether Taiwanese banks follow their major customers to go internationalization, outward investment from Taiwan which is measured by the aggregate amount of outward investments except of the investments in financial and insurance industry will be considered in this study. Financial service companies sometimes display the phenomena of "customer following" and "market seeking". (Hellman, 1996; Àlavarez-Gil et al., 2003). The statistic of Taiwanese outward direct investment gathered from the Investment Commission R.O.C. (Taiwan) as yearly data. The data do not include direct investment in financial and banking sector to get rid of the problem of autocorrelation.

Hypothesis 4. The Taiwanese outward direct investment in a host country has positive influence on the FDI of Taiwanese banks in a host country. The greater the Taiwanese outward direct investment in a host country, the greater the OFDI of Taiwanese banks in the host country.

Geographical Distance (*Dist*)

Differences in time zones have a significantly negative impact on the location of FDI (Stein and Daude, 2007). Berger (2007) suggested that geographical proximity is also a prominent motive for explaining the banks' decision to expand their business in a certain country. In gravity model research, the time-variant geographical distance which is measured by the price of crude oil multiply the distance between the capital cities of the two nations is often act as a proxy of information costs. In this study, the bilateral time-variant distance variable is measured by the yearly average prices of crude oil multiply the distance between the capital cities of Taiwan and the nine ASEAN nations (in kilometers). The information about geographical proximity was collected from the French center for research and expertise on the world economy (CEPII). Data for the crude oil annual spot price per barrel (in USD) was procured from the World Bank Commodity Price database.

Hypothesis 5. The geographical distance between Taiwan and a host country has negative influence the FDI of Taiwanese banks in a host country. The greater the geographical distance between Taiwan and a host country, the lower the amount of the OFDI of Taiwanese banks in the host country.

Control of Corruption (*Cor*)

Corruption level in the host country has a negative impact on FDI inflows (Sadig, 2009; Alemu, 2012; Zander, 2021). Nevertheless, sometimes the adverse influences of corruption vanish and even becomes positive but statistically insignificant after controlling for other features of the host country. Levels of corruption were calculated by the Control of Corruption (COC) Index of the World Bank´s Worldwide Governance Indicators. Refer to Zander (2021), the index was rescaled to that it ranges from 0 to 5. The lowest COC index is represented as 0, while 5 being the highest. In the year 2001, the COC Index does not have values, so the value in 2001 was estimated by using the average of the years before and after.

Hypothesis 6. The degree of control of corruption of a host country has positive

influence on the FDI of Taiwanese banks in a host country. The higher the degree of control of corruption of a host country, the greater the OFDI of Taiwanese banks in the host country.

Interest Rate Spread (*Int*)

Interest rate spread is the difference between average interest rate charged by banks on loans to private sector customers and the average deposit interest rate paid by commercial banks. which is regarded as an essential component of retail bank profitability. Both Latin-American and Asian banks are market seekers (Hsieh, Shen, & Lee, 2010). The higher the relative interest rate in the host country, the higher is the willingness for foreign banks to enter that country (Drumond and Jorge, 2013). The data was collected from the open-source database of IMF and the World Bank.

Hypothesis 7. The interest rate spread of a host country has positive influence on the number of FDI of Taiwanese banks in a host country. The higher the interest rate spread of a host country, the greater the OFDI of Taiwanese banks in the host country.

Panel data modeling is used for examining inward FDI in this study. The estimation was undertaken by applying pooled OLS model, fixed and random effect models. Variance inflation factors (VIF) detects the multicollinearity issue in the model. Fisher unit root test needs to be performed to check whether the panel data set is stationary or not. Then, Hausman (1978) test denotes the optimal choice of models. Table 2 presents an overview of the dependent and independent variables that will be used.

Table 2. Variable description and sources.

Variables	Description	Data Source
MS	Host country per capita GDP (current US$)	World Bank National Accounts data
CEGDP	Volume of domestic credit to the private sector on total GDP (%), average 3 years	World Bank National Accounts data
EF	Economic freedom index is graded on a scale of 0 to 100	The Heritage Foundation
BT	The total value of imports and exports between Taiwan and the host countries respectively	The Ministry of Finance, R.O.C. (Taiwan)
TDI	The total investment amount of Taiwan except the investments in financial and insurance industry	The Investment Commission R.O.C. (Taiwan)
Dist	Bilateral distance between Taipei City and capital cities of AMS	CEPII The World Bank
Cor	Control of corruption	World Bank Governance Indicators
Int	Interest rate spread (Lending rate minus deposit rate, %)	The World Bank, IMF

Source: Authors

Since the explanatory power of variables in different periods may be distinctive,

the estimations of Pooled OLS method, Fixed Effect Model (FEM), and Random Effect Model (REM) were checked. With respect to the results of the F-test, LM test, and Hausman test, the optimal model may be selected. In this study, STATA 13 computer packages were applied to conduct an empirical model and estimate the coefficients. The Hausman test can help decide between fixed or random effects model. When the null hypothesis assumes that there is no correlation between the individual effect and the explanatory variables, the estimated values obtained by the fixed effect model and the random effect model are consistent, but the fixed effect model is not efficient; When the null hypothesis is not accepted (accept the alternative hypothesis), the random effect model is not efficient. Hence, if the intercept term (α_{it}) is not correlated with the explanatory variables (regressors), estimating the random effects model is a more appropriate choice; If the intercept term and the explanatory variables are correlated, the fixed effects model should be selected.

When there is no noticeable difference in the individuals of the sample, the OLS estimator is an effective method and the conventional Pooled OLS model can be applied; When there are individual differences in the sample, decision between the fixed effect model and the random effect model should be made. To determine whether there are individual differences in the sample, it is necessary to further determine the appropriate vertical and horizontal models. This paper performs the F test and LM test of the model to confirm that the vertical and horizontal data model is more appropriate than the Pooled OLS, and then use the Hausman test for the selection of a fixed model or a random model.

Lastly, few statistical challenges have to be addressed.

(1) Missing values are dealt with by listwise deletion.

(2) Negative values are set to zero.

(3) Heteroskedasticity: Breusch Pagan testing reveals the presence of heteroskedasticity.

Table 3. Summary statistics with mean, standard deviation (sd), minimum and maximum value

Variables	Obs	Mean	Std. Dev.	Min	Max
FDI	180	539000	1280000	0	6590000
lnFDI	180	9.57	4.906	0	15.701
MS	180	7269.536	14149.882	137.168	66188.781
lnMS	180	7.779	1.402	4.921	11.1
CEGDP	155	65.364	47.271	3.121	149.373
lnCEGDP	155	3.748	1.09	1.138	5.006
EF	180	59.434	12.953	33.5	89.4
lnEF	180	4.062	.212	3.512	4.493
BT	180	7364.144	6895.152	3.567	29113.557
lnBT	180	7.671	2.356	1.272	10.279
TDI	180	4700000	10800000	860	43947841
lnTDI	180	12.994	2.717	6.757	17.599
Dist	180	160000	87353.546	28404.82	402000
lnDist	180	11.822	.591	10.254	12.903
Cor	180	3.273	2.541	0	10
Int	169	6.58	5.215	1.431	25
lnInt	169	1.645	.665	.358	3.219

Source: Author's computations

5. Result

This section presents the results obtained via our gravity model. Because there are missing values in the data set, fisher unit root test is applied to check whether the time series in the panel data set are stationary or not. The results of Fisher unit root test tells that all the time series contain no unit root and are stationary. Further, the values of variance inflation factors (VIF) of the series are all greater than the 0.2. According to Hair et al. (2010), the multicollinear predictors may not affect the linear regression. According to the output of Hausman test, fixed effect model is the optimal model.

5.1 Static Panel model

According to the results of Hausman test, the fixed-effect model is the optimal model for the panel data set. Table 4 presents the results of the static panel model. The significant variables are shown to be per capita GDP (*lnMS*), economic freedom (*lnEF*), Taiwanese OFDI in real sectors (*lnTDI*), and geographical distance (*lnDist*) which are statistically positive at the and 10% level in the fixed effect model. The significantly positive influence of per capita GDP (*lnMS*) and economic freedom (*lnEF*) on OFDI of Taiwanese banks support the OFDI of Taiwanese banks' market-seeking motivation proposed in the previous literatures. In terms of the customer-following motive, *lnBT* and *lnTDI* are the variables to investigate whether Taiwanese banks followed their customers abroad. In the fixed effect model, the results of *lnBT* and *lnTDI* indicate that bilateral trade and OFDI in real sectors have significantly positive effects on OFDI of Taiwanese banks. In other words, the Taiwanese banks followed the overseas expansion of Taiwanese enterprises in ASEAN nations.

Table 4. Panel regression model results.

Sample (Model) Variable	(1) MODEL1- OLS model	(2) MODEL2- Random effect	(3) MODEL3- Fixed Effect
lnMS	1.672***	1.672***	0.945*
	(0.326)	(0.580)	(0.503)
lnEF	10.862***	10.862***	4.058**
	(1.417)	(3.397)	(1.990)
lnBT	0.276	0.276	1.279***
	(0.192)	(0.309)	(0.471)
lnTDI	1.003***	1.003***	1.677***
	(0.110)	(0.176)	(0.307)
lnDist	-1.036***	-1.036***	-1.516***
	(0.305)	(0.365)	(0.390)
Cor	-1.007***	-1.007***	0.384
	(0.137)	(0.296)	(0.279)
lnInt	0.547	0.547	-0.588
	(0.416)	(0.495)	(0.581)
_cons	-48.104***	-48.104***	-28.741***
	(6.093)	(14.488)	(8.659)
Number of Obs	169	169	169
R^2	0.526	0.526	0.635

Standard errors in parentheses

*, ** and *** indicate statistical significance at 10%, 5% and 1% levels.

Source: Author's computations

The variable of geographical distance (*lnDist*) contributed significantly negative impact on *lnFDI* at the 1%level. It means that Taiwanese banks preferred to expand their business and directly invest in the financial sector of the nine ASEAN nations which have relatively closer geographical proximity. In terms of the effect of control of corruption (*Cor*) of host countries on Taiwanese OFDI in financial industry, the estimation outputs of *Cor* give complicated evidence with respect of different models. In the fixed effect model, control of corruption (*Cor*) is insignificantly positive related to the dependent variable (*lnFDI*). Although several studies proposed that the level of control of corruption positively affected foreign direct capital inflows. Sometimes the effect of corruption control becomes negative but statistically insignificant after controlling for other features of the host country such as the institutions factors (Sadig, 2009). *lnInt* (Interest rate spread) is the only macroeconomic variable which was found to have an insignificantly negative impact on *lnFDI*. This result does not match the evidence of existing studies.

3.2 Robustness Checks

Alternative variables were chosen for the robustness checks. The *lnMS* was substituted with *lnCEGDP* (Volume of domestic credit to the private sector on total GDP (%), average 3 years). Domestic credit to private sector refers to financial resources provided to the private sector by financial and depository corporations. Table 5 shows the robustness check with the substituted variable (*lnCEGDP*) to test the reliability of the previous results. According to the results, *lnCEGDP* had significantly positive effect on *lnFDI* at the 1%level. The more the volume of domestic credit to the private sector on total GDP in ASEAN nations, the more attractive to the location choice of direct investment of Taiwanese banks. The effects of economic freedom (*lnEF*), and Taiwanese outward direct investment in real sectors (*lnTDI*) were statistically and significantly positive on direct investment of Taiwanese banks. *lnInt* (Interest rate spread) was found to have a significantly negative impact on lnFDI at 5% and 10% levels. This result shows the same implications from the estimate results of the models that used *lnMS* (per capita GDP) as the proxy of market size. Additionally, *lnDist* was only significantly and negatively impact *lnFDI* at the 10% level in the fixed effect model without considering time effect.

Table 5. Panel regression model results (Robust).

Sample (Model) Variable	(1) MODEL1-OLS	(2) MODEL2-RE	(3) MODEL3-FE	(4) MODEL4-FE
lnCEGDP	1.760***	1.760***	1.724***	1.734***
	(0.263)	(0.522)	(0.334)	(0.349)
lnEF	9.698***	9.698***	5.639***	3.569
	(1.499)	(3.405)	(1.978)	(2.213)
lnBT	0.666***	0.666	0.419	-0.097
	(0.212)	(0.485)	(0.472)	(0.560)
lnTDI	0.487***	0.487	1.513***	0.687*
	(0.129)	(0.331)	(0.256)	(0.363)
lnDist	-0.386*	-0.386	-0.629*	0.887

Sample (Model) Variable	(1) MODEL1-OLS	(2) MODEL2-RE	(3) MODEL3-FE	(4) MODEL4-FE
	(0.230)	(0.403)	(0.364)	(0.743)
Cor	-0.455***	-0.455***	0.332	0.738**
	(0.093)	(0.154)	(0.296)	(0.356)
lnInt	0.826*	0.826**	-0.287	0.094
	(0.449)	(0.421)	(0.613)	(0.668)
_cons	-43.197***	-43.197***	-36.092***	-33.624***
	(6.166)	(16.105)	(8.320)	(11.128)
Number of Obs	155	155	155	155
R^2	0.596	0.596	0.687	0.726
Year FE				YES

Standard errors in parentheses
*, ** and *** indicate statistical significance at 10%, 5% and 1% levels.
Source: Author's computations

5. Conclusion and Recommendation

This study analyzed the determinants for the location choice of outward FDI of Taiwanese banking industry into ASEAN member countries using gravity model with panel data from 2000 to 2019 which treated the Taiwanese OFDI in financial industry as the dependent variables and included market size, economic freedom, bilateral trade volume, outward direct investment from Taiwan in real sectors, geographical distance, control of corruption, and interest rate spread as independent variables. Because there have been no overseas branches of Taiwanese banks in Brunei Darussalam, the selected countries consist of Cambodia, Indonesia, Lao PDR, Thailand, Philippines, Malaysia, Myanmar, Singapore, Vietnam. The expected effects of the variables are positive except of geographical proximity. However, the results from panel data analysis give complex and mixed outcome.

Although Taiwanese banks are expanding internationally at an accelerating pace, their limited knowledge of foreign markets and financial sectors, and the various macroeconomic conditions of ASEAN nations severely complicate their FDI strategies currently, including the decision of where to invest in particular. This paper not only reviews the theoretical literature explaining financial FDI, also provides evidence on how the macroeconomic determinants of ASEAN countries influenced location choices of Taiwanese banks. From this review, major conclusions are as follows.

First, as this paper studied Taiwanese OFDI location choice from a financial industry perspective rather than focusing on the general patterns, some empirical insights were obtained. The results of the empirical study found that Taiwanese banks follow their corporate customers to expand business in ASEAN nations, which means that location choice of Taiwanese banks in ASEAN were determined by the customer-following factor, such as direct investment from home country and the value of bilateral trade between Taiwan and ASEAN nations. Additionally, Taiwanese banks and other financial institutions were also market-seekers who preferred to directly invest or establish branches and offices in countries which had high per capita GDP and/or the volume of domestic credit to the private sector on total GDP. High volume of domestic credit lent to the private sector compared to the GDP ensuring the prospective economic

expansion and further direct investment in financial industry in the host countries. In other words, when Taiwanese banks considering the oversea expansion and direct investment in financial industry in ASEAN, market-seeking factor are influential determinants. Based on the similar or new demands in the new foreign market, Taiwanese banks expand the concept of "local market" in the host countries. Another indicator be classified as the market-seeking variable is the economic freedom index. This paper indicates that the countries with higher levels of economic freedom were more preferable for internationalization of the Taiwanese banking industry.

Second, the fluctuation of interest rate in host countries had insignificantly positive effect on the location choice. This was because the interest rate determined both the return and the cost of lending. The fluctuation made the profit control more difficult and discouraged the outward FDI of the Taiwanese banks. Third, the effects of corruption control were uncleared. In the OLS and some of the Random Effect models showed that the more corruption attracted the outward FDI while in Fixed Effect model reveals the insignificance. Taiwanese banks realized that host countries in ASEAN may face high corruption situation, but they might ignore this problem because corruption does not harm banking industry much under the transparency control by the central banks of each country. This shield of the transparency control allowed Taiwanese bank to focus on their businesses without worries on the high corruption.

Typically, the effect for each location determinant will be distinctive noticeably in terms of the relationship and volatility transmission in different perspectives and uses the result of this study as the decision path of investment for the academician, practitioners, policymakers, and investors. First of all, to become an international or regional financial center, ASEAN nations need to pursue substantial economic development, such as improving the economic size and encouraging international trade. Because large market potential and trade activities attract foreign banks and FDI inflows in the financial sector. Facilitating economic growth and increasing economic freedom should be the two effective ways to attract and anchor foreign banks and FDI inflows in the financial industry in ASEAN countries. In addition, Taiwanese financial institutions should evaluate client resources, market potential, and geographical distance of host countries when planning overseas expansion in ASEAN nations. Secondly, countries with fewer restrictions on the banking industry and higher economic freedom are more attractive to foreign banks. Governments are encouraged to reduce financial restrictions and increase economic freedom. Finally, this study encourages ASEAN countries to improve control of corruption and reduce fluctuation in the interest rate spread to attract FDI in the real sector (manufacturing or service industries) which further increases FDI inflows in the financial sector due to customer-following motive.

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Willingness to Pay and Attributes of Elderly Food Products on Elders' Choices in Chiang Mai

Kantida Chavitranurak[1], Anaspree Chaiwan[2], and Supanika Leurcharusmee[3]

Abstract

In the situation and the concern of entering the elderly society of Thailand and everything for elderly are becoming more important on the global market. Elderly's food product is still a new product in the market and still needs development in every aspect to meet the market needs as much as possible. The purpose of this study was (1) to estimate the willingness to pay for elderly food products of elders in Chiang Mai. (2) to determine the attributes of elderly food products on elders' choices in Chiang Mai. (3) to find the value of the willingness to pay on elderly food products. In this study using a sample of 400 Thai's consumers in Chiang Mai who buy the food for the elderly without chronic diseases. This study proposes the contingent valuation (CV) technique to measure the willingness of individuals to pay a price premium for elderly food products on elders' choices in Chiang Mai. To obtain the mean "willingness to pay" (WTP), a bivariate probit model was applied to provide information about the crucial variables that affect the WTP. The study revealed that variables that better approximates WTP are based on the lifestyle and knowledge about elderly's food rather than the usual socioeconomic factors. The mean WTP on the premium price for elderly food products is approximately 19.575 Bath per 1 unit of product. To access the market potential, this study shows that the suitable attributes of elderly food products which is consistent with consumer preferences are composed of nutritious, provide vitamins and minerals to the body and easy to chew and digestion. In addition, elderly food products should be available in any places and convenient for customers to buy.

Keyword: Willingness to pay, Food product, Elderly

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1. Introduction

Global aging society situation

Many countries around the world are exposed to aging society. Society with more than 7% of the total population aged 65 and over of the total population. The United Nations predicts that the world will enter the Aging Society by 2050, with 14% of the total population going to be 65 years old, equivalent to that by 2050, a quarter of the world's population will be aged over 65 years old.

The regions are expected to have the number of populations 65 years old or over double between 2019-2050 are following:

North Africa and West Asia
Central and South Asia
East and Southeast Asia
Latin America.

While the number of people aged 80 and over has tripled from 143 million people in 2019, Predicted that in 2050 the total number will be 426 million people.

The average age of the elderly from 2045 to 2050 is 77 years old And tends to increase to 83 years old in 2100.

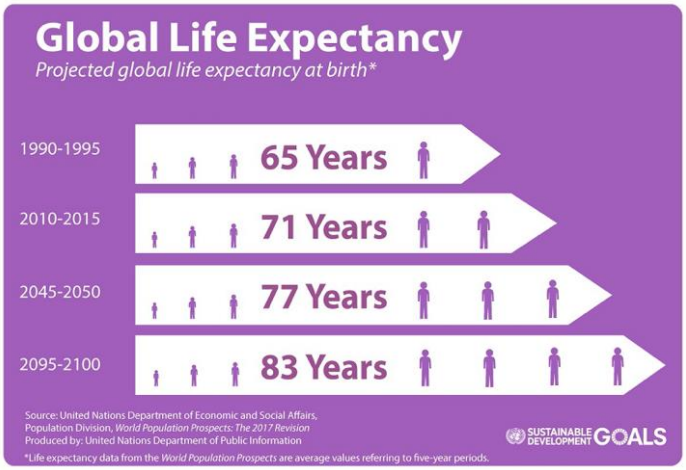

Figure 1: Global life expectancy
Source: United Nations Department of Public Information. (2017)

Thailand aging society situation

Thailand is entering an aging society since 2004 according to the definition of the United Nations that the elderly or the population aged 60 years and over, accounting for 10 percent of the total population. There are approximately 18 percent of the elderly population in 2020, and it is forecast that by 2040 there will be 30 percent of the elderly population, or almost one-third of the country's population. (J. Karakate, 2014)

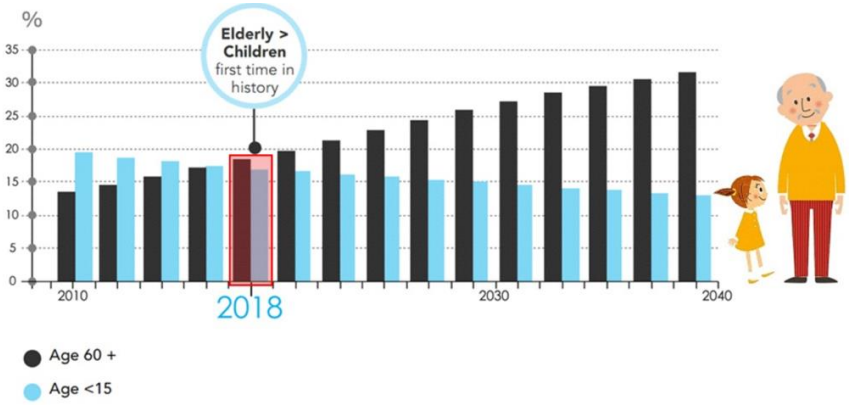

Figure 2: Proportion of the population under age 15 and 60 years or over during 2010-2040
Source: National Statistical Office. (2014)

According to the Figure 2, In 2014 the population in Thailand is 65,203,979 people aged 60 years and over 10,569,021 people or equivalent to 16.2 percent of the total population, meaning Thailand has entering an aging society. Thailand will enter a complete aging society with people over 60 years old, more than 20% of the total population.

Changes in the Thai population structure found that the Thai society has entered the aging society tends to increase the number and proportion of the elderly aged 60 years and over and due to changes in the age structure of the population. Caused by the proportion of the population of different ages, when the population is classified into three age groups, the main population is the childhood (Age less than 15 years), labor age (15-59 years) and elderly (age 60 years and over) found that during the year 2010-2040, the proportion of young and labor population. Tends to decrease while the proportion of the elderly population It is expected to increase steadily from 13.2% in 2010 to 32.1% in 2040 and it is noteworthy that in 2017 it is expected that the proportion of the childhood population is the same as the proportion of the elderly population. As a result of the progress Medicine and Public Health Including the distribution of public health services and from family planning policies that reduce the fertility rate of the population Therefore increasing the elderly population and live long the increasing age is something that cannot be avoided.

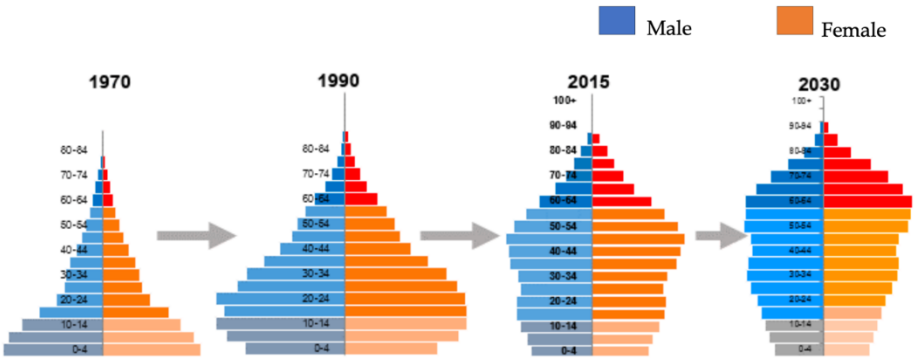

Figure 3: Changing age structure of Thai population
Sources: Calculated from population census, 1970, 1990 and 2010 and population projection for Thailand, 2010- 2040, NESDB. (2020)

Thailand's TFR has now reached an extremely low level (Jones, 2011a). This has resulted in a change in the population age structure which will significantly lessen the size of the labor force of the country in the next two decades. In 2015, it was estimated that there were 43 million people who were of a working age (15-59 years). In the next 20 years, the labor population in this age group will decline to be only 35 million (NESDB, 2013). Thus, Thailand needs to initiate measures in order to mitigate the impact of a shrinking labor force with other policy options, which can be done feasibly. (P. Prasartkul, S. Thaweesit1 and S. Chuanwan, 2019)

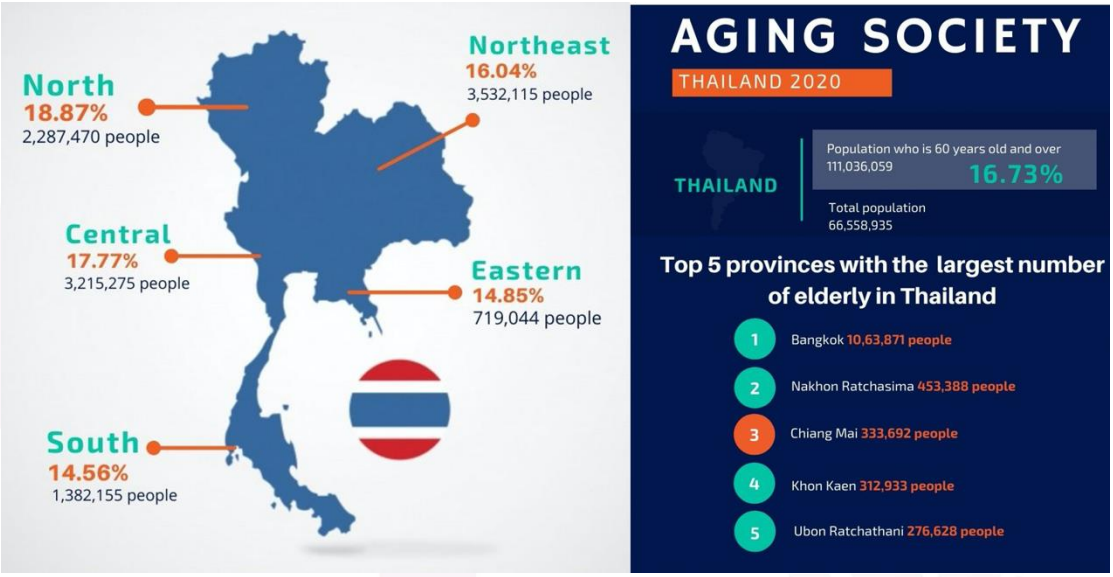

Figure 4: Thailand's aging society 2020
Source: Department of Provincial Administration. (2020)

Currently, Thailand has the total population 66,558,935 people. Number of people aged 60 years and over is 11,136,059 people or 16.73%. Northern region has the largest number of the elderly is 2,287,470 people, or 18.87%. And Chiang Mai province is in the top 5 provinces with the largest number of the elderly in Thailand.

Following with the 12th draft of the Economic Development Plan, the focus is on setting the development direction aimed at the transition of Thailand from middle-income countries to high income countries with stable and sustainable and happy society. And has given the importance of improving health by promoting the development of medical technology and innovations to support aging society in terms of health products and housing for the elderly and the focus on the middle-aged and late-aged elderly group tends to increase. The elderly will likely increase from 10.3 million (16.2 percent) in 2015 to 20.5 million (32.1 percent) in 2040, reflecting the growing burden of health costs. The United Nations estimates that 2001-2010 will be the century of the elderly, meaning more than 10 percent of the population of the global population is 60 or over, in 2015, the number of the elderly in Thailand is 7.2 million and is expected to increase to 11 million in 2020 (Kasikorn Research Center, 2015). Aging Society will change various functions of the body system, organ and physical performance and the brain system will deteriorate resulting in various ailments such as changing taste perception, the function of the digestive system and absorption is

reduced. Chewing and swallowing disorders occur, the state of malnutrition, metabolic disorders resulting in diabetes, obesity, high blood pressure and osteoporosis.

The elderly has a lower energy demand from adulthood due to reduced muscle volume and mass. The decrease in muscle mass may be due to the decrease in energy expenditure for daily activities and the rate of new tissue regeneration rates with increasing age but the need for other nutrients including vitamins and minerals are not reduced. Therefore, it is important to consider and pay attention to the dietary requirements of the elderly with reduced energy but get complete nutrients to repair in worn out parts and disease resistance.

Food is very important to everybody. People with good nutrition are in good health, have a good life and not too stressful. Various changes inside of the body will go slowly. In contrast, those with poor nutrition, drinking alcohol and overweight or underweight. The body will deteriorate quickly. For the elderly, it's often prone to malnutrition because when entering the age of the elderly, there will be physical, social and economic changes that may lead to malnutrition, such as the elderly with congenital diseases. It may be an obstacle to go looking for food outside or even self-cooking being alone at home. Lack of contact with outside society, neglect in food to the problem that they need to spending money carefully because income has decreased or none due to having to leave the fulltime job. Some of the elderly people turn to be alcoholic due to social change or psychological problems. When the elderly drink a lot of alcohol, the body turns to alcohol energy causing anorexia and lack of other essential nutrients, such as vitamin B1, folic acid, etc. In addition, chronic congenital diseases that are often found in the elderly lead to anorexia or makes the body need more nutrients than usual. The elderly is more prone to malnutrition than other population groups and the problem that is found in the elderly is that they often do not pay much attention to health care and food consumption because still lacking knowledge and understanding of nutrition. It is difficult to provide the elderly with adequate and complete nutrition with dietary restrictions and the body systems cannot digest and burn as well as in youth. The glands do not taste well, teeth are unable to chew food and anorexic causing the lack of some essential nutrients resulting in a decrease in the immune system which is a chance for various diseases. Which the development of food product for the elderly should have adequate nutrition, modified to be suitable according to the age and needs of the body, increase the variety of food, add more nutrition that contain beneficial suitable for the elderly to complete and balanced nutrition, to slow down the symptoms of old age and help to maintain a healthy body. However, elderly diets also have precautions. If they have been overloaded with certain nutrients, it can be toxic to the body.

Food products for the elderly in Thailand are still few due to technology limitations and knowledge that is specialized. And access to various sources of information or knowledge. Some restrictions on copyright or being prohibited from publishing, causing SMEs spend a lot of time to studying and spending a lot of research budget. As a result, the development of food products for the elderly is just research that has not been applied in commercial production. And there are many products imported from abroad due to the quality standards and modern production technology causing the elderly to consume high price products.

This study of the willingness to pay and attributes of elderly food products on elders' choices in Chiang Mai to answer the question of socioeconomic characteristics in Chiang Mai province about elderly food products consumption and purchase, The knowledge and attitude on the elderly food and the willingness to pay for the elderly

food increased from the normal food products on elders' choices. And knowing the needs of consumers on food for the elderly will lead to decision making of food products for the elderly of the private sector to gives consumers more choices to buy products that meet their needs. In addition, the government sector will find guidelines to promote and educating the elderly about their food. And to drive Thailand towards the development of production and consumption of elderly food products that can meet the needs of the elderly.

When manufacturers of food products both government sector and private sector know the willingness to pay for attributes of elderly food products, it will lead to the development on elderly food products giving the elderly more choices of food, have the good food products, good health, reduce sickness and diseases leads to longevity. And can create more benefit for the society and economy of the country.

2. Methodology

The data use Contingent Valuation Method (CVM) analyze with Bivariate Phobit model analysis to determine the Willingness to Pay (WTP) and the difference between normal food product and food products for the elderly.

Data analysis in this study CVM analysis was chosen by using Doubled Bounded Dichotomous Choice because the closed ended questionnaire can solve Starting Point Bias problems. And Single Bounded Dichotomous Question give the mean of WTP variance lower compared to the double Bounded Dichotomous Question (Michell and Carson, 1989, Haneman et al., 1991 and NOAA, 1993). In this thesis will present a pattern with a method for analyzing the data by using Double Bounded Dichotomous Question.

Data analysis using a Double Bounded Dichotomous Question

Analysis of willingness to pay for elderly food product by The Double Bounded Dichotomous Question will ask whether the respondents were willing to pay the proposed amount.

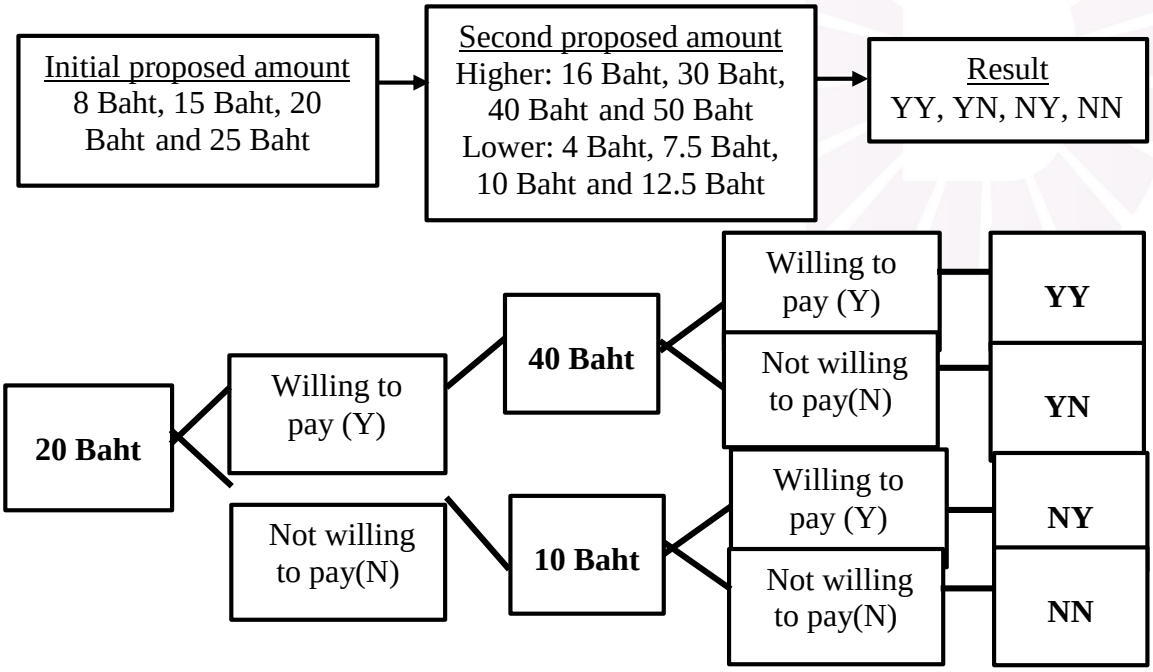

Figure 7.4.2 Shows the possible of using a Double Bounded Dichotomous Question

The responses given by the respondents were of four possible options: YesYes, YesNo,NoYes, NoNo. We would call them YY, YN, NY, NN, respectively. The calculation is as follows:

$$\Pr(YY) = \pi^{YY}(B_1^s, B_1^U) = 1\text{-}G(B_i^U;\theta),$$
$$\Pr(YN) = \pi^{YN}(B_1^s, B_1^U) = G(B_i^U;\theta) - G(B_1^s;\theta),$$
$$\Pr(NY) = \pi^{NY}(B_1^s, B_i^L) = G(B_1^s;\theta) - G(B_1^L;\theta),$$
$$\Pr(NN) = \pi^{NN}(B_1^s, B_1^L) = G(B_1^L;\theta),$$

When B_1^s = the initial amount.
B_1^L and B_i^U = the amount of the second bid.
$G(B_1^s;\theta)$ = Cumulative Probability Distribution of the Bid with the Parameter Vectorθ.

The maximum likelihood equation is Joint Density Function of the Likelihood Function. The goal is to find opportunities to find what every respondent makes which is equal to the chances that all consumers will choose to multiply together but we cannot know which way the respondents will choose to answer, so we must show them all. And it will be marked with an index value indicating which option was chose and which option was not chosen as follows.

$$lnL(\theta) = \sum_{i=1}^{n} d_1^{YY} In\{1 - G(B_i^U;\theta)\} + d_1^{YN} ln\{G(B_1^U;\theta) - G(B_i^s;\theta)\} + d_1^{NY} ln\{G(B_1^s;\theta) - G(B_i^L;\theta)\} + d_1^{NN} ln\{G(B_1^L;\theta)\}$$

Estimate the Maximum-likelihood (ML) for Doubled Bounded Model from First – order Condition

$$\frac{\partial ln\mathrm{L}(\hat{\theta})}{\partial \theta} = 0,$$

To study willingness to pay and to analyze factors determining willingness to pay on elderly food products in Chiang Mai Province. This study will use the Bivariate Probit Model, an analysis method developed by Cameron and Quggin (1994), by assuming that the WTP distribution is Linear Distribution.

Green (2003) says that the Bivariate Probit Model is a model developed after the regression analysis by Classical Multi-equation Regression Model which considers system of equations to have related Error Term Green (2007) consider the Bivariate Probit Model to have the form of equations as follows;

$$y_{,1}^* = \beta_1' X_{,1} + \varepsilon_{,1} \quad , \quad y_{,1} = 1 \text{ if } y_{,1}^* > 0$$
$$y_{,1} = 0 \text{ if In other cases}$$
$$y_{,2}^* = \beta_2' X_{,2} + \varepsilon_{,2} \quad , \quad y_{,2} = 1 \text{ if } y_{,2}^* > 0$$
$$y_{,2} = 0 \text{ if In other cases}$$
$$[\varepsilon_{,1}, \varepsilon_{,2}] \sim N_2[0,0,1,1,\rho], -I < \rho < 1$$

When y_1 is the equation obtained from the Initial Bid.

y_1 is the equation obtained from the second bid (Follow-up Bid).

According to Krinsky and Robb's (P.wilner Jeanty, 2007) can find the Mean WTP

$$Mean\ WTP = \frac{-\bar{x}\beta'}{\beta_0}$$

When $\bar{x}$ is the mean of the independent variable.
β' is the vector of the coefficient of the independent variable from the approximation.
β_0 is the coefficient of the Follow-up Bid variable.

In this calculation, will use the STATA program.

Data Collection

This study will collect the data from 400 sample of Thai elderly in Chiangmai by face-to-face interview, By the period of conducting a study will be November 2020 until the end of December 2020. And will divide by 4 starting price levels, each starting price level, there were 100 questionnaires, interviewed from sample groups who bought products at department stores, supermarkets and markets in Chiang Mai Province, using random sampling with independent variables in the table 7.1

Table 7.1 Independent variables and the meaning

	Independent variables and the meaning	Symbol
Gender		
	Female = 1; Male = 0	GEN
Age	Age of the respondents	AGE
Status		
	Single = 1; Others = 0	STA
Education level		
	Diploma or lower = 1; Others = 0	EDU1
	Bachelor's degree = 1; Others = 0	EDU2
	Upper bachelor's degree (Dependent variable)	
Household's income		
	Lower than 30,000 Baht = 1; Others = 0	HH1
	Between 30,001-50,000 Baht = 1; Others = 0	HH2
	Between 50,001-70,000 Baht = 1; Others = 0	HH3
	More than 70,000 Baht (Dependent variable)	

	Independent variables and the meaning	Symbol
Household's size	Number of household members	MEM
Confidence	Confidence level of elderly food products in Thailand: Not confident = 0; Confident = 1; Very confident = 2	CONFI
Purchasing behavior of elderly food products	Frequency of purchasing food product for elderly: Never, Occasionally, Often and Usually	BEHAVE
Attitude	If food product for the elderly is the product that can be found in the market generally, Will it affect your purchase? Yes = 1; No = 0	ATTI
Basic Knowledge	The score level from the test with the scale of score 0 - 10	SCORE
Knowledge assessment about food for the elderly	Self-assessment level from respondents on the level of knowledge about food for the elderly. With three levels, ascending 0-2	KNOW

3. Result

The study of willingness to pay and attributes of elderly food products on elders' choices in Chiang Mai. the study was presented by categorizing the findings into two sections, as follows:

3.1 Socio-demographic behaviors

3.2 Test results for hypotheses

3.1 Socio-demographic behaviors

From the survey found that gender of the sample were 207 males or 52 percent and the remaining 193 or 48 percent are females, with an average age of 57.84 years old. And most of the marital status is 91 percent married, 7 percent single and 2 percent divorced.

When considering the educational level of the sample, the respondents were 400 people. Most of them, representing 188 people, or 47 percent, graduated with bachelor's degree. Followed by 35 percent graduated with below diploma, 35 percent graduated with diploma, The remainder, accounting for 2.5 percent, graduated with postgraduate.

When considering the level of household's income, the large number of 166 people or 41.5 percent, having a household income between 30,001-50,000 Baht per month. Followed by the group with income between 30,001-50,000 Baht per month, less than 30,000 Baht per month and more than 70,001 Baht per month were 27 percent 24.5 percent and 7 percent, respectively.

When considering the occupation of the sample, the large number of 154 people or 38.5 percent are retired. Followed by the group of private business owners 128 people, company employees 82 people, civil service or government employee or state enterprise employee 31 people and stay at home mom or dad 5 people, which are 32, 20.5, 7.75, and 1.25 percent, respectively.

To measure the knowledge of the food for the elderly from the respondents, the question is "Do you have knowledge and understanding of food for the elderly?" by giving respondents self-assessment. The assessment level is divided into 4 levels, which are low level, moderate level, and high level. More than half of the respondents, representing 283 people, or 59.5 percent assessed that they had moderate level of knowledge. and when the respondents answered the questionnaire using 10 questions. The results showed that most of the samples had a moderate level of knowledge consistent with the self-assessment results.

Following that, it was revealed that the initial recommended value of 20 Baht was based on a willingness to pay more per 1 product unit (when compared to general food product). By investigate willing to pay first and second bid and explain the findings from the investigation based on their willingness to pay on the first offer, respondents did not purchase 315 people or 78.75 percent and purchased 85 people or 21.25 When just those who made the purchase were included, 52 people or 13 percent were prepared to pay on the second offer. total, accounting for 61.18 percent of those prepared to pay for the first bid) that shown on table 1.

Table 1: Demonstration of the willingness to pay for elderly food products.

Willing to pay		**Frequency**	**%**
First bid	Not purchase	315	78.75
	Purchase	85	21.25
	Total	400	100.00
Second bid	Not purchase	348	87.00
	Purchase	52	13.00
	Total	400	100.00

Source: From the data collection survey.

In addition, when asked the respondents "Do you think that the information about food products for the elderly (in terms of benefits) is sufficient?" the result of the study found that 85 percent had been around for information about the food products for the elderly sufficient and only 15 percent need additional information about food products for the elderly.

From the assessment of the attitude about confident in production systems and technology on food products for the elderly in Thailand at the present, the assessment level is divided into 3 levels, which are low confidence, moderate confidence, and confident. Figure 6 shows that 76 percent of them have moderate confidence, 15 percent are confident, and 9 percent low confidence.

When considering about purchasing behavior from the frequency of purchasing food products for the elderly in Chiang Mai, frequency level divided into 3 levels, sometimes, often, and always. Figures 7 shows that Most of the samples are 53 percent often bought, 35.75 percent always bought, and 11.25 percent sometimes bought.

This shows that the possibility of creating a food product for the elderly's market is feasible when considering the behavior of more than half of the respondents who are already consuming other types of food products for the elderly's and when asked if the food products for the elderly are readily available, for example in supermarkets and

department stores, will make them more likely to buy food products for the elderly. The study found that more than half of the respondents said they were more likely to buy it.

Part 2 Test results for hypotheses

2.1 A Pearson Correlation Coefficient

A Pearson correlation coefficient analysis was utilized in the investigation. To ascertain whether or not the variables utilized in the study were significantly associated with one another. Problems will arise if each pair of variables is significantly linked with each other. Multicollinearity As a result, the interpretation in the regression analysis is erroneous. The Pearson correlation coefficient (r) must be between -1 and 1 (Machin et al., 2018), and the Pearson correlation coefficient (r) for each variable pair must be less than 0.80. (Stevens, 1992) The outcomes were as follows:

Table 1. Variable Pearson correlation coefficient analysis findings

Model 1	WILLP1	GEN	AGE	STA	EDU1	EDU2	HH1	HH2	HH3	CONFI	BEHAVE	SUF	SCORE	KNOW
WILLP1	1	0.049	0.065	-0.042	.099*	-0.073	0.045	0.021	-0.013	0.158**	0.002	0.026	0.021	-0.037
GEN		1	0.120*	0.019	0.115*	-0.107*	0.090	0.029	-0.114*	-0.041	0.045	-0.051	0.011	0.013
AGE			1	-0.191**	0.775**	-0.766**	.462**	-0.106*	-0.262**	0.137**	0.022	-0.036	-0.013	-0.024
STA				1	-0.132**	0.146**	-0.084	-0.045	0.106*	-0.062	-0.010	0.040	0.007	0.057
EDU1					1	-0.951**	0.517**	-0.059	-0.321**	0.100*	0.004	-0.034	-0.003	-0.012
EDU2						1	-0.490**	0.101*	0.307**	-0.075	0.000	0.062	0.000	0.024
HH1							1	-0.480**	-0.346**	0.087	-0.018	0.000	0.028	-0.019
HH2								1	-0.512**	-0.034	-0.013	0.036	-0.032	0.036
HH3									1	-0.061	-0.022	-0.030	0.059	-0.021
CONFI										1	0.122*	0.253**	0.031	-0.049
BEHAVE											1	0.000	-0.037	-0.005
SUF												1	0.046	-0.042
SCORE													1	0.019
KNOW														1

Source: From the data collection survey and cellulated with STATA program.

Table 2. The table continues from the previous one

Model 2	WILLP2	GEN	AGE	STA	EDU1	EDU2	HH1	HH2	HH3	CONFI	BEHAVE	SUF	SCORE	KNOW
WILLP2	1	-0.001	-0.032	-0.015	0.011	-0.036	0.004	-0.024	-0.017	0.001	0.061	-0.014	0.087	-0.073
GEN		1	0.120*	0.019	0.115*	-0.107*	0.090	0.029	-0.114*	-0.041	0.045	-0.051	0.011	0.013
AGE			1	-0.191**	0.775**	-0.766**	.462**	-0.106*	-0.262**	0.137**	0.022	-0.036	-0.013	-0.024
STA				1	-0.132**	0.146**	-0.084	-0.045	0.106*	-0.062	-0.010	0.040	0.007	0.057
EDU1					1	-0.951**	0.517**	-0.059	-0.321**	0.100*	0.004	-0.034	-0.003	-0.012
EDU2						1	-0.490**	0.101*	0.307**	-0.075	0.000	0.062	0.000	0.024
HH1							1	-0.480**	-0.346**	0.087	-0.018	0.000	0.028	-0.019
HH2								1	-0.512**	-0.034	-0.013	0.036	-0.032	0.036
HH3									1	-0.061	-0.022	-0.030	0.059	-0.021
CONFI										1	0.122*	0.253**	0.031	-0.049
BEHAVE											1	0.000	-0.037	-0.005
SUF												1	0.046	-0.042
SCORE													1	0.019
KNOW														1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Source: From the data collection survey and cellulated with STATA program.

According to Table 2, which shows the findings of Pearson's correlation coefficient analysis of Model 1 and Model 2 discovered that each pair of variables may have a maximum value of 0.775 and that a value less than 0.80 (Stevens, 1992) would not cause issues. Except for the EDU1 variable, which has a value of 0.951, this variable EDU1 cannot be utilized in regression analysis.

2.2 Bivariate Regression Analysis

Utilized Bivariate Regression Analysis to examine the factors that influence elders' willingness to pay and the characteristics of geriatric food items. The outcomes were as follows:

Table 2. The outcome of variable testing model

Variables	WTP the 1st Bid		WTP the 2nd Bid	
	Coefficient	SE.	Coefficient	SE.
Constant	-0.778	0.9313	1.956*	0.7847
GEN	0.145	0.1478	0.024	0.1629
AGE	-0.131	0.2070	-0.418	0.2524
STA	-0.105	0.3119	-0.169	0.3513
EDU2	-0.248	0.2117	-0.457	0.2481
HH1	0.673	0.4133	-0.326	0.3452
HH2	0.705	0.3808	-0.307	0.3046
HH3	0.706	0.3855	-0.321	0.3163
CONFI	0.581**	0.1731	5.572**	0.3878
BEHAVE	0.026	0.1585	0.215	0.1752
SUF	0.074	0.2487	-0.141	0.2507
SCORE	-0.426	0.8994	5.498**	0.3426
KNOW	-0.018	0.2010	0.465*	0.2017
ρ	0.234		0.488	
Log likelihood	-149.632		-114.766	
Wald statistic	129.909		229.403	

Source: From the data collection survey and cellulated with STATA program.

The result about the most important attribute of food for elderly with the question "What attributes do you feel are necessary in the majority of three elderly food products", nutritious 135 people or 33.75 percent was discovered to be the most common initial attribute. The second feature is provide vitamins and minerals to the body 139 people or 34.75 percent, and the final one is easy to chew and digestion 120 people 30 percent.

The results of hypothesis testing revealed that confidence level of elderly food products in Thailand statistically at the 0.05 level in both models (p=0.001, p=0.000) and basic knowledge of elderly food significantly at the 0.05 level in model 2 (p=0.000).

4. Discussion

From the results of the study, it was found that if food products for the elderly are readily available for purchase in supermarkets and department stores will result in more than 95 percent of respondents are more likely to buy food products for the elderly. It shows initially that the marketing potential of the food products for the elderly still has a high probability.

From the results of the study, the willingness to pay the difference in food products for the elderly prices was on average 19.575 baht per unit. but also, a guideline for private and government agencies to consider If the product is sold and the price difference is approximately 19.575 baht per 1 product unit, will it be worth production, or how to create more value for the product to be the most appealing to consumers. When considering factors in determining willingness to pay, this study found that cognitive attitude factors about food products for the elderly are more important than socio-economic factors. If consumers cannot clearly differentiate between general food products and food products for the elderly, the level of prices that consumers are willing to pay more for food products for the elderly will not high.

In addition, when considering the relationship between wiliness to pay values and socio-economic variables such as income, education, gender, occupation, knowledge, confidence level. It was found that the confidence level of food production and system in Thailand and the knowledge of elderly food are the factors that positively influenced the willingness to pay.

And the top 3 important attribute of food for elderly is nutritious, provide vitamins and minerals to the body and easy to chew and digestion.

5. Conclusion and Recommendation

5.1 Conclusion

Thailand is entering an aging society. It means that the elderly age group is more than the working age group. Therefore, we should focus and giving important on the elderly because of the elderly with poor health may cause obstacles in the development of the country. Food is essential for human life. Having good food leads to good health. But to have a good food product, it must go through research and development processes, especially food products for the elderly that are not available in the market.

This study aims to find the value of the willingness to pay on elderly food products and the attributes of elderly food products by using sample of 400 elderly people aged 60 years and over who do not have chronic diseases or people who buy food for the elderly who do not have chronic diseases living in Chiang Mai and use

contingent valuation method to measure the willingness to pay and double bounded technique to ask the question.

The result are people are willing to pay approximately 19.575 baht per 1 unit of product and the top 3 attributes of food for elderly is nutritious, provide vitamins and minerals to the body and easy to chew and digestion.

The result from the study will provide manufacturers with information for making production decisions for reach to the demand of consumers, to set the selling price, at the same time country administrators or related persons can use the information to develop plans on food product for elderly in the future.

5.2 Recommendation

1. From the result, it shows that food product for elderly is considered a product that has potential to grow. Therefore, producers, distributors and related organizations should start planning for production to support the in the upcoming aging society in the future.

2. From the result about the attributes of food for elderly, producers or manufacturers may be able to combine the attribute that consumers need from this study with other attributes for consumers to gain more benefit and accessible to more consumers.

3. From the result, it was found that the confident in production systems and technology on food products for the elderly in Thailand and the knowledge of elderly food are the factors that positively influenced the willingness to pay. Therefore, building confidence and educating people about food for the elderly. Will make people pay more attention and focus on food for the elderly. This will positively affect Thailand's aging society in the future.

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Early impact of the COVID-19 epidemic on import and export from the perspective of shipping

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Abstract

In January 2020, an epidemic caused by a new coronavirus (COVID-19) broke out and spread rapidly to more than one hundred countries in the world. We fear that COVID-19 is making global shipping worse. Consequently, it is very important to keep our eyes on its impacts on global shipping. In this paper, we use the decreasing global number of container ships in operation to measure the impact of the COVID-19 epidemic. We find COVID-19 is making global shipping worse, we analyse this decrease from three perspectives: production, consumption and transportation. Then, we present potential impacts of the epidemic in multi-aspect to the shipping industry, port, shipping company and seafarers. At last, we insist on three priorities to limit those impacts and risks. This contribution aims to provide early insight into the epidemic from the perspective of the shipping industry stakeholders and offer managerial implications for the shipping policy.

Keywords: COVID-19, global shipping, shipping recession, global risk

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1. Introduction

In January 2020, an epidemic caused by a new coronavirus (COVID-19) first broke out in central China's Wuhan which was a major domestic and international transport hub with a population of more than 14 million. On January 27, the World Health Organization (WHO) upgraded the COVID-19 risk level from 'high' to 'very high'. By the time of writing, the epidemic had spread rapidly to more than one hundred countries in the world. WHO declared COVID-19 a global 'pandemic' on March 20 and fear began to show in world markets. The epidemic is of global impact. We fear that COVID-19 is making global shipping worse.

In the past decade, two factors threatened any improvement in the shipping industry. Firstly, global shipping had not recovered from the 2008 crisis yet. The Baltic Dry Index (BDI) collapsed from 10,844 points in May 2008 to 747 points in December 2008 in just half a year, then reached the lowest points in history (290 points) in February 2016 (Kamal, I. M., Bae, H., Sunghyun, S., Kim, H., & Yun, H. 2019) and now recorded only 629 points (Jambeck, Geyer, Wilcox, Siegler, & Law, 2015). Secondly, President Trump's unpredictable policies impacted global trade (ElifNuroglu & Kunst, 2014). Figure 1 reported two significant turning points triggered by the US-Sino trade friction. At the end of 2019 the United States and China concluded a Phase One trade agreement, the global shipping industry was supposed to witness abating uncertainty, and however, it was then struck by the COVID-19 epidemic.

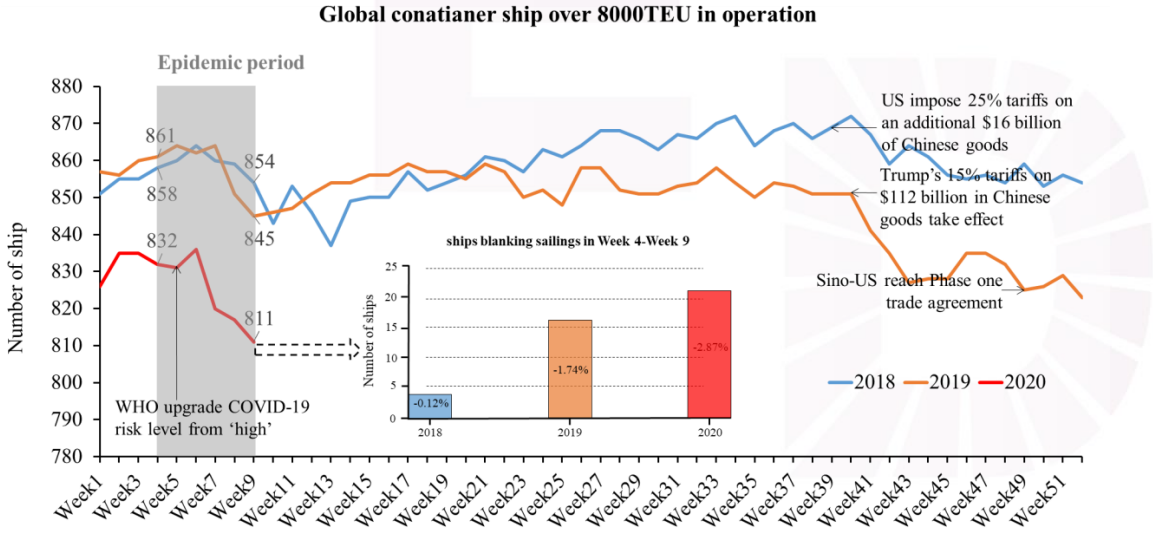

Figure 1. The number of global container ships over 8000 TEU in operation. (Data source: www.shipxy.com)

The epidemic period exactly overlapped with the Chinese New Year. Owing to the seasonality effects of the Chinese New Year, container shipping lines would always blank sailings to cut costs. As indicated by Figure 1, the global number of container ships with over 8000 TEU in operation decreased by 0.12% during the 2018 Chinese New Year; additionally affected by the US-Sino trade friction, then fell to -1.74% in the same interval of 2019. Now, in 2020, the value recorded -2.87%, which

implies COVID-19 was making global shipping worse.

2. Background

This decrease could be explained from three perspectives: production, consumption and transportation. At the moment of the epidemic outbreak, China was in the Chinese New Year. The workers were all back home for the holidays. After the implementation of strict isolation, they were all locked down at home, unable to return to the factories, which caused production to stop. Meanwhile, due to the rigid isolation policies, people were ordered to stay at home, and all businesses were requested to close, which froze consumption. Freezing of production and consumption led to a decline in shipping supply and demand.

At the time of writing, the global impact of this epidemic is as yet unknown, however, according to the data from the Ministry of Transport of China, 9 out of the 11 Chinese coastal provinces recorded negative growth in container throughput, and the container throughput of the total Chinese coastal ports in February 2020 shrank by 10.6% in contrast with those in 2019 (see Figure 2). Obviously, the impact of this epidemic is quite serious. With the worldwide spread of the epidemic, the world economy and trade can be expected to witness an instant decline, which would negatively impact shipping soon.

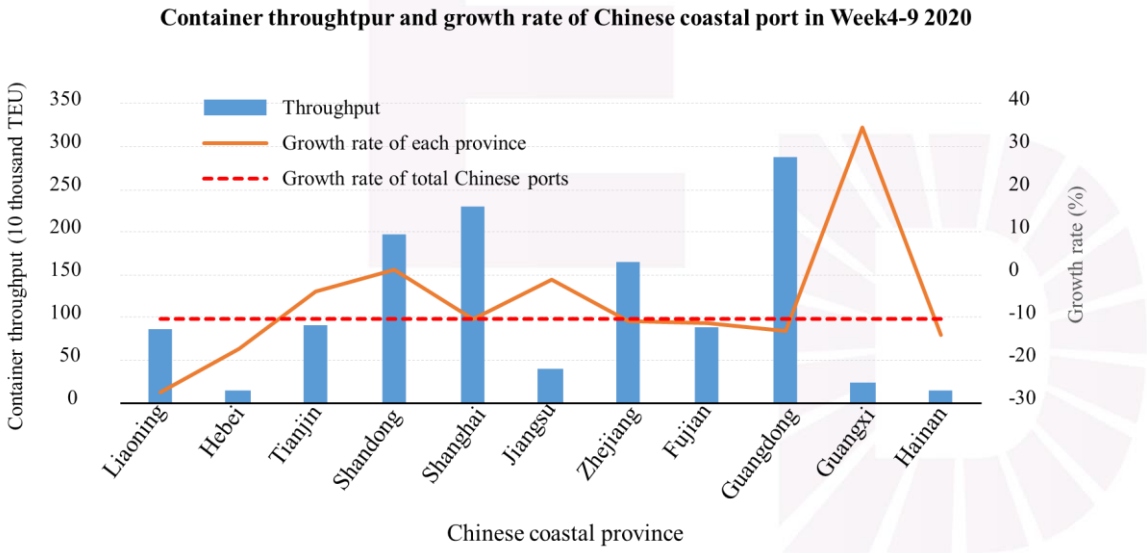

Figure 2. Container throughput of the total Chinese coastal ports in February 2020. (Data source: the statistical yearbook data of the National Bureau)

The effects of the epidemic on shipping are emerging and seem pessimistic. The reason is that while this epidemic is getting better in China and South Korea, Europe and the US are out of control, and the rest of the world is getting worse. We fear COVID-19 would impact shipping in multiple aspects.

Economy declines and abating trade. A severe pandemic can destroy up to 1% of global GDP at the most conservative estimates (Kong, 2017), in fact, the economic challenge posed by the COVID-19 is immeasurable at the present moment. With isolation policies being imposed globally, the economy and trade can be expected to

decline as indicated by slumping stock markets and could lead to extensive line adjustment and capacity suspension in shipping.

Port closed and efficiency decrease. The rapid human to human transfer of COVID-19 has been confirmed widely (Etkin & Welch, 1997). Ports are the nodes of commodity collection and distribution with frequent personnel mobility, which means a high risk of infection. For instance, after a case of COVID-19 was detected at Bayport and Barbour Cut, Houston port suspended operations at the two terminals (Zhang, 2019). In spite of the International Maritime Organization (IMO) asking its member states, amid the viral outbreak, to undertake all possible measures to prevent unnecessary delays of ships, stricter quarantine and inspection measures are being implemented in ports to prevent the virus from entering, which implies longer stay time in ports and reduced efficiency in port operations (Beaver, 1966).

Blank sailing and service suspension. With the decline of economy and trade due to the COVID-19 impact, global carriers are planning to blank sailings to adapt to the global freight volume loss (Antonowicz, 2014). Additionally, more and more countries are imposing the 14-day self-isolation on international ships, which force more ships to wait in the anchorage. All major ocean cruise lines had entered a 30-day voluntary suspension in light of the COVID-19 since March 13 (White, 2009). If the epidemic fails to improve in due time, we believe that the suspension would be extended.

Seafarers were isolated and crew changeovers delayed. To shut off the epidemic spread, almost all port authorities prohibit seafarers to disembark as ships arrive at the port. What's more, every month, around 100,000 seafarers need to be changed over from the ships which they operate to comply with relevant international maritime regulations. However, the relief seafarers are not able to join the vessels due to travel bans, a point that has been raised as urgent in the agenda of high-level meetings of UN member countries. Unfortunately, those meetings have been cancelled owing to the epidemic.

The impact of emergencies has been widely studied by scholars. Hongying. S (2010) analysed China's CPI under the impact of the two financial crises in 1997 and 2008. The outbreak of SAR makes people reassess the medical system, investigated its impact on the current and future emergency department operation (Marley, C. T., Levsky, M. E., Talbot, T. S & Kang, C. S, 2004), and explored its short-term impact on China's future economy (Hai W., Zhao Z., Wang J & Hou, Z. G, 2004). The parameter estimation of the linear regression model has been applied to many fields such as impact analysis and prediction. The influence of port effect on the regional economic development of Beijing, Tianjin and Hebei is studied. By selecting the elements of logistics and transportation system and port related elements as research indicators, the model is established and optimized by using least squares regression (OLS) and partial least squares regression (PLS) based on Douglas production function, to obtain the parameter estimation (Libo and Daming W, 2016). Tom studies the main factors affecting fiscal revenue, such as tax, GDP, social fixed asset investment and the number of social employees. He uses the least square method to estimate the regression parameters and then uses the F test and t-test to test the significance of the regression equation. Finally, he forecasts and evaluates the model (Xiaqing Z, 2017).

3. Methodology

For China's shipping economy during the epidemic period, mainly shipping import and export business, the infrastructure is ships, and the impact of shipping on the economy, the basic expression of the empirical model is as follows:

$$\ln Y = a_i + \beta_1 \ln \text{ship}_{it} + \beta_2 X_{it} + \varepsilon_{it} \quad (1)$$

In equation (1), *i* represents the place, t represents the time, ln*Y* represents the total import and export volume of the explained variable, ln *ship* represents the shipping transportation infrastructure, ln*teu* represents container throughput, and X represents other control variables. The core explanatory variable is ln*ship*. In the selection of control variables, referring to relevant literature research, this paper selects government expenditure (ln*gov*) and transportation employment (ln*ep*). The final empirical model expression is:

$$\ln Y = a_i + \beta_1 \ln \text{ship}_{it} + \beta_2 \ln teu_{it} + \beta_3 \ln gov_{it} + \beta_4 \ln ep_{it} + \varepsilon_{it} \quad (2)$$

4. Result

The core explanatory variable selected in this paper is the logarithm of total imports and export according to the level of economic aggregate. The logarithm of container throughput is selected as the core variable to explain the development level of container transportation.

In terms of index selection of control variables, government expenditure can promote economic growth and improve residents' income through the multiplier effect. Some theories believe that government expenditure has a crowding-out effect on Residents' consumption, but both crowding in effect and crowding out effect show that government expenditure can affect residents' consumption. This paper uses the logarithm of the proportion of government general budget expenditure to GDP to express the level of government expenditure.

In terms of data sources, this paper selects the panel data of China's total import and export volume, container throughput and the number of operating ships during the epidemic period from 2018 to January to February 2020. The data used in the study come from the statistical yearbook data of the National Bureau of statistics and provincial statistical bureaus.

Table 1. Descriptive statistics of each variable

Variable	Meaning	Observed value	Mean value	Standard deviation	Minimum	Maximum
ln*Y*	Import and export level	88	8.276	0.379	7.725	9.414
ln*ship*	Number of ships sailing	88	0.731	0.756	-0.944	1.966
ln*teu*	container throughput level	88	3.692	0.567	2.364	4.962
ln*gov*	Government expenditure level	88	-2.194	0.259	-2.672	-1.632
ln*ep*	Crew employment rate	88	10.522	1.005	7.495	11.804

In this paper, short panel data is selected as the model, and there are three commonly used econometric models: random effect, fixed effect and mixed regression model. Then, the commonly used F test and Hausmann test are used to test and screen the three models. The specific process is processed by Stata14 software; the regression results obtained from the empirical model are shown in Table 2.

Table 2. Regression results of the empirical model

Variable	Mixed regression	Fixed effect	Random effect
ln*ship*	0.351 ***	0.123 *	0.197 ***
	t=5.52	t=1.91	t=2.93
ln*teu*	0.354 ***	0.398 ***	0.404 ***
	t=4.34	t=6.42	t=6.85
ln*gov*	0.557 ***	0.625 ***	0.663 ***
	t=4.38	t=3.16	t=3.85
ln*ep*	-0.207 ***	-0.177 **	-0.180 ***
	t=-3.25	t=-2.15	t=-2.83
cons	5.537 ***	3.767 **	4.795 ***
	t=12.58	t=2.62	t=5.29
R-squared	0.839	0.833	

***, **, * are significant at the confidence levels of 1%, 5% and 10%, respectively.

5. Discussion

From the regression results, the coefficient of the number of sailing ships and container throughput is positive and significant, indicating that the number of sailing ships and container throughput can promote the total import and export volume from 2018 to 2020. Because the P-value is 0.0000, it is considered that there is an

individual effect, and the fixed effect is better than the mixed regression. When heteroscedasticity exists, the traditional Hausmann test does not apply to the fixed-effect model and random effect model. Because the test results show that the P values are less than 0.05, the fixed-effect model rather than the random effect model should be used.

For H_0: $\beta_1=\beta_2=\beta_3=\beta_4=0$, H_1: β_1, β_2, β_3, β_4 are not all equal to 0, given the significance level $\beta=0.05$, find out the critical value Fa (4, 21) =2.840 with degrees of freedom k=4, n=26, 26-k-1=9 in the F distribution table. The value of R^2 is 0.833, the value of F-statistic is 11.08＞Fa=2.840. It shows that the model fits the relationship between variables well, the overall linearity of the equation is significant, and it passes the F test.

To sum up, the specific expression of the empirical model of shipping level and total import and export volume is as follows:

$$\ln Y = 3.767 + 0.123 \ln \text{ship}_{it} + 0.398 \ln teu_{it} + 0.625 \ln gov_{it} - 0.177 \ln ep_{it} \quad (3)$$

In equation (3), the core explanatory variables ln*ship* and ln*teu* are significant variables. The formula shows that for every 1% increase in the number of sailing ships, the total import and export volume will increase by 0.123%, every 1% increase in the number of container throughput, the total import and export volume will increase by 0.398%.

It is one-sided and inaccurate to use a single index to evaluate the impact of the epidemic on the economy, which should be combined with various indicators. The supply-demand balance between the total import and export volume, container throughput and the number of ships onboard is a dynamic change. After quantifying the correlation, we can quantitatively monitor the supply-demand balance of ships and the stability of the shipping industry. In terms of the impact on the total import and export volume, the comparison between the number of shipping ships and container throughput shows that the impact of container throughput on Residents' consumption is greater than the number of shipping ships, and the impact of crew employment level on the total import and export volume is more significant than the first two. This is because more than 90% of China's foreign trade import and export freight volume is completed by sea. No matter what kind of sea transportation mode, it is inseparable from the participation of crew members. During the epidemic, import and export procedures became strict, and more staff were needed at ports and terminals to cope with the increased epidemic control. In addition, the crew's workplace mobility is strong, increasing the probability of COVID-19 infection and an increase in the turnover rate of relevant posts. Advance the isolation period so that at least 14 days are counted into working hours. All the above increase the employment rate, resulting in a negative correlation between import and export volume and employment rate.

6. Conclusions

The novel coronavirus pneumonia COVID-19 has a negative effect on China's economy. But with the government's strong measures to prevent and control the epidemic, the domestic epidemic situation has been basically controlled. During the

post epidemic period, it will face the risk of shipping congestion. The phased impact of the epidemic on the shipping industry still needs the vigilance of the industry and the government, this section provides some efforts on the following that would limit impact and risk.

Prepare an anti-crisis strategy. At present, the world's top experts cannot predict when the epidemic will end, and the vaccine may not be put into use within the foreseeable period, therefore, the impact of the epidemic may not disappear immediately. Considering the panic of Europe and US in response to the epidemic, the effect of their anti-crisis measures has not been verified, and the worst impacts of COVID-19 on the economy and trade may not totally emerge at present. It recommends that shipping companies should implement operation strategies similar to anti-crisis 2008 and comply with the shipping cycle.

Develop automation and information technologies. COVID-19 has confirmed rapid human to human transfer, so in addition to reducing human contact, it is more effective to shut off the spread through automatic and semi-automatic technology. With the development of 5G communication technologies, semi-automatic bridge cranes and visual remote operation technology are easier to be popularized, and the Internet of things and other technologies will also make accurate positioning and real-time loading and unloading of goods possible. International trade includes customs declaration, consignment, storage, logistics and other links. Agency services mostly involve the manual submission of documents, which increase the risk of human-to-human transfer. Therefore, we recommend integrating trade, port, logistics, shipping, and other information platforms, realize online declaration and information sharing, and reduce the direct contact of personnel in all transportation links.

Push forward the high-level meetings of UN member countries discussing the joint fight against the epidemic. The epidemic is now a common threat to every country in the world, and no country can stay out of it. Shipping is the bridge connecting the world, and more than 80% of international trade in goods by volume is carried by ships. Therefore, it is an urgent agenda to push forward the high-level meetings of UN member countries to discuss the shipping connectedness. Due to the uncertainty of the development of the epidemic and the inconsistency of prevention and control measures, arranging seafarer shift or repatriation is still one of the biggest challenges facing the shipping industry. Seafarers should be officially designated as ‘key workers’ worldwide and exempted from Covid-19 travel restrictions. The government should strengthen education and training in ship operation safety, epidemic prevention and control, rights and interests’ protection and professional ethics, educate crew members to enhance epidemic prevention and control awareness, strengthen self-protection, and properly respond to emergencies such as epidemic infection. Complete vaccination as soon as possible to reduce the probability of infection among crew members.

It is a consensus that the world economy and global shipping have not really recovered from the 2008 crisis. Now they are struck by the COVID-19 epidemic again. The situation and prospects are worrying. In the coming future, the shipping industry, port, shipping company and seafarers would be impacted by the epidemic. It’s no doubt that the epidemic is now a common threat to every country in the world, and no country can stay out of it. We strongly recommend shipping companies to prepare an anti-crisis strategy, the shipping industry to develop automation and

information technologies, and the UN to push forward the high-level meetings of member countries discussing the joint fight against the epidemic.

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Analyzing the Effects of Foreign Direct Investment on Unemployment in Myanmar by using Bayesian Regression

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Abstract

The research of this study aims to find the impact of foreign direct investment on unemployment in Myanmar. This paper is used the variable that have been applied unemployment as dependent variable and the rest of the other variables are independent such as foreign direct investment (FDI), inflation rate (INFL), exchange rate (EXCH), gross domestic product growth rate (GDPG) and population size (POP). The period of the study was covered from 2000 to 2019 as annual data and also collected from World Bank. The study analyses by using Bayesian Regression with Markov Chain Monte Carlo (MCMC) method to denote and imply the empirical result. The purpose of the study has been taken to determine the influence of FDI on unemployment of Myanmar by two specific objectives which are; first of all, we would examine the impact of foreign direct investment on unemployment in Myanmar. Next objective is to contribute in the policy implication process towards foreign direct investment (FDI) and reducing unemployment according to upgrade with FDI. The main findings of the study indicate that FDI has reverse and significant effect on unemployment. The developing country likes Myanmar it can be said that foreign direct investment enhances the host country's economy alongside of increasing GDP.

Keyword: FDI, Unemployment, Bayesian
JEL Classification Codes: C11, E22, J21, O10

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1. Introduction

The fundamental reason for this research is that inflows of foreign direct investment (FDI) are often seen as an important catalyst for economic growth in the developing countries (Khun, 2018). According to finding by Balcerzak & Zurek in 2011, globalization and capital availability from international communities can be a great opportunity for developing countries. One of the reasons is that foreign capital can be advantageous to developing economies; in which, foreign direct investment (FDI) can be a useful source for advancing technological skill sets and knowledge sharing for the human resource development of the host countries. It can be said that FDI usually brings a good impact for the labour market because its inflows can decrease unemployment rate significantly (Balcerzak & Zurek, 2011). Since FDI is considered as a driving force for employment, technological advancement, increased productivity and most importantly economic growth, it is essential to establish a correlation or relationship between FDI and generating employment opportunities (Adeyemi, 2018).

In terms of many years' economic isolation, Myanmar is one of the least developed countries in Southeast Asia. The country economic situation primarily based on agricultural economy and it was previously known that Myanmar was on the top list of the leading export of rice in the world (ESCAP, 2012). As a natural resources rich country with extractive resource sectors such as natural gas, teak, jade, timber and mining. Myanmar is a major natural gas exporter in which natural gas sales alone contributes 60% of the country's total export earnings according to Blackpeak (2017). As a result, there has been a significant increase in foreign investment by the extractive resource sectors. Myanmar government data also indicate that total amount of foreign direct investment from 1988 to April 2017 reached $71 billion. Under its national economic development plan, the government aims to attract $140 billion of FDI by 2030. It is also stated that FDI in Myanmar rose by 45 percent to $4.3 billion which is the third consecutive year of increase according to ASEAN Investment Report 2018. Then, the rise has been contributed by the significant increased investment in extractive industries and manufacturing activities. It is important to figure out which sectors have been benefiting from FDI inflows on the perspective of creating jobs. While analyzing the labor market (WB, 2017), about 70 percent of the rural labor force, or 53 percent of the total labor force, is employed in the agriculture, forestry and fishing sectors. As the result of being in a pre-transition phase of agricultural development, many of those employed in rural trade and manufacturing sectors are likely to be mainly involved in primary processing and in the trade of agricultural products. On the other hand, Myanmar's unemployment rate was stable at around 0.78 from 2010 to 2015. After that from 2016, its unemployment rate is rising to 1.58% in 2019. Therefore, investigating the level of labor of participating in different sectors has become important so that we can understand the actual impact of FDI upon reduction of unemployment rate.

In 2006, Oni claimed that the increased level of the country's economy will probably rely on the level of reduced unemployment rate; consequently, it will reduce the level of poverty. Among many other macroeconomic variables, the objective to increase employment level is important in many developing countries for which unemployment can lead to a rate of poverty to be increased (Adeyemi, 2018). For the study period of the paper from 2000 to 2019, Myanmar was in a transitional period and have been facing many challenges and opening to opportunities in terms of strategies for economic

development including strategies for attracting for foreign investments and creating job opportunities. Although it has acquired opportunities and been facing many challenges, it can be seen with many sectoral developments because it is a developing country. To increase the country's GDP, its unemployment numbers have to be reduced by ensuring better accessibility of job opportunities to all working-age groups.

According to Soylu, the most important priorities of not only developed but also developing countries' economies is minimizing unemployment and achieving a high rate of economic growth in which employment and economic growth are two important macroeconomic variables in terms of a country's success indicator in economy. The unemployment rate is also one of the key macroeconomic variables. After the discovery of a relationship between unemployment and growth by Arthur Okun in 1962 (Foxman, 2012), it can be said that employment levels and GDP are correlated and creating job opportunities should be considered for economic growth as well. Moreover, they can be considered as essential elements of economic policies of many countries especially in developed countries (Soylu, 2017). On the other hand, resources have been mentioned in the highlight of most Neoclassical theories and models to drive economic growth. Increases in income per capita and in gross domestic product (GDP) per capita were in good consideration to indicate decent results by early scholars (Malizia, 1990).

Therefore, understanding the relations between foreign direct investment and unemployment is very important regarding the economic growth and the prosperity of the country. Although the employment rate in the country plays an important role in terms of economic growth with a consideration to foreign direct investment inflows, little research has been done on analyzing the effects of Foreign Direct Investment on Unemployment in Myanmar. The limited research on developing countries with respected to unemployment in terms of analyzing the impact of foreign direct investment highlighted the need to conduct this research paper. The findings from the research paper can be supportive to policy implication processes towards foreign direct investment in the country.

2. Methodology

In this study, Bayesian Regression will be used as an essential method to analyze and contribute to the empirical result. In order to provide the feasibility and accuracy, result is utilized to choose the selected research approach which is a step to offer the consistent and proved result. For that reason, Bayesian Regression is exercised as a tool to support the precise result in this research paper. Additionally, according to the limited data, we employed Bayesian Regression which is a useful and suitable estimator to find the probability distributions. Furthermore, this method found to be growing in popularity and accessibility in the academic work as more empirical studies are practicing Bayesian approach. In this research work, the unemployment rate of Myanmar is composed to be the dependent variable whilst the five main variables are set to be the control variables to analyze the effects of foreign direct investment on unemployment in Myanmar. The annual data from the period 2000 to 2019 were collected from databank of the World Bank and analyzed by Bayesian Regression model with using R software.

This could be written below:

$$UNEMP = f(FDI, INFL, EXCH, GDPG, POP) \quad (1)$$

where,

UNEMP is the unemployment rate of Myanmar (%)
FDI is the net inflows of FDI into Myanmar (In Billion USD)
INFL is Myanmar inflation rate (Consumer Price Index)
EXCH is the exchange rate of Myanmar (US Dollar)
GDPG is Myanmar GDP growth rate (%)
POP is the population size of Myanmar (Total)

Hence, the regression model of this equation could be written in the form

$$UNEMP_t = \beta_0 + \beta_1 FDI_t + \beta_2 INFL_t + \beta_3 EXCH_t + \beta_4 GDPG_t + \beta_5 POP_t + \varepsilon_t \quad (2)$$

In the Bayesian point of view, linear regression is formulated by using probability distributions. The response, $\mathcal{Y}$, is not estimated as a single value, but it is assumed to be drawn from a probability distribution. The model for Bayesian Linear Regression, with the responses sampled from a normal distribution is described by:

$$\mathcal{Y} \sim \mathcal{N}(\beta^T X, \sigma^2 I) \quad (3)$$

A normal distribution characterized by a mean and variance is to generate the output $\mathcal{Y}$. The mean for linear regression is the transpose of the weight matrix multiplied by the predictor matrix. The variance is the square of the standard deviation σ, multiplied by the identity matrix. Bayesian Linear Regression is used with the purpose of determining the posterior distribution for the model parameters; not to observe the model parameters' single "best" value. So, two main benefits of Bayesian Linear Regression can be found; firstly, a guess for what the model parameters should be from the domain knowledge can be included in the model known as Priors and secondly, Posterior which allows uncertainty about the model. In order to choose Bayesian model, it is required to consider about proper prior distribution on regression coefficients so that it can connect Normal-Gammas which lead to closed from expression for marginal likelihoods, in which Zellener's g-prior is one of the most popular. For the prior distributions of regression coefficients, most work in this area utilizes g-priors proposed in Zellener (1986). Zeller's g-prior is defined as

$$\beta|g, \sigma^2 \sim N(0, g\,(X^T X)^{-1}\sigma^2) \quad (4)$$

where g is an unknown scalar parameter to be specified.

This Bayesian model was proposed by Thomas Bayes, who developed a specific case of Bayes' theorem in his paper published in 1763. In several papers spanning from the late 1700s to the early 1800s, Pierre-Simon Laplace expressed the Bayesian interpretation of probability.

3. Result

The analysis showed the simulation with MCMC by Bayesian Regression. All the way we get through conditional posterior distributions from every single variable and variance, we employ Gibbs sampling as a determining too to use sampling for all those distributions. To observe each chain by MCMC diagnostics simulation with 100,000 iterations and 50,000 as burn-in for running only one single with very long iteration. What is more, it will include MCMC summary output which presents the description of each variable and variance in terms of Posterior Mean, Standard Deviations, Naïve Standard Error and Time-series Standard Error. Moreover, the quantiles of interest output reveal the values of all parameters and variance which takes the certain quantiles 2.5%, 25%, 50%, 75% and 97.5% as in 95% as confidence interval. This study will also examine diagnostic tests such Geweke Diagnostic Test, Raftery and Lewis Test, Cross-correlation Test and Autocorrelation Test.

According to Table 1, it illustrates the MCMC output which is mentioned Mean and Standard Error. In the table, the foreign direct investment (FDI) has negative relationship with unemployment. The result of the analysis is showing that inflation rate (INFL) and exchange rate (EXCH) were shown the positive impact on unemployment regardless of gross domestic product growth rate (GDPG) and population size (POP) which are reverse correlation with unemployment in Myanmar.

Table 1: MCMC Output (Mean and Standard Error)

Description series	Mean	Standard Deviation	Naïve SE	Time-SE
Intercept	1.701	3.396	1.074	1.066
FDI	-9.556	6.995	2.212	0.000
INFL	5.676	3.708	1.172	1.172
EXCH	4.438	1.763	5.576	5.543
GDPG	-2.866	3.463	1.095	1.095
POP	-1.187	6.421	2.030	2.014
Sigma2	4.505	2.022	6.395	9.056

Source: Author's calculation (R program)

Note: FDI = Foreign Direct Investment, INFL = Inflation rate, EXCH = Exchange rate, GDPG = Gross Domestic Product growth rate, POP = Population size

Table 2 presents the quantiles of interest of each parameter and variance. The results of the Table 1 show that FDI has a negative correlation with unemployment in Myanmar together with mean (-9.556) and standard error (2.212). In addition to Table 2, for the first quantile, it displays that FDI take into account negative with (-2.34) and followed by negative value (-1.822), (-9.592) and (-5.078) for 25%, 50% and 75% correspondingly. Amongst the quantiles, it is the most interesting result that emerged from the last quantile 97.5% indicates that there is a positive with (4.350) while the rest

quantiles are negative. It can be said that one unit increase (decrease) in FDI inflow causes unemployment increase (decrease) with -9.556 unit as the value of the mean.

Table 2: MCMC Output: (Quantiles for each variable)

Description	2.5%	25%	50%	75%	97.5%
Intercept	-5.041	-4.069	1.693	3.809	8.414
FDI	-2.341	-1.404	-9.592	-5.078	4.350
INFL	-6.761	-1.822	5.594	2.942	7.932
EXCH	9.472	3.308	4.440	5.571	7.935
GDPG	-9.795	-5.067	-2.862	-6.397	3.993
POP	-1.385	-5.312	-1.157	2.927	1.158
Sigma2	2.068	3.158	4.052	5.324	9.616

Source: Author's calculation (R program)

Note: FDI = Foreign Direct Investment, INFL = Inflation rate, EXCH = Exchange rate, GDPG = Gross Domestic Product growth rate, POP = Population size

Based on the fact that the inflation rate (INFL) has a positive impact on unemployment on Myanmar mean with (5.676) and standard error (1.172). Furthermore, as stated in Table 2, it shows that INFL has adverse sign for the first and second quantile (-6.761) and (-1.822) together with finish as being positive value (5.594), (2.942), and (7.329) for 50%, 75% as well as 97.5% reciprocally. This mean that one unit increase (decrease) in inflation rate causes unemployment increase (decrease) with 5.676 units as the value of mean. It can be said that inflation rate performs a positive indicator that influence the unemployment in Myanmar. This finding is the complete opposite of the Philips curve which states that inflation and unemployment have a stable and inverse relationship; if the economy is growing, this is obvious to see that inflation increases and more jobs are created, in other words, it means less unemployment.

For exchange rate, it is demonstrated that it has positive correlation with unemployment in Myanmar. As stated in Table 1, it presents the mean of EXCH (4.438) and standard error (5.576). In addition, according to Table 2, it can be crystal clear seen that there is a positive sign for every single quantile for 2.5%, 25%, 50%, 75% and 97.5% with (9.472), (3.308), (4.440), (5.571) as well as (7.935) respectively. Volatile exchange rates may also increase unemployment through lowering investment in physical capital (Belke and Gros, 2001).

3.1 Mackov Chain Diagnostic Test Result

3.1.1 Geweke Diagnostic Test

The Geweeke (1992) test is based on a test for equality of the means of the sampled values of the first window and the last part of the window. According to Table 3, it stated that Z-score does not produce in high value. Hence, very low the p-value most for all parameters are not happened in this test.

Table 3: Geweke Diagnostic Test
Fraction in 1st window = 0.1
Fraction in 2nd window = 0.5

Intercept	FDI	INFL	EXCH	GDPG	POP	Singma2
2.2282	-Inf	0.7244	-1.0908	-4.1339	-1.8706	0.3167

Source: Autor's calculation (R program)
Note: FDI = Foreign Direct Investment, INFL = Inflation rate, EXCH = Exchange rate, GDPG = Gross Domestic Product growth rate, POP = Population size

3.1.2 Raftery and Lewis Diagnostic Test

For Raftery and Lewis Diagnostic Test illustrates the number that needed to be run and discarded (burn-in) and the dependence factor which is used to report the convergence in the chain. For the result in Table 4 below in particular sample size requirement are sought to ensure the posterior estimates of the 0.025 tail probabilities *(q)* with accuracy +/- 0.005 I *(r)* and the probability 0.95 *(s)*. All of these variables have the same lower bound (3746) which is the number of independent sampled values that needed to estimate the posterior within the specified degree of accuracy and probability.

Table 4: Raftery and Lewis Diagnostic Test
Quantile (q) = 0.025
Accuracy (r) = +/- 0.005
Probability (s) = 0.95

Description (I)	**Burn-in (M)**	**Total (N)**	**Lower bound (N min)**	**Dependence factor**
Intercept	2	3910	3746	1.04
FDI	2	3887	3746	1.04
INFL	2	3900	3746	1.04
EXCH	2	3906	3746	1.04
GDPG	2	3878	3746	1.04
POP	2	3903	3746	1.04
Sigma2	3	4071	3746	1.09

Source: Author's calculation (R program)
Note: FDI = Foreign Direct Investment, INFL = Inflation rate, EXCH = Exchange rate, GDPG = Gross Domestic Product growth rate, POP = Population size

3.1.3 Autocorrelation and Cross-Correlation

Found on the Table 5, the autocorrelation in the midst of variables and variance do not state high values in the chain. The values decreased as the number of lags are added. Similarly, Table 6, which illustrates cross-correlation also do not show any evidence of high correction. Consequently, there is no evidence in non-convergence in the chain.

Table 5: Autocorrelation result

Lag	Intercept	FDI	INFL	EXCH	GDPG	POP	Sigma2
0	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1	-0.007	-0.002	0.001	-0.005	0.003	-0.007	0.334
5	0.002	-0.000	-0.004	-0.002	0.002	0.001	0.003
10	-0.001	-0.001	0.004	0.001	-0.006	-0.000	0.001
50	-0.002	0.008	-0.003	-0.004	-0.000	-0.002	-0.001

Source: Autor's Calculation (R program)

Note: FDI = Foreign Direct Investment, INFL = Inflation rate, EXCH = Exchange rate, GDPG = Gross Domestic Product growth rate, POP = Population size

Table 6: Cross-Correlation result

Description	Intercept	FDI	INFL	EXCH	GDPG	POP	Sigma2
Intercept	1.000	0.082	-0.190	0.541	-0.644	-0.994	0.003
FDI	0.082	1.000	0.112	-0.188	0.309	-0.145	0.004
INFL	-0.190	0.112	1.000	-0.063	0.028	0.178	0.006
EXCH	0.541	-0.188	-0.063	1.000	-0.016	-0.584	-0.003
GDPG	-0.644	0.309	0.028	-0.016	1.000	0.562	-0.003
POP	-0.994	-0.145	0.178	-0.584	0.562	1.000	-0.003
Sigma2	0.003	0.016	0.000	-0.003	-0.003	-0.003	1.000

Source: Autor's Calculation (R program)

Note: FDI = Foreign Direct Investment, INFL = Inflation rate, EXCH = Exchange rate, GDPG = Gross Domestic Product growth rate, POP = Population size

3.2 Markov Chain Monte Carlo Plot Results

3.2.1 Kernel Density

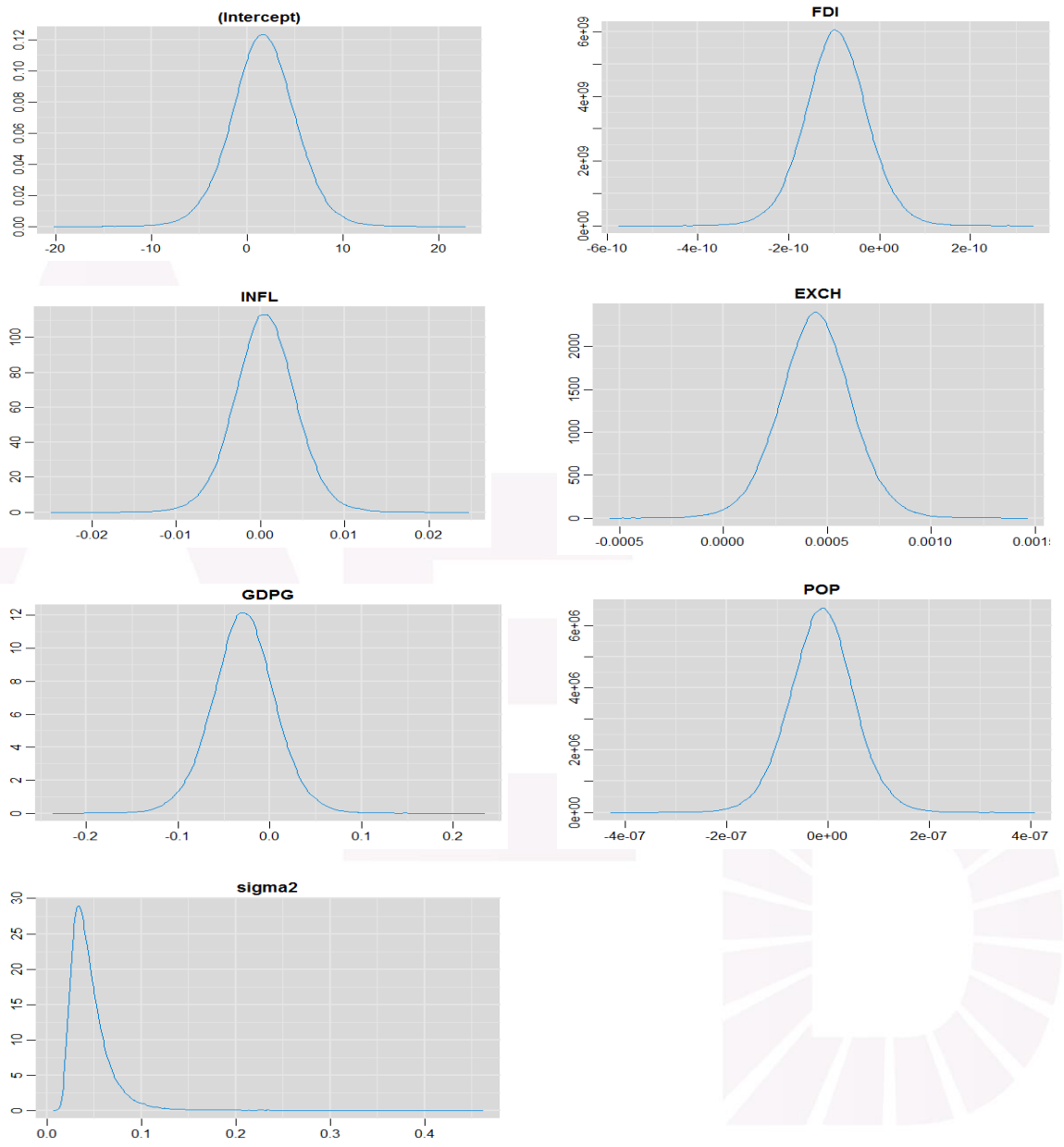

Figure 1: Kernel Density Plot
Source: Autor's Calculation (R program)
Note: Plot result

3.2.2 Trace Plot Result

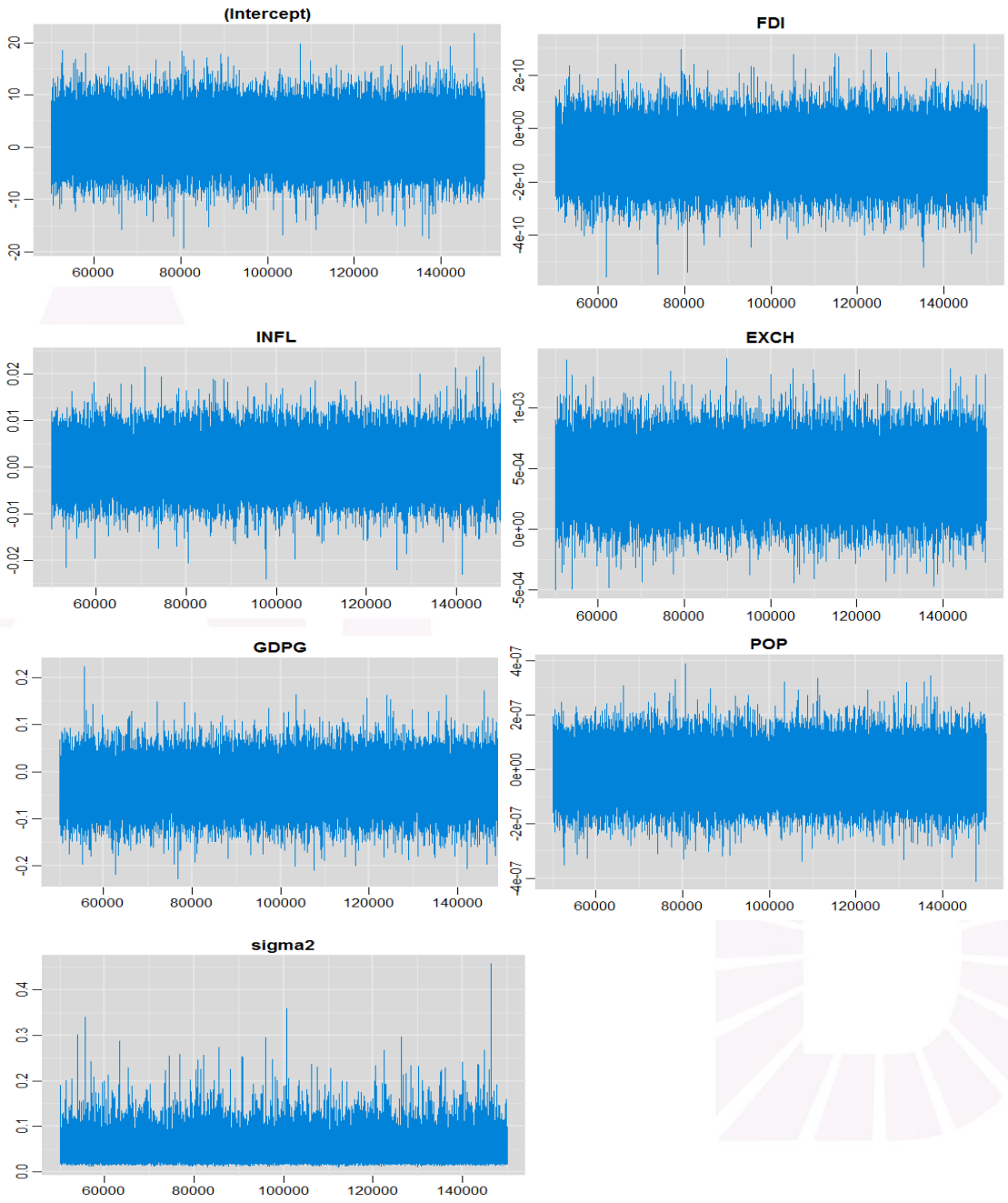

Figure 2: Trace Plot
Source: Autor's Calculation (R program)
Note: Plot result

3.2.3 Running Mean Plot Result

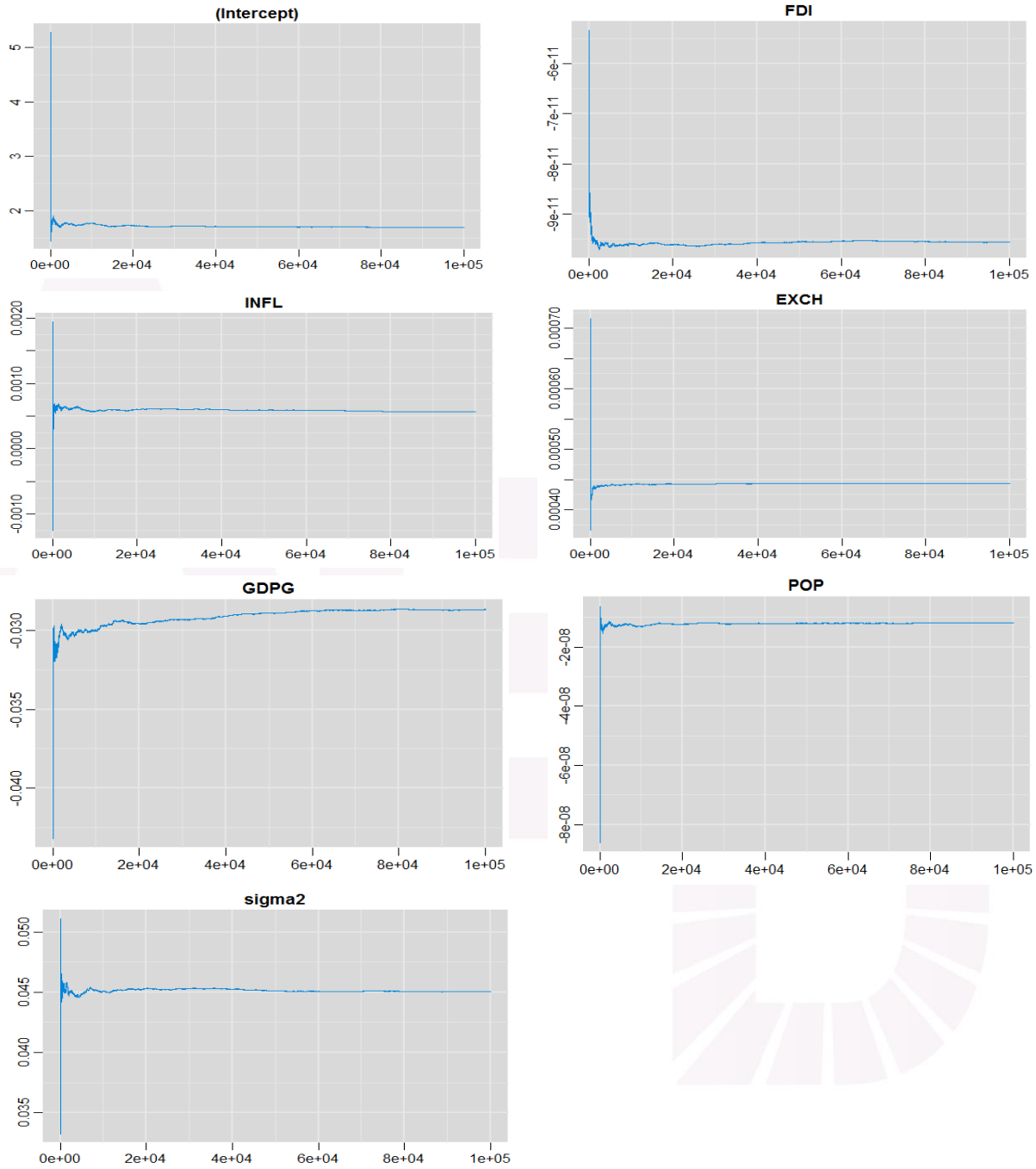

Figure 3: Running Mean Plot
Source: Autor's Calculation (R program)
Note: Plot result

3.2.4 Autocorrelation Plot Result

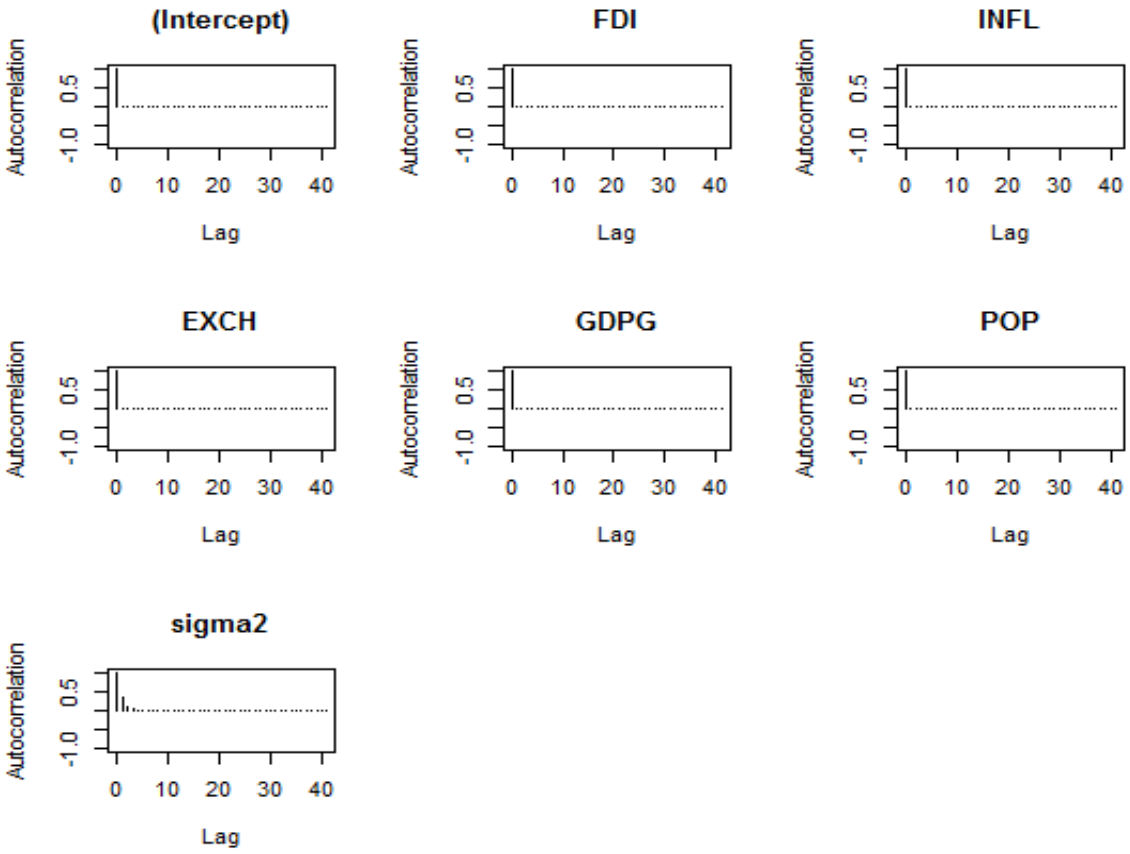

Figure 4: Autocorrelation Plot
Source: Autor's Calculation (R program)
Note: Plot result

4. Discussion

The empirical results display that FDI has a negative correlation with unemployment in Myanmar together with mean (-9.556) and standard error (2.212). It can be said that one unit increase (decrease) in FDI inflow causes unemployment increase (decrease) with -9.556 unit as the value of the mean. According to Balcerzak & Zurek (2011), FDI usually brings a good impact for the labour market because its inflows can decrease unemployment rate significantly. The variable inflation rate that has been found to have positive correlation with unemployment in Myanmar mean with (5.676) and standard error (1.172). It can be said that inflation rate performs a positive indicator that influence the unemployment in Myanmar. Ademola & Badiru (2016) stated that there has been a positive relationship with inflation and unemployment. Besides, they also mentioned that in developing countries, unemployment and inflations has become major concerns as these indicators are important in macroeconomics and they are also factors for economic growth and development.

The result also illustrated that the exchange rate is statistically revealed to have positive correlation with unemployment. This finding robustly supports those previous many papers studied by Chimnani and Bhutto (2006) and (Atya, 2017) which figure out that exchange rate has significantly positive correlation on unemployment. On the other hand, many previous studies, (Bakhshi, 2016) and (Geerolf, 2020) found out that there is a negative relationship between exchange rate and unemployment. Based on the fact that increase or decrease of exchange rate has some effects on unemployment. For the variable GDP growth rate has verified negative relationship with unemployment in Myanmar with mean (3.463) and standard error (1.095). MCMC output shows that population has been negative relationship with unemployment. According to Table 4.1, it mentions that the mean of population POP (-1.187) and standard error (2.03). As we can see in Raftery and Lewis Test result, all of these variables have the same lower bound (3746) which is the number of independent sampled values that needed to estimate the posterior within the specified degree of accuracy and probability.

5. Conclusion and Recommendation

The study of the paper examines that analyzing the effects of foreign direct investment on unemployment in Myanmar. This study exerts time-series data with 20 years from 2000 to 2019. As a dependent variable, we used unemployment whilst FDI, Inflation rate, Exchange rate, GDP growth rate and Population rate are applied to be independent variables in this study. Bayesian Regression is employed as an essential tool with MCMC methods to estimate posterior distributions. In order to stimulate from a Markov Chain (MCMC), as a particular popular algorithm, Gibbs sampling is applied to indicate for all conditional posterior distributions. More than that Markov Chain diagnostic tests are measured in the study such as Geweke test, Raftery and Lewis test, Correlation and Cross-correlation test that considerable test to assure the convergence in the chain. Additionally, MCMC also demonstrates many effective plots such as Kernel density plot, trace plot, running mean plot and autocorrelation plot to visualize the index of the convergence and stationary in the chain in this study.

The result of the study represents that the foreign direct investment (FDI) as one of the explicit variables is the negative impact on unemployment in Myanmar and it is not statistically significant in Myanmar. It means that unemployment is more influenced by other factors. In this study, the inflation rate (INFL) and exchange rate (EXCH) have been revealed that there is positive relationship with unemployment. In spite of other two variables named gross domestic product growth rate (GDPG) and population size (POP) are the reverse correlation with unemployment in Myanmar. There was no statistically significant relationship between unemployment and other variables in this study. However, this study has limited accessible data so many variables can be analyzed in further study. In addition, the period of the study was not examined during Covid-19 pandemic in this research so unemployment rate could have effects by other factors.

For the policy recommendation, two main sectors have been involved in the recommendations namely enabling environment for FDIs and preparation for human capitals. While creating workable conditions and situations for FDIs, focus points are mentioned in this recommendation's session. First of all, in order to share maximized

benefits with the society, both policy making and policy implication are important to nurture an enabling environment for FDIs (OECD, 2020). Moreover, it is required to have policies and regulation which can guarantee safe and reliable situations with less complicated procedures for the establishment of investments and to attract investors. For the specific sectoral recommendations, development of infrastructures particularly in transport sector should be in consideration to reduce costs (ADB, 2016) and the Central Bank should ensure the inflation and exchange rate to stabilize the economy. In addition to the above four recommendations, political stability is also critical for the FDI flow and growth of the economy. For the preparation of human capitals for employability and human resources for future investments, two main areas have been recommended. First of all, the government should invest more on human resources for job readiness skills. Finally, developing government's strategy and improving expenditure on education sector is also important to train young people to have practical skills for employment and have internship opportunities.

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Determinants of Tourists' Expenditure on Tea Souvenirs: An Empirical Evidence from the Tea Tourism in Thailand

Xiaohui Fu[1] Pairach Piboonrungroj[2] Warattaya Chinnakam[3] Chukiat Chaiboonsri[4] and Bing Yang[5]

Abstract

Tea tourism as an emerging niche market has become more and more widespread, with the improvement of people's health consciousness. Through a study in Thailand, this study aims at identifying the factors influencing tourists' expenditure on tea souvenirs. Four hundred eleven questionnaires were administered; Tobit model were adopted on based on tourists of tea tourism. The results show that tea tourists and non-tea tourists have significant distinctions in terms of their expenditure of buying tea as souvenir. Tea tourists are mainly those think that drinking tea is a healthy lifestyle; they tend to both males and females (yet female account a significant higher proportion than males), over 60 years old, who have tea tourism experience. This research also gives some marketing suggestions for this ecological market.

Keyword: Tea tourism, tourists' expenditure, souvenirs

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1. Introduction

1.1 Role of tea in the global economy

Tea is the second most-consumed beverage in the world after water (World tea news, 2018). It is consumed by a range of age groups in all levels of society Worldwide there are approximately 25,000 cups of tea consumed every second or 2.16 billion cups per day. (Global Dubai Tea Forum 2018) Global tea consumption will create new rural income opportunities and improve food security in tea-producing countries, according to a new report released by Food and Agriculture organization of the United Nations. The tea industry makes a vital contribution to the economy of the producing countries. Tea is utilized not only as beverage, but also has collection value, suche as the Pu'er tea in China. The most expensive Pu'er tea is worth as much as 1,035 RMB. Tea has been recognized as one of the top beverages in terms of economic value.

With the gradual development of the tourism sector, people willing to engage in new tourism experiences as a niche tourism emerged as a new concept (Fernando, 2015; Fernando 2014). The niche tourism market refers to the market where a specific tourism product can be personalized to meet the needs of a particular tourist segment for example the tea tourism has been identified as one niche Tourism segment emerged. Tourism noticeably has the potential to enhance the brand image and marketing of tea-producing destinations. Contemporary tourists seek out authentic and unique experiences related to the appreciation and consumption of the beverage. Tourism related to tea encourages both consumption and the development of relationships with potential customers as not harming the tea estates but providing double income (Fernando et al.,2016). China's tea industry is the largest in the world and has dominated the global tea industry for centuries since China introduced tea to the world.

With more than 2.87 million hectares of land devoted to tea cultivation, China is the world's largest tea producer. In 2019, China produced more than 2.77 million tons of tea, accounting for 40 percent of the world's total tea cultivation. China exported 381,000 tons of tea in 2019, accounting for more than 21 percent of the total global tea supply in that year, according to the International Trade Center. Tea is also important in economic employment in China, where more than 80 million people work as tea growers, workers or salespeople

Ministry of Tourism and Sports of Thailand (2012) examined the information relating to the souvenir business and found that in 2014, the allowance in this business was 1.26 million baht, and it is increased to 1.38 million baht in 2015. Overall, the economic expansion was accounted for 9.6%. Because of the increasing number of tourists, a high growth led to souvenir business. Department of Tourism (2014) reported that the domestic tourists spent for souvenir shopping 14.05% and the foreign tourists spent souvenir 16.05%. According to Collins-Kreiner and Zins (2011), souvenirs helped keep the memories from travelling and completed travelling experiences. Because each souvenir has its own local and cultural characteristics, it can help satisfy the tourists (Swanson & Timothy, 2012).

Nowadays, tourism began to interest in preservation tourism both with emotional to preserve and conserve the environment (Chantamart and Thabhiranrak, 2018). Various modes of tourism are welcomed in the world, like farm stay, coffee tourism, safari tourism, medical tourism, gastronomic tourism. And tea tourism now is applied in many countries such as India, Sri Lanka, Japan, China. Tea-related tourism has parallels with food-related tourism such as wine tourism, which has been

investigated by many researchers (Brown, Havitz & Getz, 2007; Demhardt, 2003; Williams & Dossa 2003). As pointed out by Jolliffe (2007). Worldwide, tea-related tourism develops well in many countries such as Thailand and Sri Lanka (Jolliffe, 2003; '"Tea Tourism' Project,"
2005; United Nations World Tourism Organization [UNWTO], 2005).

Tea tourism in India

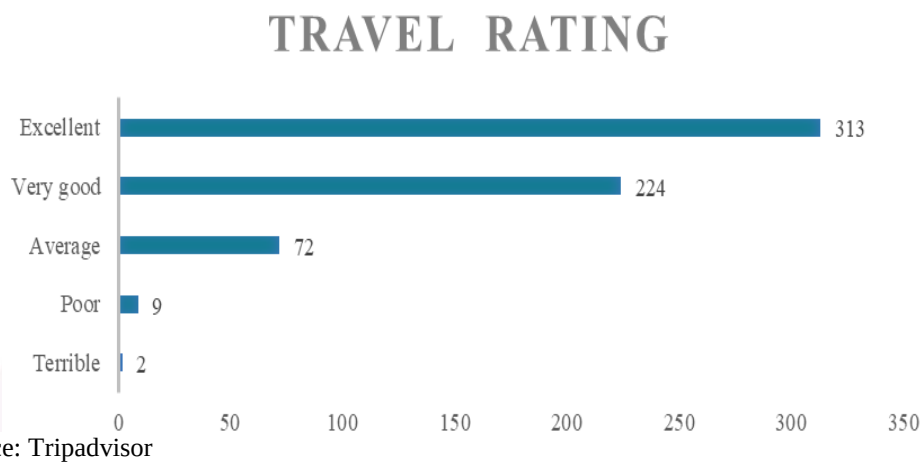
India is a country of tea-producing, exporting, and consuming in the world. The well-known two brands black tea of "Darjeeling" and "Assam" belong to India. It grows in the Darjeeling district, Kalimpong District in West Bengal. There are 80 odd operational tea gardens in this area that span across thousands of acres of land area on open hill slopes. High on the hills with a cool breeze and misty weather, planters and workers come together to form a wonderland where tea grows in the finest form like nowhere else in the world. There are bungalows, the tourists can stay and enjoy fresh organic food from the backyard garden. When tourists wake up, they can sip a cup of the finest aromatic tea that was plucked fresh from the gardens.

Tourists also have the opportunity to see how to garden workers deftly pluck the two leaves with a bud and learn about their lives. Tourists also have access to have a look and learn about tea processing in the factory where some of the best tea in the world are withered, rolled, dried, sorted, and packaged.

Tea tourism in China

Now tea tourism is also popular in China. Tea is originated in China. The famous tea of Pu'er, West Lake Longjing, etc. comes from China. So, tea tourism is more mature than in Thailand. China' s tea culture can date back to the Han Wei, Jin and southern, and northern dynasties. And now tea tourism is applied in Zhejiang, Yunnan, Fujian etc. Tea Culture Festival is held in those above areas to attract tourists, including selling the best quality tea, tea tourism experiencing activities, frying tea competition.

Though tea history in Thailand has a short history, tea in Thailand is also popular, especially "Cha yen". And the most important factor is that the growth in health consciousness among Thailand's domestic consumers. Some famous ready-to-drink in Thailand, such as Ichitan, Oishi have a rapid development, Thailand's RTD tea sector witnessed an annual growth of 18.7 percent, and total RTD tea production exceeded 497 million liters. In 2019, tea plants in Thailand reached 69.11mkg. The main tea plantations are in the north of Thailand, because of the mountainous landscape and cooler climate. Other than Chiang Mai, the neighboring cities Chiang Rai and Mae Hong Son have their tea plantations, including the winning tea at World Tea Festival. There is some famous tea plantation offer good quality tea leaves. The first one is Doi Mae Salong 101 Tea Plantation in Chiang Rai; it was the first Thai tea plantation to grow oolong tea. The second one is also in Chiang Rai, called Choui Fong Tea Plantation, a vast array of tea brands such as Oishi, Ichitan, Lipton, Unif and Malee at 7-Eleven or supermarkets in Thailand, their tea leaves all come from this tea plantation. The third one is Singha Park (Boon Rawd Farm), this place is the manufacturer of the famed Singha Beer, you also can find fruit orchards, vegetable farms, flower fields, and family attractions here. And lots of events are held here, like music festivals, cycling events as well as Singha Park International Balloon Fiesta



Source: Tripadvisor

Figure 1: Comments from tripadvisor

These are reviews of Doi Mae Salong 101 tea plantation on Tripadvisor. It shows that 87% of travelers think tea tourism is very good/excellent, only 9 tourists think it is poor and 2 people gave terribly. The majority of tourists can accept this new mode of tourism but still needs to be improved. (Tripadvisor)

Source: Statista

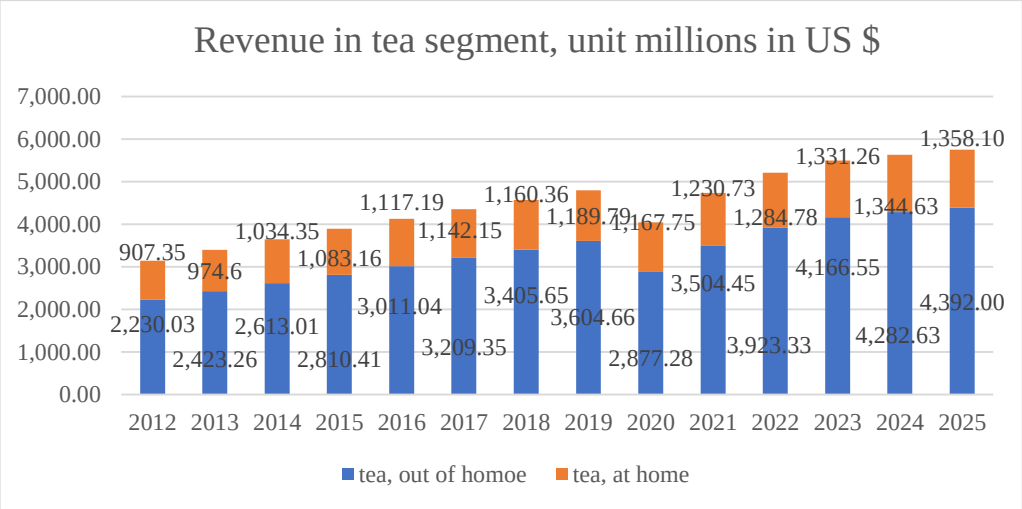
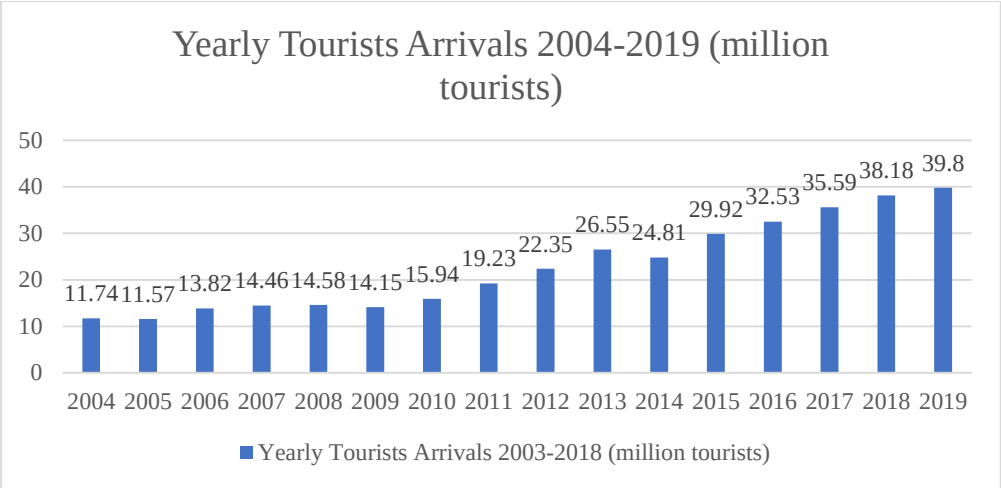


Figure 2: Revenue in the Tea segment amounts from 2010 to 2020 in Thailand

The chart above shows that both tea segment revenue 2413.9 at home and out of home are increasing year by year, from 2,413.9 million dollars to 5,523.1 million dollars. If this huge market is developed, it will create a great economic effect.

According to figure 3, the tourism industry plays an essential role in Thailand's economy. The National Economic and Social Development Council stated that from February 2019, tourism accounted for 18.4 % of the GDP of Thailand. It has risen from a level in 14.2 % of GDP just four years earlier. From the chart, we can see that the tourist arrival is increasing year by year. If Thailand can make full use of this trend, which can promote travel and tourism to be diversified, and then stimulate the related tea industry.



Source: Ministry of Tourism and Sports of Thailand

Figure 3: Yearly Tourists Arrivals 2004-2019 (million tourists)

Top countries in International Tourism Receipts				
Countries			US Dollars	Last	5-years CAGR
1		**United States**	264,576,771,524.82	2019	+2.3%
2		**Spain**	81,368,231,322.91	2019	+2.6%
3		**France**	72,889,635,550.68	2019	+ 1.6%
4		**Thailand**	66,156,342,273.97	2019	+11.5%
5		**Germany**	60,254,410,077.19	2019	+0.5%

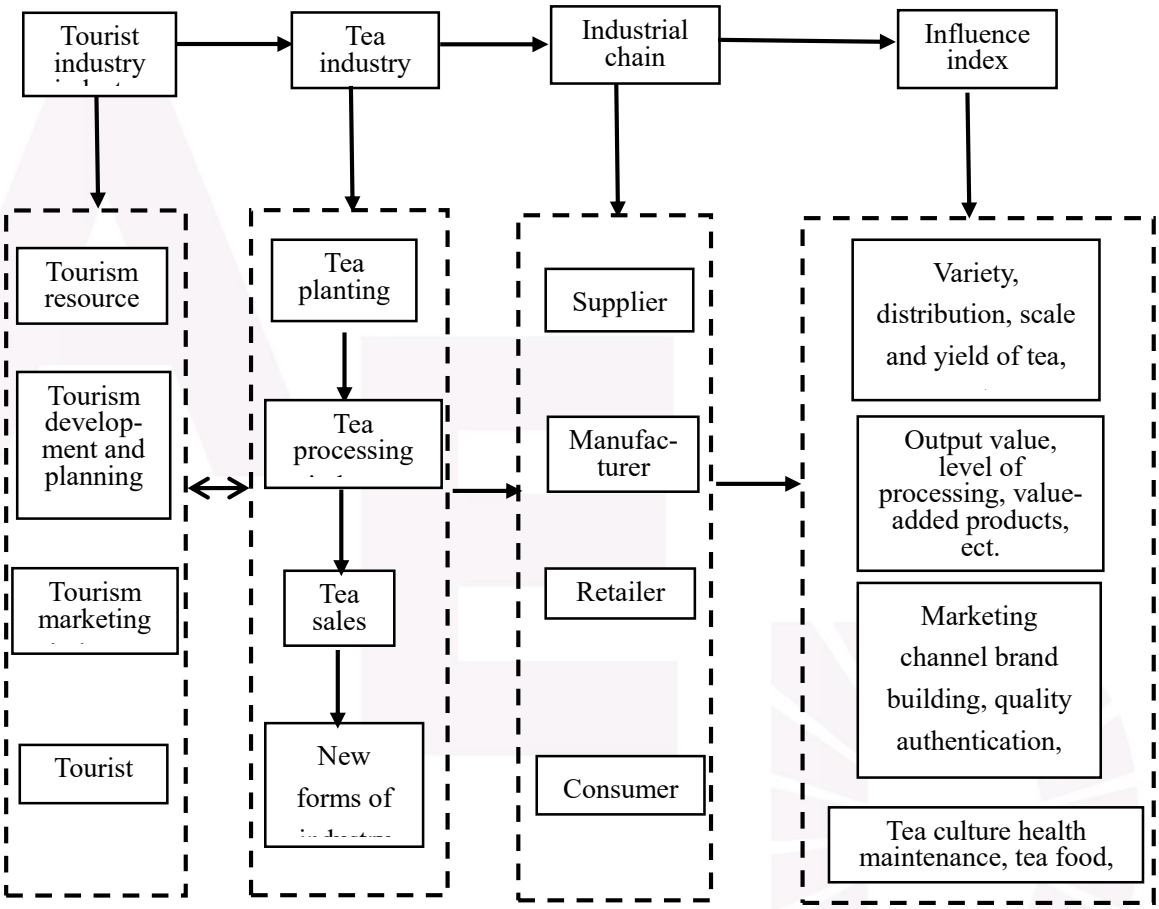
Source: Nation Master

Figure 4: Top countries in international tourism receipts in the world in 2019

According to figure 4, we can see that Thailand ranked 4th in 2019, which has huge potential and absolute advantages in the tourism and travel market, and it will increase in the next year. It is possible for Thailand to take advantage of this trend to upgrade in the multiple modes of tourism to earn more money and create job opportunities.

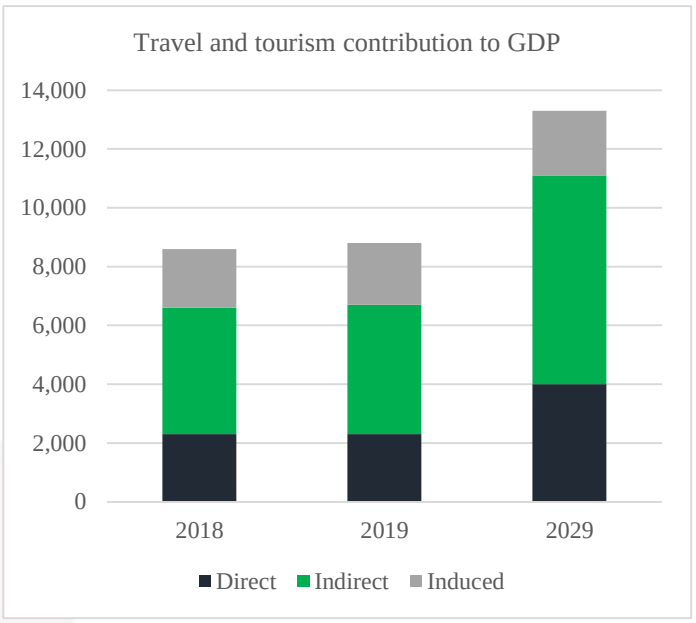
Apart from that, we can see from figure 5, developing tea tourism will bring certain influence on tea-related industry from the perspective of industrial chain and industry integration, and then develop the local economy. In fig.6 and fig.7, both total contribution and percentage of travel and tourism to GDP is rising. It shows that tourism and travel industry have a significant impact on the economy. From figure 9, we can see that international spending in Thailand is top 1, which leisure spend accounted for 90.6%, ranked third. Therefore, it is possible to promote tea-culture tourism in Chiang Mai.

Tourists consumption is an activity or tourism product. Tourists consumption in Thailand was an important activity for inbound tourists in 2018. It is presented by the Tourism Authority of Thailand (TAT) as a record; the average expenditure per person of inbound tourists for accommodation 30%, followed by shopping 25%, Food and drinks 21%, transportation 10%, sightseeing fee 4%. (see table 1).



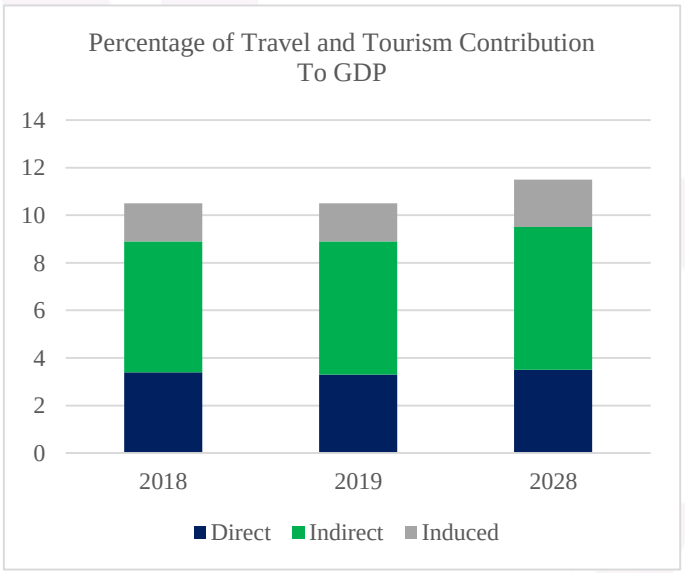
Source: Made by author

Figure 5: Tea tourism impact analysis



Source: world travel and tourism council

Figure 6: Travel and tourism contribution GDP



Source: world travel and tourism council

Figure 7: Percentage of travel and tourism contribution GDP

Table 1: Money spent per day category (2018)

Source: Ministry of Tourism and Sports, Thailand

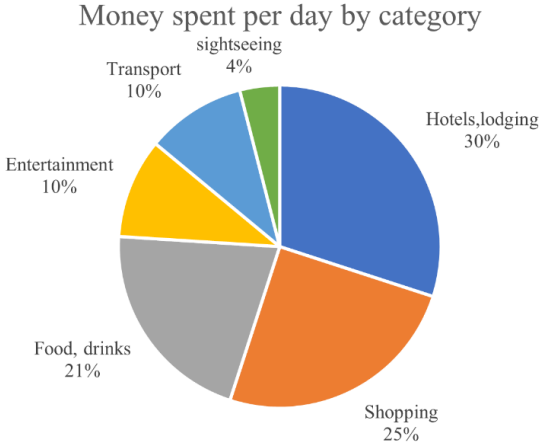


Table 2: Travel and tourism contribution to GDP

	2018 T&T GDP growth (%)	Domestic spend, % share of total, 2018	International spend, % share of total, 2018	Leisure spend, % share of total, 2018	Business spend, % share of total,2018
1 United States	2.2	81.2	18.8	71.3	28.7
2 China	7.3	85.8	14.2	81.4	18.6
3 Japan	3.6	82.5	17.5	68.5	31.5
4 Germany	1.2	85.2	14.8	83.1	16.9
5 United Kingdom	1.0	84.4	15.6	65.9	34.1
6 Italy	3.2	76.2	23.8	79.1	20.9
7 France	4.1	65.7	34.3	80.5	19.5
8 India	6.7	87.2	12.8	94.8	5.2
9 Spain	2.4	44.8	55.2	88.5	11.5
10 Mexico	2.4	85.2	14.8	94.1	5.9
11 Australia	3.2	76.1	23.9	84.4	15.6
12 Brazil	3.1	93.8	6.2	87.9	12.1
13 Canada	2.9	76.3	23.7	63.7	36.3
14 Thailand	6.0	19.8	80.2	90.6	9.4
15 Turkey	15.0	38.6	61.4	87.4	12.6

Source: world travel and tourism council

1.2 Tea tourism in Thailand

1.2.1 Doi Pu Muen

Doi Pu Muen is a new eco-style tourist attraction, where focuses on local Lahu traditions and culture. A village located in the Pa Hom Pok mountain range in Mae Ai. Doi Pu Muen sits at the source of our very own Ping River and is an area where Lahu people emigrated from south Tibet 130 years ago. Doi Pu Muen is also a place

that supported by Chiang Mai MICE policy, aiming at specifically increase the capacity of the village to act as a host for the corporate travelers targeted by the Chiang Mai MICE. Over the last decade, the village had established a vibrant community-based tourism (CBT) program. Observing local cooking on an open fire hearth, picking and processing tea, picking and processing tea, making a basket, viewing a cultural performance, and staying overnight in a local bamboo house are included in highlighting the Lahu way of life. “the Lahu tea heritage home” project is agreed upon after February 2018 meeting in Chiang Mai. The project aims to develop tea tradition at Doi Pumuen as an experiential CSR (Corporate Social Responsibility) activity for a corporate group. Focusing on the tea heritage and culture of Doi Pumuen would contribute to economic status and social development including education and healthcare. (Jolliffe, Piboonrungroj. 2018)

1.2.2 Ahpa Tea

The name “Ahpa tea” is derived from the Lahu language, ‘Ah pa’ means ‘Father’ and therefore, the name can translate into ‘tea from father’. Ah pa tea is a kind of Assam tea Ah pa tea once won a prize of organic tea from Onecert. The tea-growing areas are 790 Aker, 1,400 tons per year, and Ah pa tea growing areas are 3.95 Aker, 7.7 tons per year. Ah pa tea has a full-bodied malty flavor, deep aroma, rich color and brisk taste. In addition, this tea leaves behind a sweet after taste in your mouth. Which is known for reducing cholesterol and blood pressure, as well as reducing intestinal bacterial.

Ahpa tea has various species to choose as souvenirs. 1. Green tea, which is grown at a height of 1,300 meters above sea level at Doi Pu Muen. And the products are produced with the top leaf only by hand processing. 2. Wild tea, is a kind of natural tea, grown at a mountain of 2,000 meters above sea level. And the unique point of this tea as its name suggests, wild tea is free grown and is not being planted by people. 3. White tea. Its leaves and buds are picked just before they are fully open when they are covered in fine white hairs. It is the least processed of all the tea categories. The leaves are simply dried in the sun. White tea is paler in color and has less aroma than black and green tea. Its flavor is light and slightly sweet. (Yok. 2018)

All these tea souvenirs are packed in beautifully designed tin cans for easy carrying. And mini tea packages are provided too for a sample. You can experience how to pick tea, how to process tea, and how to make perfect tea here. And you have the opportunity to taste food made by tea and can enjoy the most pristine natural scenery and local customs.

To promote a series of souvenirs from Ahpa tea, they corporates with review Chiangmai, and Tat Chiang Mai, let us go website, create feunk’s leaving room in Youtube. And they attend lots of expos to let more people know Ahpa tea.

Though tea tourism has been developing in Thailand, few people know about it, so it is necessary to study this topic.

2. Materials and Methods

2.1 Theoretical Model

Downward and Lumsdon (2000 2003) proposed a simplified theoretical model for studying the determinants of the levels of tourist expenditure. As standard demand theory predicts, the individual k's demanded quantity q of a given commodity j at time t is given by

$$q_j|t = q(p_j, B_k, T_k|t) \quad (1)$$

where p_j is j's relative price, B_k is consumer k's budget and T_k are her tastes. As reported above tourism goods are considered as normal, and this implies that income has a direct relationship with expenditure (Agarwal & Yochum, 1999; Downward & Lumsdon, 2000). Eq. (3) is not suitable for assessing the demand characteristics from cross section data. The fact that it refers to a fixed moment in time implies that it does not provide the necessary information for assessing changes of relative prices. Although the latter can be imputed from external sources re- porting the price levels of goods, using prices directly remains a tricky question. The reasons are to be ascribed, among others, to the difficulties in isolating prices from quantities, and in defining what the tourism good is in order to compute an opportune price index—see also what reported in Section 3.2.2. This leads to the following Engel curve representation of Eq. (3) that provides a more convenient reference for assessing the demand of all the tourist goods purchased by k:

$$\sum_j p_j q_j|t = pq\,(B_k, T_k|t) \quad (2)$$

where p_j on the right side becomes a fixed scale factor, and $\sum_j p_j q_j$ is total expenditure at t. The need to estimate the elements concurring in differentiating markets leads scholars to express both Bk and T_k in terms of measurable consumer's characteristics. Hereinafter we adopt the distinction of Wang, Rompf, Severt, and Peerapatdit (2006) into socio-demographic (S_k), trip-related (TR_k) and psychographic (P_k) characteristics, plus the fourth category of economic constraints C_k. The latter extends the concept of income to include all economic restrictions in spending (see Alegre, Mateo, & Pou, 2010; Alegre & Pou, 2004). Trip-related variables also include what literature calls ‘time constraints’, which typically concern the length of stay in the holiday place. Model (4) thus becomes

$$\sum_j p_j q_j|t = pq\,(C_k, S_k, TR_k, P_k|t) \quad (3)$$

2.2 Model specification

In this paper, an econometric model Tobit is run to estimate the expenditure of tourists. y. during their travel. Additionally, Log likelihood test to determine optimal values of the estimated coefficients to support the effectiveness of my hypothesis. Log Likelihood value is a measure of goodness of fit for any model. Higher the value, better

is the model. Pearson residuals to check the model fit. The data source is the first data collected from 2018-2019 in tea garden online. Four different specifications for each factor (20) are estimated. In Tobit model the tourism expenditure reference category are the factors may influence tourism expenditure during their travel.

Table 1 describes dependent and independent variables included in the estimation. Independent variables regard soi-demographic, trip-related and psychographic factors of tourism. The dependent variables are the budget in spending souvenir during tourism. The total sample was split into k groups according to the empirical factors proved by other authors that may related to my study. To identify each subfactor, a dummy variable was built corresponding to zero if the expenditure spent and 0 otherwise.

These dummy variables aim to capture marginal effects on consumption of goods and services resulting from tea tourists.

The factors are showing in the following chart.

Table 3: Dependent and independent variables included in the model

Dependent variables	**Description**
$Expen_i$	Logarithm of total expenditure in tea souvenirs. Here I give 4 scales: 1=200฿ 2=300฿ 3=400฿ 4=500 ฿
Independent variables	**Description**
Demographic factors:	
Age	Age of tourists
Gender	Gender of tourists
Education	Education level of tourist
Nationality	Nationality of tourists
Occupation	Occupations of tourists
Economic factor:	
Personnel income	Monthly income of tourists
Trip-related factors:	
Way of tourists	Package tour or non-package tour of tourists
Party size	1=Alone 2= With friends 3=With family 4= With spouse 5=With colleagues
Attractions	Including local art and folks, nature scenery, festival, way of life
Activity	A series of activities held by villagers at their home,
Ancillary	including visit tea park, pick up tea, processing tea, and learn some local dialect about tea.
Amenities	Including 1. Telecommunication, 2. safety and security, 3. Sanitary facilities, 4. Instructions and guidance, 5. Health care, 6. Bank services. he availability of food and beverage outlets,
Awareness	accommodation, and retail shops the knowledge of the destination of tea tourism in Thailand and the knowledge of the tourism activities in Thailand.

Dependent variables	Description
Length of stay	It refers to how long the tourists stay at the destination
Psychographic Factors Attitudes of tourists	Tourists' attitude of drinking tea
Purpose of travel	Tourists' purpose of travel
Consumer preference	Tourists' preference of tea like bottled tea leave...

Source: The author

The specification of the model is described by:

$$\begin{aligned}\text{Expen}_i = {} & \beta_1(age) + \beta_2(gender) + \beta_3(\text{education}) + \\ & \beta_4(nationality) + \beta_5(occupation) + \\ & \beta_6(monthly\ income) + \beta_7(packge\ tour) + \beta_8(non-package\ tour) + \\ & \beta_9(party\ size) + \beta_{10}(attractions) + \\ & \beta_{11}(activities) + \beta_{12}(ancillary) \\ & + \beta_{13}(amennities) + \beta_{14}(awareness) + \beta_{15}(Length\ of\ stay) + \\ & \beta_{16}(tourists'\ attitude) + \beta_{17}(travel\ purpose) + \\ & \beta_{18}(tea\ function) + \beta_{19}(tea\ taste)\end{aligned}$$

3. Result

3.1 Profile and Characteristics pf Survey Respondents

Table 1: The demographic profiles of respondents

Question	Variables	Frequency	Percentage
Age Group	18-24 years old	73	17.76
	25-31 years old	83	20.19
	32-38 years old	59	14.36
	39-45 years old	51	12.41
	46-52 years old	36	8.76
	53-59 years old	23	5.59
	Over 60 years old	86	20.92
Gender	Male	194	47.20
	Female	217	52.80
Nationality	Asia	261	63.50
	Europe	74	18.00
	North America	48	11.68
	Oceania	24	5.84
	Africa	3	7.29
	South America	1	0.24
Occupation	Student	63	15.33
	Professions	110	26.80
	Workers/Employees	126	30.70
	Freelancer	69	16.80

Question	Variables	Frequency	Percentage
	Retired	43	10.50
Level of education	Primary school	22	5.35
	Compulsory education	49	11.92
	High school	57	13.87
	Tertiary education	216	52.60
	Master's degree	62	15.10
	Doctor's degree	5	1.20

Source: By author

The basic personal information of samples are as follows:

Age: Among the 411 valid samples, the highest proportion age group are over 60 years old and 25 to 31 years old, accounting for 20.92% and 20.19% respectively, which is almost even.

Gender: As it can be seen from table 4.1, females show a higher percentage (52.8%.) in tea tourism, while males show a lower percentage (47.2%).

Occupation: The respondents are characterized by high occupational status. Workers/Employees were about 30.70 % of tourists work in company. With the following of those work as professions (26.8%) like teacher, doctor. Freelancer 16.8%, student 15.33%, and retired 10.5 %. It indicated that most of tourists work in the private sector.

Level of education: Over half of respondents had been received tertiary education, which reach to 52.6%. 62 tourists had got the master's degree, with the percentage of 15.1%. 13.87% of respondents completed high school.

Table 3.2: The economic questions of respondents

Question	Variables	Frequency	Percentage
Travel budget	2000฿ or lower	62	15.09
	2,000 ฿–2,999฿	87	21.17
	3,000 ฿–4,499฿	76	18.49
	4,500 ฿–5,000฿	70	17.03
	5,000฿ or more	116	28.22
Cost in tea souvenir	200฿ or less	264	64.23
	300฿	68	16.55
	400฿	43	10.46
	500฿or more	36	8.76
Appropriate personal income for 200฿ for a can of tea (40 grams)	10,000฿ or lower	149	36.25
	10,000฿–14,999฿	142	34.55
	15,000฿–29,999฿	65	15.82
	30,000฿-4,4999฿	34	8.27
	50,000฿ or more	21	5.11
Annual household income	50,0000฿ or lower	138	33.58
	500,000฿-599,999฿	103	25.06

Question	Variables	Frequency	Percentage
	600,000฿-699,999฿	95	23.11
	700,000฿-799,999฿	46	11.19
	800,000 or more	29	7.06

Source: By the author

Travel budget: About a quarter of tourists (28.22%) spend 5,000฿ or more during travel, while 21.17% respondents plan to spend 2,000 ฿ to 2,999฿ in their trip. 18.49% respondents would like to spend 3,000 ฿ to 4,499฿ in vacation, followed by those budgets in the period of holiday is 4,500 ฿ to 5,000฿ (17.03%). 15.09% tourists are willing to spend only 2000฿ or lower on their journey. It shows that most people tend to spend more money in tea tourism.

Cost in tea souvenir: From the chart above, we can see that over half of travelers (64.23%) prefer spending 200฿ or less in souvenirs purchase. 16.55 % respondents would like to spend 300฿ in purchasing tea souvenirs. 10.46 % of travelers tend to buy souvenirs within 400฿. Under 8.76 % of tourists spend a significant portion of their budget in souvenirs, about 500฿or more.

Appropriate personal income for 200฿ for a can of tea (40 grams): With regard to this factor, 36.25% tourists think that personal income of 10,000฿ or even lower can afford a 40 gram can of tea that worth of 200฿. Followed by 34.55 % those salary about 10,000฿–14,999฿ accept that a 40 gram can of tea selling 200฿ is affordable for them. While 15.82 % respondents consider that when their monthly income reach 15,000฿–29,999฿, they will buy this kind of tea. 8.27 % of repliers believe that their earning is 30,000฿-4,4999฿, they may buy the tea of 200฿. And 5.11% interviewees deem it reasonable price for them only when their pay up to 50,000฿ or more.

Annual household income: In my survey, 33.58% of respondents' household income is 50,0000฿ or lower. About a quarter of people's household's income is 500,000฿-599,999฿. The tourists' household income is 700,000฿-799,999฿ accounting for 11.19 %. Under 7.06% of interviewees' household income is 800,000฿ or more.

3.2 Descriptive analysis of the trip-related factors and psychographic factors

Trip-related-factors

As mentioned about the way of tourists, three quarters pf tourists chose non-package tour, a quarter of people would like to book package.

As for the travel partners choosing, over a quarter of tourists prefer travel with their friends. 23.84% people would like to travel with family, while 20.19 % travel with spouse. And 14.11% people would rather travel alone. Only 0.97% tourists will travel with colleagues.

Regarding the influencing factors of attractions, 44.53% respondents pay attention to local scenery. 25.06% tourists are attracted by local art and folks. And 18.25% respondents focus on local food and beverages. Only 2.43% people go there because of the local festival holding.

Measurement scales of the utility of destination:

There are 5 variables contributing to construct theactivities. Each of variable is asked in 5 points scaled questions: 5-Extremely prefer to 1-not at all prefer. Namely "do you like visiting King's commemorative tea park follow King's path to original tea tree in the village. Viewing the Camellia sinensis var. assamica tea drying outside of a Lahu home at Lahu tea heritage homes", "Picking tea using traditional basket, experience village life. Learning tea processing and speaking Lahu of "pick tea" and "process tea"", "Observing and participating in tea village lifestyle. Enjoying Lahu cuisine and brew tea under the help of local people and learning Lahu language of "Have a cup of tea"", "Seeing tea seedling as the King's legacy. Visiting tea nursery to see tea seedlings in Lahu home", "Participating in tea related crafts appreciating the self-sufficient Lahu way of life. Demonstrating tea basket weaving and bamboo teacup making." All 5 variables are extremely preferred by more than 53.12% of the respondents. About 1.74% of the respondents are not at all prefer these activities held by local people.

There are 6 variables contributing to construct "ancillary". The first variable is, "availability of telecommunication", 65.94% of the respondents think it is extremely important, while 2.92% respondents think that it is not important in scenic area. 67.15% of the tourists thinks the second variable is extremely important. 69.83% of the respondent regard as the third factor is extremely important. While only 39.42% of the respondents consider that the fourth variable is extremely important. With respect to the fifth variable, 28.95% of the tourists deem it is moderately important. 31.39% of the tourists hold the view that it is moderately important for them.

There is 1 variable contributing to construct "awareness". 40.39% of the respondents think that they know about moderately much of tea tourism.

There is 1 variable contributing to construct "tea tourism". Up to 77.37% of the respondents haven't been to tea plantation.

There are 4 variables contributing to construct "the length of the stay". 45.74% of the tourists will return home immediately. 31.34% of the respondents are willing to stay in the destination one night. 14.60% of the respondents tend to stay in the destination for two nights. Only 8.52% of the respondents want to stay in the destination more than two nights.

There is 1 variable contributing to construct "attitude of the tourists". 38.20% of the respondents agree that drinking tea is a healthy lifestyle. With the following of 32.60% of the respondents strongly agree that drinking tea is a healthy way of life. 23.84% of the respondents neither agree nor disagree the point of view. Only 3.41 of the respondents disagree drinking tea is healthy lifestyle, under 1.95% strongly disagree drinking tea is healthy lifestyle.

There are 5 variables contributing to construct "travel purpose". Over a quarter of the respondents want to experience and know about local scenery and culture. 35.28% of the respondents go to tea tourism is for relaxing themselves. 9.49% of the respondents go to tea plantation only because they go there on holiday. 1.46% of the

respondent want to take beautiful photos there.

There is 1 variable contributing to construct "consumer preference", up to 71.29% of the respondents have been drinking some forms of tea like bottled tea, tea leaves. 28.71% of the respondents do not drink any form of tea.

3.3 Result of Tobit model

Pearson residuals

	Min	1Q	Median	3Q	Max
mu	-2.538	-0.5335	-0.1543	0.5625	3601
loglink(sd)	-0.710	-0.6717	-0.4970	0.1117	8.477

From the Pearson residuals, it shows us that my linear prediction is correct, they are normally distributed in my samples. My data can be used as influenced statistics

Table 3.3 Tobit result

	coefficient	**S.E.**	**prob**	
Gender				
female	0.0000			
male	-1.0464	7.9654	0.8955	
Occupation				
Have job	25.4855	13.4152	0.0575	*
Formal job	-9.0757	10.2910	0.3778	
Government job	-0.9537	11.1779	0.9320	
Education				
Bachelor and above	13.3889	10.2049	0.1895	
Master and above	9.4697	11.1716	0.3966	
Doctor and above	3.9522	4.1665	0.3428	
Budget				
budget2,500	10.0774	13.2739	0.4477	
budget3,750	26.0134	13.6946	0.0575	*
budget5,250	27.7446	14.3152	0.0526	*
budget6,000	113.3649	14.1280	0.0000	***
Income				
income12,450	-14.3333	9.4274	0.1284	
income22,450	4.7667	12.1939	0.6959	
income37,450	13.3775	16.4828	0.4170	
income50,000	39.2489	19.4109	0.0432	**
constant	124.4960	27.2183	0.0000	***
(Intercept):2	4.3461	0.0349	0.0000	***
age	0.1748	0.0825	0.0340	***
Seeing tea plantation	15.8086	6.6429	0.0173	**
Participating activities	15.10146	6.73991	0.0251	**

	coefficient	S.E.	prob	
Previous tourism experience	21.81748	9.55606	0.0224	**
Length of stay	5.13446	4.8106	0.2858	
Positive attitude	11.65673	4.59481	0.0112	**

Signif. codes: 0.05-0.1 "*", 0.01-0.05 "**", < 0.01, "***"
Log-likelihood: -2369.42 on 799 degrees of freedom
Number of Fisher scoring iterations: 4
No Hauck-Donner effect found in any of the estimates

From the result above, we can see that age is significantly important in tourists' expenditure. As the age of tourists increases, it is observed that they tend to purchase more tea related souvenirs. Which is consistent with the result of Weagley & Huh, 2004. Once the decision of making a trip has been taken, older people spend more on tourism than the young. It was seen that tourists who have job will spend more than those tourists without work. Jang et al. (2004) reached the same conclusion. Budget constraint is a determinant factor. It shows that the more budget tourists set aside for their travel, the more souvenirs they will purchase. Income level is also a factor that influence tourists' purchasing willingness. It effects in a statistically significant manner. This result acquired in this study support the conclusion of Downward and Lumsdon (2000) and Leones et al. (1998). This study reveals that activities contribute to increase daily expenditure. They will show a higher interest in souvenirs if more related activities are held. Seeing tea seedling as the King's legacy then visiting tea nursery to see tea seedlings in Lahu home and participating in tea related crafts appreciating the self-sufficient Lahu way of life, demonstrating tea basket weaving and bamboo teacup making are the two activities with a stronger effect in daily expenditures.

3.4 Calculate the upper and lower 95% confidence intervals for the coefficients.

(Intercept):1	56.31847849	179.6619750
(Intercept):2	4.28310009	4.4200274
age	0.01470465	0.3382284
gender	-17.04124749	14.1337665
occupation	-1.80400849	12.6960559
education	-2.99762982	14.0026182
budget2,500	-14.93743852	36.8040089
budget3,750	1.04286158	54.7699027
budget5250	-0.66074448	55.7410208
budget6,000	87.17522055	142.7444796
income12,450	-33.74883197	2.9741679
income22,450	-20.11076713	27.7431794
income37,450	-20.57339905	44.1003107
income50,000	3.03507824	79.1959855

Seeing tea garden	3.18834735	29.2460987
Participating activities	-29.12913819	-2.5509464
Tourism previous tea tourism experience	2.84209134	40.3812733
Length of stay	-3.85989727	14.9341612
positive attitudes of drinking tea	2.51172922	20.5160928

4. Discussion

This paper focuses on finding out the factors that influence the tourists' expenditure on tea souvenirs. Thailand is a tourism-oriented country. So, it is necessary for Thailand to grab this emergent market to develop as a comprehensive tourism country.

In this study, the author estimated the determinants that influence the tourists' expenditure on tea souvenirs on the basis of Tobit model.

Tea, being one of the most consumed and popular drinks after water, has its own history behind it. The art and science involved in making the cup that most people start their day with are rarely known to a few. The tea tourism takes the leap to not just introduce tourists to a new country and its heritage but immerses them to get involved directly into the tea making process from start to finish.

5. Conclusion and Recommendation

As the result shows that 8 variables influence the tourists' expenditure on tea souvenirs. Including age, budget at three levels; seeing tea seedling as the King's legacy, visiting tea nursery to see tea seedlings in Lahu home is significant; participating in tea related crafts appreciating the self-sufficient Lahu way of life. Demonstrating tea basket weaving and bamboo teacup making; previous tea tourism experience; and tourists who hold the view of drinking tea is healthy lifestyle. It explains that tea tourists are those people experience tea tourism and they have opposite attitude about tea, they eager to know more about tea through lots of tea activities whatever they drink tea or not in the past. However, Therefore, the author has the following suggestions for Thailand's policymakers.

First, Thailand should make different tour package and complete related infrastructure according to different age to satisfy different age groups. For over 60 people and tourists aged 25-30 years old are the main tourists in tea tourism.

Second, pushing various price of tour package including favorable price and expensive price to offer better service for tourists.

Third, activities are significant in the research. This suggests that it is necessary and advisable to develop and implement some strategies or policies to complement the offer of activities or experiences to increase tourist expenditure.

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The Early Adoption Behavior and the Willingness to Pay for Electric Vehicles in Thailand

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Abstract

The number of new registered electric vehicles in Thailand increased by 191 percent from 2017 to 2020, indicating that Thai people are becoming more interested in electric vehicles. The main objectives of this research were to examine characteristics of early adopter of electric vehicles and assess factors affecting the willingness to pay for electric vehicles in Thailand. The data was obtained from an online survey of people who were interested in purchasing an electric vehicle. There were 165 respondents in this study. For the methodology, the logit model was used to estimate factors affecting the early adoption behavior. Afterward, the endogenous treatment effect model was used to estimate the effects of being early adopters, together with demographics, vehicle usages and environmental concern factors, on the willingness to pay for electric vehicles of potential consumers. The endogenous treatment effect model was selected as it is robust to endogeneity bias due to respondents' self-selection to be early adopters.

The results showed that demographics of early adopters and high willingness to pay consumers were different. While age, job status, living area and environmental consciousness significantly affected the early adoption behavior, only individual income and household income per head affected the willingness to pay. In particular, older employees or business owners, who lived in an urban area and were environmental conscious, were more likely to be early adopters. Those with high individual and household income had a higher willingness to pay. In addition, those who drove their cars regularly and had more cars in the households were more likely to be early adopter. The factors that determine early adoption decisions can help electric vehicle manufacturers target their early adopter customers. The findings also shed light on the fact that early adopters may not be willing to pay more than other potential customers

Keyword: Willingness to Pay, Electric vehicles, Consumer behaviors
JEL Classification Codes: C92, D01, D10, Q55

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1. Introduction

The rapid development of the economy and society has exacerbated the problem of resources and the environment. As a result, everyone is paying more attention to the environment issues, such as fast changing the world's climate and depleting limited resources. One of the key reasons is the expansion of energy consumption, which largely supplied by fossil fuel. As Thai economy grows, the production and development of new innovations using technology to preserve and replace resources and the environment has been applied in industries, businesses and then daily activities.

EVs are cutting-edge vehicles that uses electric energy stored in batteries or other electric energy storage devices as an energy source. According to statistics from Thailand's Department of Land Transport, there have been a total of 2,854 electric vehicles (EV) registrations in 2019, including 1,572 new units. This was a 380 percent increase from the 325 EVs registered in 2018. A total of 153,184 automobiles were partly the hybrid (HEV) and plug-in hybrid (PHEV) vehicles. The plugs are PHEVs, and EVs reported 51 percent more new ones in 2019 than the previous year (bangkokbiznews, 2020).

Thailand's EVs strategy demonstrates that the country is launching an EV sector and developing the market, which is more innovative for Thais. Furthermore, the number of people who utilize EVs is expected to rise in the future. However, EVs in Thailand are still more expensive and have distinct characteristics than conventional vehicles. As a result, it's worth looking into information on EVs and the willingness to pay for them in Thailand.

Literatures adopts different models to examine the willingness to pay and demand for EVs in several countries, including Germany (Hackbarth and Madlener, 2016; Achtnich, 2012), Denmark, Finland, Iceland, Norway, Sweden (Noel et al, 2019), the Netherlands (Hoen, Koetse, 2014), the United States, China (Helveston, 2015), and Thailand (Suanmali, Tansakul, 2019, Tangtaku, 2015). Previous research has found several factors that affect early adoption behavior and willingness to pay for EVs. The study's significant factors were divided into three categories, which are socioeconomic, driving behavior, and environmental consciousness. Socioeconomic factors are internal factors that a direct impact on early adoption behavior and willingness to pay for an EVs. Achtnicht, 2012, Noel, et al., 2019, Noblet, Teisl, & Rubin, 2006, Ramos-Real et al., 2018, Hulshof, Mulder 2020) found that age, gender and income salary are positively willingness to pay for EVs. Therefore, socioeconomic includes gender, age, marital status, income per head, job status, living area, number of children, education and household income. Driving behavior is external factor that impact on early adoption behavior and willingness to pay for an EVs. It refers to individual behavior that affect to interest and willingness to pay. Those behavior include daily use of car, the number of used cars, the number of household cars and type of used car. Moreover, external factors such as the environment have an impact on people's willingness to pay for EVs. (Achtnicht, 2012,) found that 91 percent of respondent focus on environment protection and they are highly concern about environment impact of vehicle and emphasis the need for vehicles.

As the EV industry in Thailand is at the launching state, the main objectives of this research were first (1) to examine characteristics of early adopter of EVs and then (2) assess factors affecting the willingness to pay for EVs in Thailand. For the methodology, this paper uses the logit model was used to estimate factors affecting the

early adoption behavior. Factors affecting the willingness to pay for EVs are estimated using linear regression. In addition, as the decision to early adopt the EVs is potentially endogenous, this study also uses the endogenous treatment-regression model to estimate the factors affecting the willingness to pay for EVs.

2. Methodology

2.1. Data and Survey design

Data are collected from survey of people who interested in EV in Thailand. The scope of the study is observation car owner or respondent should be over the age of 18 years old and have a driving license in Thailand.

The survey instrument consisted of 4 sections with 21 questions. Section 1 asked respondents about their interest in EVs. Section 2 asked respondents about behavior of using cars in their daily life. In Section 3, the respondents were asked about their daily environmental consciousness behaviors in the Likert scale questionnaire. Lastly, Section 4 collected socioeconomic characteristics.

The survey was distributed on a Facebook group composing of people who are interested in EV in Thailand. Respondents had to be over the age of 18 years old. There was a total of 165 responses completed in the sample.

2.2 Data analysis

For the factors determining the decision to early adopt EVs, this study uses the Logit regression as follows: The binary response variable Y, which we denote $p=P(y=1)$. They assume a linear relationship between the predictor variables and the log-odds (also called logit) of the event that $Y=1$. This linear relationship can be written in the following mathematical form (where ℓ is the log-odds, b is the base of the logarithm, and α are parameters of the model):

$$\ell_i = log_b \frac{p_i}{1-p_i} = w_i\gamma$$

where $p_i=P(t_i=1)$ and t_i is the dummy variable for early adoption (decision to purchase an EV within 5 years). w_i are vectors of explanatory variables for the early adoption behavior including socioeconomic, vehicle consumption behavior and environmental concern factors.

Factors affecting the willingness to pay for EVs are estimated using linear regression as follows:

$$y_i = x_i\beta + \delta t_i + \varepsilon_j$$

where y_i is the willingness to pay for EVs and x_i are the covariates explaining the willingness to pay including socioeconomic, vehicle consumption behavior and the early adopter decision.

In addition, as the decision to early adopt the EVs is potentially endogenous, this study also uses the endogenous treatment-regression model to estimate the factors affecting the willingness to pay for EVs. The model is composed of an equation for the outcome y_i and an equation for the endogenous treatment t_i as follows

$$y_i = x_i\beta + \delta t_i + \varepsilon_j$$
$$t_i = \begin{cases} 1, if\ w_i\gamma + u_i \\ 0, Otherwise. \end{cases}$$

3.Result

The data in this study were collected using an online survey. There were 165 respondents from a Facebook group of EV enthusiasts in Thailand. For the characteristics of respondents in the sample, 58.7 percent were male, and the average age was 28 years old. Most respondents were single and had a bachelor's degree. Most of the respondents were employed as permanent employees with the average personal income of 41,395 baht per month. The variable descriptions are as shown in Table 1:

Table 1. Summary statistic of variables

Variable	Description	Mean	S.D.
Socioeconomic			
Male	Gender dummy variables (1 if male only, = 0 otherwise)	0.587	0.493
Age	Age of respondent	28.485	8.471
Married	Married dummy variables (1 if married only, = 0 otherwise)	0.197	0.399
Income	Income of respondent	41395	56175
Living area	Residential area dummy variables (1 if city only, = 0 otherwise)	0.718	0.451
Bangkok	Province dummy variables (1 if Bangkok only, = 0 otherwise)	0.491	0.501
Career	Career dummy variables (3 = executive or CEO, 2 = employee, 1= unemployed)	2.035	0.579
Household with children	Number of children	0.239	0.704
Household income	Income of household	117575	89135
Driving behavior			
Number of used cars	Number of used cars	1.449	1.033
Type of car	Type of vehicles dummy variable (2 = European car, 1 = Asian car, 0 = nothing)	1.149	0.522
Daily use of car	Vehicle's behavior dummy variables (3= always, 2= sometime, 1= infrequent)	2.353	0.776
Number of household cars	Number of household cars	2.347	0.798

As the data were collected from EV enthusiasts, 69.46 percent reported to be early adopters, which means that they planned to purchase an EV within the next five years. From the 30.54 percent of the non-early adopters, 21.56 percent planned to buy EVs in

10 years and 8.98 percent had no plan to buy EV. The overall willingness to pay of EVs were 2,097,873 baht. On the average, the early adopters were willing to pay more than the non-early adopters. The willingness to pay was 2,361,918 baht for the early adopters and 1,701,805 baht for non-early adopters.

For the factors affecting the early adoption behavior and willingness to pay, this study examined three sets of variables, which are (1) socioeconomic, (2) driving behavior and (3) environment consciousness factors. Model 1 uses the Logit regression to estimate factors affecting the early adoption decision where the Regression EA1 shows results with all covariates and Regression EA2 shows results with only significant covariates. Model 2 uses the linear regression to estimate factors affecting the willingness to pay where Regression WTP1 shows results with all covariates and Regression WTP2 shows results with only significant covariates. Finally, Model 3 estimates both the decision to early adopt and the willingness to pay simultaneously using the endogenous treatment effect model.

Results of the three models presented in Table 2 show consistent estimations. For the early adopter decision, the results show that demographics of early adopters and high willingness to pay consumers were different. While age, job status, living area and environmental consciousness significantly affected the early adoption behavior, only individual income and household income per head affected the willingness to pay. In particular, older employees or business owners, who lived in an urban area and were environmental conscious, were more likely to be early adopters. Therefore, those who drove their cars regularly and had more cars in the households were more likely to be early adopters.

On the other hand, the results show that gender and married status insignificant affected the early adoption behavior. For driving behavior, a number of used cars and types of cars insignificantly affected the early adoption behavior, the only number of household cars that effect to early adoption behavior. Besides, household factors include a number of children and household income had no effect on early adoption behavior.

For the willingness to pay for EVs, those with high individual and household income had a higher willingness to pay. However, the insignificant factors that affected the willingness to pay for EVs include gender, age, married status, job status, and driving behavior. The only number of used cars significantly affects the willingness to pay. While environmental consciousness also insignificantly affected the willingness to pay for EVs.

Table 2. Estimates in preference space for logit model, OLS and endogenous treatment model

	Model 1 Logit		Model 2 OLS		Model 3 Endogenous Treatment	
	EA1	EA2	WTP1	WTP2	EA	WTP
Male	-0.431		0.104			
	(-0.971)		(1.145)			
Age	0.128**	0.104**	-0.009		0.062**	
	(2.253)	(2.413)	(-1.253)		(2.441)	
Married	-0.307		-0.203			

	Model 1 Logit		Model 2 OLS		Model 3 Endogenous Treatment	
	(-0.477)		(-1.545)			
Living area	0.926**	0.850**	-0.115		0.520**	
	(2.064)	(2.022)	(-1.181)		(2.073)	
Bangkok	-0.332		0.099			
	(-0.722)		(1.050)			
Income	-0.061		0.045**	0.038**		0.045**
	(-0.688)		(2.206)	(2.079)		(2.304)
Employee	2.390***	2.079***	-0.161		1.251***	
	(3.486)	(3.626)	(-1.103)		(3.720)	
Business owner	1.712***	1.762***	0.107		1.072***	
	(2.158)	(2.585)	(0.618)		(2.638)	
Household with children	0.190		0.146*			
	(0.353)		(1.777)			
Household income	-0.056		0.175***	0.179***		0.180***
	(-0.208)		(3.085)	(3.443)		(3.502)
Daily use of car	1.238*	0.918*	-0.044			
	(1.957)	(1.698)	(-0.364)			
Number of used cars	0.094		0.102*	0.154***		0.162***
	(0.368)		(1.897)	(3.488)		(3.637)
Number of household cars	0.470*	0.541**	0.063		0.314**	
	(1.667)	(2.112)	(1.068)		(2.091)	
Type of car	0.573		0.072			
	(1.165)		(0.703)			
Environment concern	0.836**	0.806**	0.012		0.495**	
	(2.400)	(2.483)	(0.174)		(2.544)	
EA						-0.188
						(-0.915)
Constant	-8.391**	-8.351***	11.889***	11.789***	-5.016***	11.829***
	(-2.560)	(-4.085)	(20.209)	(23.276)	(-4.234)	(23.550)

	Model 1 Logit		Model 2 OLS		Model 3 Endogenous Treatment	
Observations	165	165	165	165	165	165
R-squared			0.300	0.230	0.300	0.230

z-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

To examine further in the environmental factors, Table 3 shows the relationship between environment consciousness and early adopter. The results show that early adopters have more environmental awareness than non-early adopter. Early adopters had a behavior of using cloth bags instead of plastic bags more than non-early adopter. On the other hand, non-early adopter had a behavior of using products that are more environmentally friendly than early adopter. Besides, they were the least likely to use bicycles instead of cars and motorcycles compared to other behaviors. Therefore, people who buy fast EVs are more environmentally conscious.

Table 3. Environment consciousness

Variable	**Description**	**Early adopter**	**Non-Early adopter**	**Total**	
		Mean	**Mean**	**Mean**	**S.D.**
Sort garbage	How often do you sort garbage before throwing it out?	3.627	3.288	3.395	1.011
Plastic bags	How often do you use cloth bags instead of plastic bags?	3.834	3.666	3.850	0.788
Environmental friendly product	When shopping, do you choose products that are environmentally friendly?	3.228	2.847	3.185	1.003
Recycle	Do you recycle the product?	3.560	3.272	3.508	0.962
Bicycles	Do you use bicycles to travel short distances instead of motorcycles or cars?	2.387	1.941	2.221	1.267
Plastic cup	Do you carry a personal glass of water instead of a plastic cup?	3.198	2.938	3.149	1.205
Foam	Do you reduce the use of foam packaging?	3.680	3.205	3.455	1.101
Environmental concern	Are you worried about future environmental problems?	4.196	3.841	4.089	0.870

4. Discussion

The results on the factoring affecting the willingness to pay for EVs are consistent with previous literature. Young individuals (under 30 years) and households with children have a positive effect on the willingness to pay for EVs (Noel et al., 2019) which the result found that households with children are likely more willingness to pay. Those who have high income and household income per head affected the willingness to pay for EVs. For environment consciousness, the result shows that people who concern about the environment were more likely to be early adoption behavior for an EVs that as follow as (Hulshof, Mulder, 2020) found that almost consumer in European prefers a vehicle with lower emission per kilometer and result are mean willingness to pay for emission reduction equal €199 per ton. (Achtnicht, 2012,) found that 91 percent of respondents focus on environmental protection, and they are highly concern about the environmental impact of vehicles and emphasis the need for vehicles.

In addition, the factor affecting early adoption behavior relate to previous literature. The result shows that environmental consciousness has resulted in people increasing demand for EVs as follow as (Suanmali, Tansakul, 2019) the environmental knowledge has a direct relationship and influence with consumer behavior. Age and job status, on the other hand, were more likely to be early adoption behavior for EVs, similar to (Tanaka, et al., 2014) who discovered that demographic characteristics of the respondent influence EVs preferences and indicate an intention to purchase a car within 5 years.

5. Conclusion and Recommendation

In this study, factors affecting early adoption behavior and willingness to pay for EVs can be explained by the behavior of used vehicles. On the other hand, the result shows that there was a factor that affected and non-affected with a positive relationship with early adoption behavior and willingness to pay for EVs. The result found that factors about finance were more likely to be early adoption behavior and willingness to pay for EVs. Those with job status and environment consciousness significantly affected early adoption behavior.

As the result, EV manufacturers can use the characteristics that influence early adoption decisions to better target their early adopter clients. There is a variation in potential consumers' willingness to pay. Early adopters are willing to pay slightly more than the non-early adopters. However, the difference is not statistically significant. This indicates that EV sellers can conduct some degrees of price discrimination, but the pricing strategies should focus on the heterogeneity within groups more than that between the groups of early and non-early adopters.

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Modeling of Temporal Variation of PM 2.5 in Chiang Mai, Thailand

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Abstract

While air pollution appears to be one of the most critical environmental problems, which directly from manmade with generally resulting in greater amount than natural degradation. Therefore, everyone should concern more on the concept of sustainable development, which mainly focus on economics, social, and environment for being to an approach to economic planning that attempts to raise economic growth while preserving the quality of the environment. The study aims construct a model of temporal variation of PM2.5 in Chiang Mai, which the magnitude of PM2.5 in certain periods of time can be observed every year in Chiang Mai using Fourier Series Expansion and Spline Interpolation and compare the performance of Fourier Series Expansion and Spline Interpolation. The study can conclude that the temporal variation model can use to predict the approximate value PM2.5 accurately.

Keywords: environment problems, air pollution, PM2.5, Fourier Series Expansion, Spline Interpolation

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1. Introduction

Nowadays, there has been growing concern of degradation and pollution of environment and climate change as they impact on the future development of both developed and developing countries. Therefore, people should concern more on the concept of sustainable development, which is an approach to economic planning that attempts to raise economic growth while preserving the quality of the environment for future generation. Environmental quality has many dimensions such as the air we breathe, the water we drink, the beauty we observe in nature, and the diversity of species with which we come into contact. The productivity of our resource in producing goods and service is influenced by climate, rainfall, nutrients in the soil, excessive noise, crowding, and the risk of nuclear catastrophe. All these dimensions of environmental quality may respond to economic growth in different ways. (Grossman & Krueger, 1994)

In the 20th century, pollution is a global serious issue and most countries in Southeast Asia are now cause high levels of air pollution, particularly in urban are where the annual mean levels have considerably exceeded the World Health Organization's (WHO) limits. The research from the World Health Organization (WHO) shows that an estimated 4.2 to 7 million people die from air pollution worldwide every year and that 9 out of 10 people breathe air that contains high levels of pollutants. Air pollution leads people to be exposed to fine particles in polluted air that enter deeply into the lungs and cardiovascular system, causing diseases including stroke, heart disease, lung cancer, chronic obstructive pulmonary diseases, and respiratory infections. For example, the Vietnam air quality levels were at an unhealthy level for sensitive groups of people such as children, elderly or even adults.

In 2019, Thailand was ranked as the 28th most polluted country out of the 98 countries ranked in IQAir's 2019 World Air Quality Report. Therefore, in 2019 the government announced that solving the smog and dust problem is the national agenda in February. Especially in Chiang Mai. Chiang Mai is the second largest province of Thailand with its population of 1,166,978 people. Chiang Mai is essentially Thailand's second city because the smaller and more relaxed answer to the madness of Bangkok. It is now one of the most popular provinces for both international tourists and Thai's tourists. In 2019, Chiang Mai recorded 100 billion baht in revenue from 10.8 million visitors which 70% are Thais and 30% are foreigners.

There are the arguments that Chiang Mai has been change and become worst during December to April because of the air pollution issue. There are 5 important reasons that caused air pollution problem (PM2.5) in Chiang Mai. Firstly, the meteorological condition combined with geography of location which the city is in a valley, surrounded by hills along the east to the west, trapping in the smoke and helping block any breezes that could otherwise blow it away. Secondly, Chiang Mai is a big city located in the northern part of Thailand which near by the borders of neighboring countries like Laos and Myanmar. Therefore, the smog and haze drifting in from those countries during burning season. Thirdly, the increasing of urbanization and vehicles emissions from

people who live and visit Chiang Mai. Fourthly, farmers intentionally burn off their fields to prepare the soil for the next cycle of growing rice, this process called agricultural burning which is the easiest way and lowest cost of the preparation. Fifthly, the local people are burning forest and their field to searching seasonal vegetable for selling and consumption.

One possible way to manage the damage risk incurred PM2.5 is to use the derivatives as in the weather derivative. In pricing derivative, index-related/derived weather is required. In addition, since the effective time of the derivative contract needs to be specified, the modeling of temporal variation of PM2.5 becomes a crucial component in preparing the PM2.5 derivative. The study aims at proposing a model of temporal variation of PM2.5 in Chiang Mai, Thailand. The magnitude of PM2.5 in certain periods of time can be observed every year in Chiang Mai using Fourier Series Expansion and Spline Interpolation and compare the performance of Fourier Series Expansion and Spline Interpolation.

1.1 Literature Review

1.1.1 Definition of air pollution and particulate matter (PM)

Air pollution is the contamination of air by pollutants such as dust and smoke, gases, etc. which harmful to human health, animals, and environment. Sources of air pollution can be divided into 2 types which are natural source and man-made source. Natural sources are where the nature itself creates pollutants without human involvement, such as organic compounds from plants, sea salt, suspended soil, dusts, volcanic eruptions, and forest fires. Another one is man-made source, where human activities create pollutants, such as pollution from automobiles, agriculture activities, mining activities, production process of industry, power generation etc.

Particulate Matter is solid particles and liquid droplets suspended in the air, such as dust, dirt, soot, or smoke. Some of them are large or dark enough to be seen with human eyes and others can only be seen by using an electron microscope.Particulate matter can be separated into three main grouping which are: coarse particles (PM10), is a grouping of particles with an average diameter of 10 micrometer or smaller. PM10 is directly created with source of construction work, road dust or natural dust storms. These particles can pass into our lung and irritate our nose, throat, and eyes. The second is fine dust (PM2.5), It is a grouping of particles with an average diameter of 2.5 micrometer or smaller. PM 2.5 can create by natural or man-made source, such as wildfires, volcanic eruption, vehicle exhaust, power plant emission etc. These particles can deeply pass into our lungs and even entering our bloodstream. The third is ultrafine dust (PM0.1), It is a grouping of particles with an average diameter of 0.1 micrometer or smaller. These particles originate from similar source of PM2.5. PM0.1 poses a worse threat than PM2.5, as the smaller particle size can infiltrate our bodies to an even greater extent.

1.1.2 Particulate Matter2.5 (PM2.5)

Based on a review of the literature, there are many previous study involving the impact and of particulate matter (PM 2.5) in both Thailand and foreign countries.

In Thailand, the crucial peak concentration of PM2.5 and PM10 are always occur in March every year. This may due mainly to the agricultural burning and followed by wildfire which was occurred in the country and neighboring countries. (Buadapthip, 2011; Chairattanawan & Patthirasinsiri 2019). Therefore, the impact of PM2.5 cause in both health issues and economic issues such as in 2019 the air pollution causes the economic damage to the nation anywhere from 2,600 million baht to 6,600 million baht or higher and also has native effect on tourism within the country (Borirak ,2019).

In case of foreign countries, the haze pollution has a significantly negative impact on economic development. For example, in 2015 China faced the problem of PM2.5 which an increasing of 5 μg/m3 in PM2.5 concentrations may cause a decrease of approximately 2500 yuan in GDP per capita (Hao et al, 2018). Moreover, (Samdal & Herman ,2019) studied the impact of income, preferences, and regulation on particulate matter pollution using fixed effects model found that the isolated effect of the directive is estimated to be a reduction in PM2.5 levels of 6 %. This effect is robust to inclusions of EKC-relationships in the estimation. Furthermore, the impact of PM2.5 also has significantly effect on health expenditure (Yazdia & Khanalizadehb, 2017). The estimated number of PM2.5 induced average annual premature deaths in South and Southeast Asia increased from 1,179,400 in 1999 to 1,724,900 in 2014, with a growth rate of 38% (Shi et al., 2018).

The impact of PM2.5 effected on everyone not only one group of people. Therefore, everyone should concern more on the air pollution problem and help each other to reduce the air pollution for the future generation.

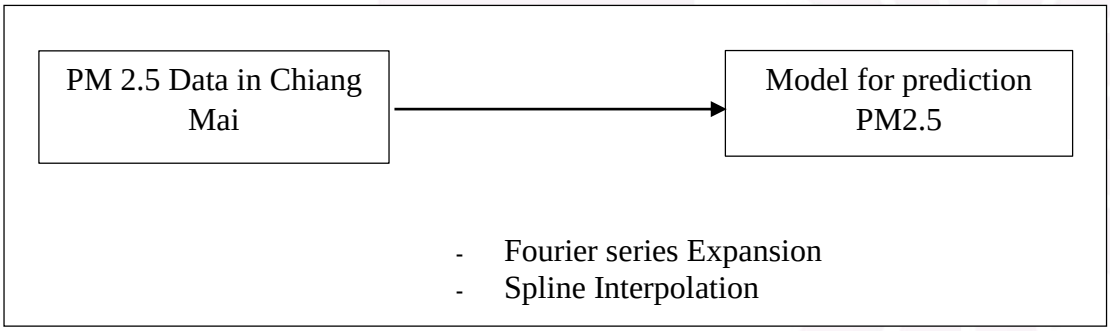
1.1.3 Fourier series

There are many researchers have studied the Fourier analyses and its advantages. For example, Fourier analyses can be used for see the length of cycle on several data sources including electricity demand, foreign currency data, monthly retail sales, quarterly GDP, labor market, productivity statistics (Liu, Paki, Stonehouse, & You, 2012), and monthly inflation rates (Omekara, Ekpenyong & Ekrete , 2013). However, Fourier series model can be used to fit the data. In 2016, Thomas & Vuuren examined and attempts to forecast South African Gross Domestic Product (GDP) monthly from January 1969 to July 2015 time series data using Fourier series analysis found that Fourier series model was fitted to the data to make accurate short term monthly inflation rate forecasts from an out-of-sample period from September 2011 to September 2012. Similarly, in 2018 the Fourier transformation on model fitting for Pakistan inflation rate affected by periodic or cyclical variation as long-term inflation cycle is 34 months and short-term inflation cycle is 20 months (Lqbal, Ahmad, & Ali,2018) In addition, in 2019 the Swedish stock market showed sign of periodic

behavior in the long term but adhered to the weak form efficiency in the short term (Fang ,2019).According to Chan et al. (2007), factors that influence buyers to bring their own bags include two basic moral philosophies, which are deontological and teleological ethical evaluations. Deontological ethical evaluation is an action that considers the moral good of the action itself, not because of the consequence of that action, such as the buyers bring their own bags because they think that it is a duty to bring. On the other hand, teleological ethical evaluation, or it can be called consequentialist ethics or consequentialism, is the evaluation base on the consequence of the action; for example, the buyers bring their own bags because they care about the environment or want to reduce unnecessary waste (Chan et al., 2007).

1.1.4 Spline Interpolation

The spline interpolation which is a form of interpolation where the interpolant is a special type of piecewise polynomial called a spline. That is, instead of fitting a single, high degree polynomial to all of the values at once, spline interpolation fits low-degree polynomials to small subsets of the values. In 2015, Rappai focus on spline interpolation, a special class of interpolation methods. The focal issue being addressed is that the augmentation of gaps within non-equidistant time series (using averages, preceding values, etc.) often leads to incorrect and misleading conclusions as the augmented time series, after the augmentation, are treated as if they were, in fact, equidistant. However, in 2017 Ahmad & Deeba studies the theory of Interpolation and its applications in numerical analysis. It specially focuses on cubic spline interpolation. Data interpolation is useful for scientific visualization for data interpretation. One of the efficient methods for data interpolation is cubic spline function.



This study would construct a model for predict PM2.5 in Chiang Mai Province, Thailand, which the data of PM2.5 is obtained from Air Quality and Noise Management Bureau, Pollution Control Department. Chiang Mai city hall and Yupparaj Wittayalai School monitoring stations are selected to be representative of PM 2.5 in Chiang Mai because of the density of population and these two areas are always have outdoor activities and events. This study constructs a model for predict PM2.5 by using Fourier Series Expansion and Spline Interpolation and compare the performance of Fourier Series Expansion and Spline Interpolation as following steps:

1. Collect the PM2.5 data.

2. Fit the model using Fourier Series Expansion.

For a function $f(x)$ periodic on an interval [0,2*L*] instead of [-π,π], a simplechange of variable may use to transform the interval of integration from [-π,π] to [0,2*L*] by letting

$$x = \frac{\pi x'}{L} \tag{1}$$

Solving for x' and substituting into (2) gives:

$$f(x') = \frac{1}{2}a_0 + \sum_{n=1}^{\infty} a_n \cos\left(\frac{n\pi x'}{L}\right) + \sum_{n=1}^{\infty} b_n \sin\left(\frac{n\pi x'}{L}\right) \tag{2}$$

Where

$$a_0 = \frac{1}{L}\int_0^{2L} f(x')dx$$
$$a_n = \frac{1}{L}\int_0^{2L} f(x')\cos\left(\frac{n\pi x'}{L}\right)dx$$
$$b_n = \frac{1}{L}\int_0^{2l} f(x')\sin\left(\frac{n\pi x'}{L}\right)dx$$

3. Fit the model using Spline Interpolation.

By definition, on every subinterval I_j given by $x_j \le x \le x_{j+1}$ the spline $g(x)$ must agree with a polynomial $q_j(x)$ of degree not exceeding such that

$$q_j(x_j) = f(x_j),\ q_j(x_{j+1}) = f(x_{j+1}) \qquad (j = 0,1,\dots,n-1). \tag{3}$$

For the derivatives we write

$$q'_j(x_j) = k_j,\ q'_j(x_{j+1}) = k_{j+1} \qquad (j = 0,1,\dots,n-1). \tag{4}$$

With k_0 and k_n given and $k_1,\dots, k_{n-1}$ to be determined later. Equations (3) and (4) are four conditions for each $q_j(x)$. By direct calculation, using the notation

$$c_j = \frac{1}{h_j} = \frac{1}{x_{j+1}-x_j} \qquad (j = 0,1,\dots,n-1). \tag{5*}$$

We can verify that the unique cubic polynomial $q_j(x)$ $(j = 0,1,\dots,n-1)$ satisfying (3) and (4) is

$$\begin{aligned} q_j(x) = {} & f(x_j)c_j^2(x-x_{j+1})^2[1+2c_j(x-x_j)] \\ & + f(x_{j+1})c_j^2(x-x_{j+1})^2[1+2c_j(x-x_{j+1})] \\ & + k_j c_j^2(x-x_j)(x-x_{j+1})^2 + k_{j+1}c_j^2(x-x_j)^2(x-x_{j+1}) \end{aligned} \tag{5}$$

Differentiating twice, we obtain

$$q''_j(x_j) = -6c_j^2 f(x_j) + 6c_j^2 f(x_{j+1}) - 4c_j k_j - 2c_j k_{j+1} \tag{6}$$
$$q''_j(x_{j+1}) = -6c_j^2 f(x_j) - 6c_j^2 f(x_{j+1}) + 2c_j k_j + 4c_j k_{j+1} \tag{7}$$

By definition, $g(x)$ has continuous second derivatives. This gives the conditions

$$q''_{j-1}(x_j) = q''_j(x_j) \qquad (j = 0,1,\dots,n-1).$$

If we use (7) with j replaced by $j-1$, and (6), these $n-1$ equations become

$$c_{j-1}k_{j-1} + 2(c_{j-1} + c_j)k_j + c_j k_{j+1} = 3[c_{j-1}^2 \nabla f_j + c_{j-1}^2 \nabla f_{j+1}] \quad (8)$$

Where $\nabla f_j = f(x_j) - f(x_{j-1})$ and $\nabla f_{j+1} = f(x_{j+1}) - f(x_j)$ and $j = 1, \dots, n-1$, as before. This linear system of $n-1$ equation has a unique solution $k_1, \dots, k_{n-1}$ since the coefficient matrix is strictly diagonally dominant (that is, in each row the (positive) diagonal entry is greater than the sum of the other (positive) entries). Hence the determinant of the matrix cannot be zero, so that we may determine unique value $k_1, \dots, k_{n-1}$ of the first derivative of $g(x)$ at the nodes.

Determination of splines

Let k_0 and k_n be given. Obtain $k_1, \dots, k_{n-1}$ by solving the linear system (8). Recall that the spline $g(x)$ to be found consists of n cubic polynomials $q_0, \dots, q_{n-1}$. We write these polynomials in the form

$$q_j(x) = a_{j0} + a_{j1}(x - x_j) + a_{j2}(x - x_j)^2 + a_{j3}(x - x_j)^3 \quad (9)$$

Where $j = 0, \dots, n-1$. Using Taylor's formular, we obtain

$$a_{j0} = q_j(x_j) = f_j \quad (10)$$
$$a_{j1} = q'_j(x_j) = k_j$$
$$a_{j2} = \frac{1}{2}q''_j(x_j) = \frac{3}{h^2}(f_{j+1} - f_j) - \frac{1}{h}(k_{j+1} + 2k_j)$$
$$a_{j3} = \frac{1}{6}q'''_j(x_j) = \frac{2}{h^3}(f_j - f_{j+1}) + \frac{1}{h^2}(k_{j+1} + k_j)$$

with a_{j3} obtained by calculation $q''_j(x_{j+1})$ from (9) and equation the result to (7), that is,

$$q''_j(x_{j+1}) = 2a_{j2} + 6a_{j3}h = \frac{6}{h^2}(f_j - f_{j+1}) + \frac{2}{h}(k_j + 2k_{j+1}),$$

and now subtracting from this $2a_{j2}$ as given in (6) and simplifying.

Note that for equidistant nodes of distance $h_j = h$ we can write $c_j = c = \frac{1}{h}$ in (5*) and have from (8) simply

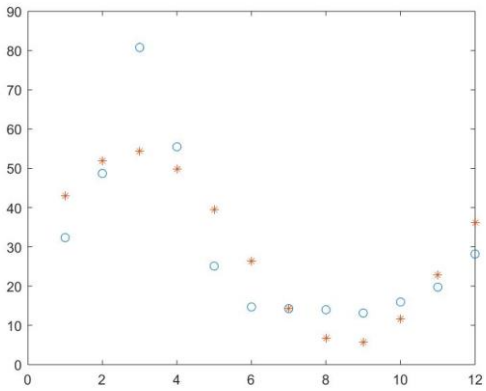
$$k_{j-1} + 4k_j + k_{j+1} = \frac{3}{h}(f_{j+1} - f_j) \qquad (j = 1, \dots, n-1) \quad (11)$$

4. Compare the performance between Fourier Series Expansion and Spline interpolation.

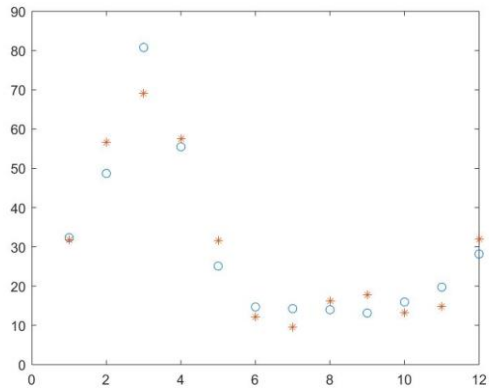
3. Results

3.1 The performance between Fourier Series Expansion and Spline Interpolation of Yupparaj Wittayalai School monitoring station

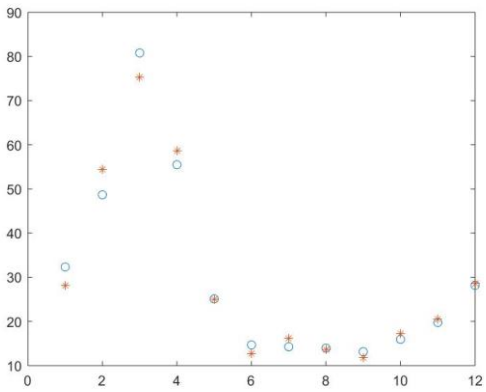
The study uses fitting Fourier coefficient to see the performance of Fourier Series Expansion. The result show that the test of the average amount of PM2.5 of fitting Fourier coefficient 5 (Fourier 5) is more precise than others (Fourier1, Fourier 2 Fourier 3, Fourier 4) as following graphs:



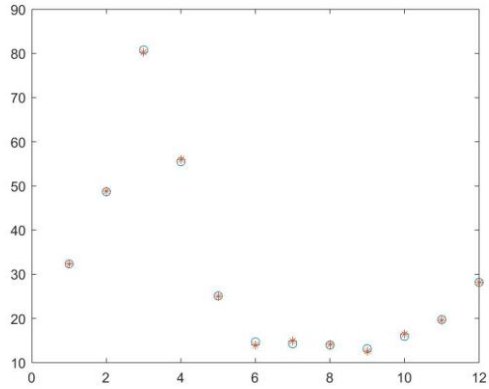
Fourier 1



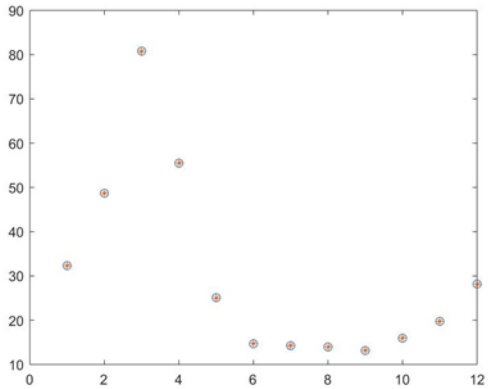
Fourier 2



Fourier 3



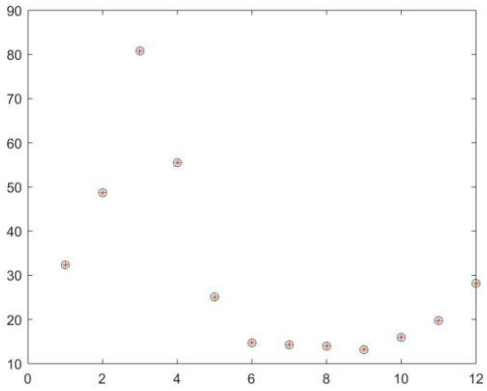
Fourier 4



Fourier 5

Note: ∘ stand for data plots, ∗ stand for test plots.

The study uses cubic splines for Spline interpolation to avoid the problem of Runge's phenomenon. The result show that the data plots and the test plots of the average amount of PM2.5 are stay at the same point.



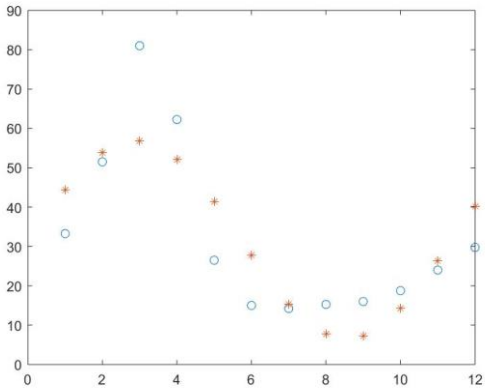
Spline Interpolation

Note: ○ stand for data plots, ∗ stand for test plots.

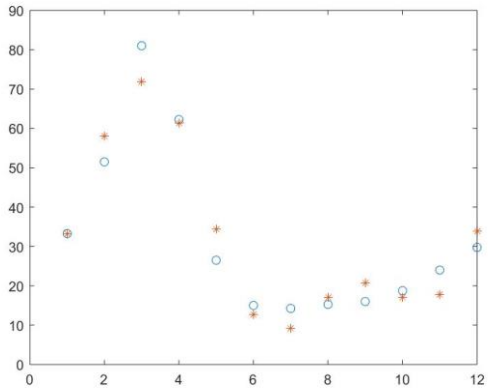
Therefore, the performance between Fourier Series Expansion of fitting Fourier coefficient5 (Fourier 5) and Spline Interpolation of Yupparaj Wittayalai School monitoring station have the same performance.

3.2 The performance between Fourier Series Expansion and Spline Interpolation of Chiang Mai city hall monitoring station

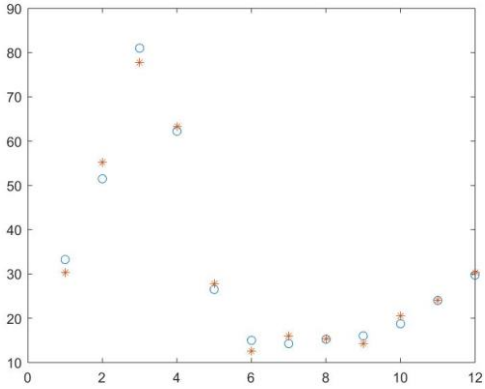
The study uses fitting Fourier coefficient to see the performance of Fourier Series Expansion. The result show that the test of the average amount of PM2.5 of fitting Fourier coefficient 5 (Fourier 5) is more precise than others (Fourier1, Fourier 2 Fourier 3, Fourier 4) as following:



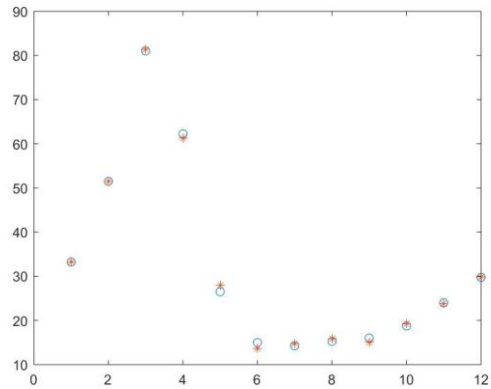
Fourier 1



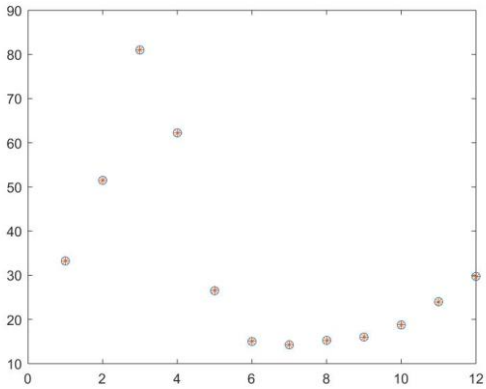
Fourier 2



Fourier 3



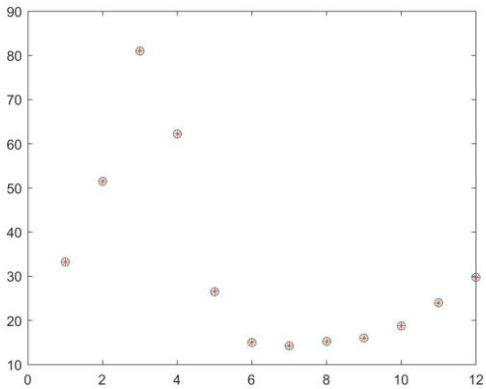
Fourier 4



Fourier 5

Note: ∘ stand for data plots, ∗ stand for test plots.

The study uses cubic splines for Spline interpolation to avoid the problem of Runge's phenomenon. The result show that the data plots and the test plots of the average amount of PM2.5 are stay at the same point.



Spline Interpolation

Note: ∘ stand for data plots, ∗ stand for test plots.

Therefore, the performance between Fourier Series Expansion of fitting Fourier coefficient5 (Fourier 5) and Spline Interpolation of Chiang Mai city hall monitoring station have the same performance.

3.3 Model Application

The original data set of air pollution concentration from Pollution Control Department (PCD) is a time series data of 24- hour average of PM2.5 in order to perform the Fourier Series Expansion in the study. It has to transformed into mean monthly data which Chiang Mai city hall and Yupparaj Wittayalai School monitoring stations are selected to be representative of PM 2.5 in Chiang Mai. The study specifies the month to compute the average of PM2.5, month_x= 3.5 which mean the study want to know the average amount of PM2.5 in March and a half month of April.

3.3.1 Yupparaj Wittayalai School Monitoring Station

The result show that the average amount of PM2.5 are varied in different coefficients of fitting Fourier model. However, the test of the average amount of PM2.5 of fitting Fourier coefficient 5 (Fourier 5) has nearly approximate value to the average amount of PM2.5 from the result of Spline interpolation.

Table 1.1: Amount of PM 2.5 ($\mu g/m^3$) at month_x = 3.5 using Fourier Series Expansion and Spline interpolation

	Amount of PM 2.5($\mu g/m^3$) at month_x = 3.5
Fit Fourier Model Fourier 5	72.4012
Spline Interpolation	73.3314

Note: The number of Fourier coefficients depends on the amount of data.

3.3.2 Chiang Mai City Hall Monitoring Station

The result show that the average amount of PM2.5 are varied in different coefficients of fitting Fourier model. However, the test of the average amount of PM2.5 of fitting Fourier coefficient 5 (Fourier 5) has nearly approximate value to the average amount of PM2.5 from the result of Spline interpolation.

Table 1.2: Amount of PM 2.5 (μg/m^3) at month_x = 3.5 using Fourier Series Expansion and Spline interpolation

	Amount of PM 2.5(μg/m^3) at month_x = 3.5
Fit Fourier Model (Fourier 5)	77.9234
Spline Interpolation	77.1506

Note: The number of Fourier coefficients depends on the amount of data.

From the model application show that if there is no record data like the example above (x= 3.5, which means a half between March and April), the temporal variation model can use to predict the approximate amount of PM2.5(μg/m^3).

4. Conclusion and Recommendation

In Thailand, the Pollution Control Department (PCD) has installed the air monitoring and meteorological stations in some main provinces, which some of them located in Chiang Mai province. Chiang Mai is essentially Thailand's second city because the smaller and more relaxed answer to the madness of Bangkok. It is now one of the most popular provinces for both international tourists and Thai's tourists. However, there are the arguments that Chiang Mai has been change and become worst during December to April because of the air pollution especially particulate matter 2.5 (PM2.5). Therefore, Chiang Mai city hall and Yupparaj Wittayalai School monitoring stations are selected to be representative of PM 2.5 in Chiang Mai because of the density of population and these two areas are always have outdoor activities and events. One possible way to manage the damage risk incurred PM2.5 is to use the derivatives as in the weather derivative. Since the effective time of the derivative contract needs to be specified, the modeling of temporal variation of PM2.5 becomes a crucial component in preparing the PM2.5 derivative. The study aims at proposing a model of temporal variation of PM2.5 in Chiang Mai, Thailand. The magnitude of PM2.5 in certain periods of time can be observed every year in Chiang Mai by using Fourier Series Expansion and Spline Interpolation and compare the performance of Fourier Series Expansion and Spline Interpolation.

The study can conclude that the temporal variation model can use to predict the approximate value PM2.5 accurately. Therefore,

1.The models can bring significant benefit to business with profit that depend on sensitive situation of the PM2.5 which would reduce the risk associated with adverse or unexpected weather condition by do weather derivative.

2. The model can be applied to other regions where the PM2.5 occurrence is due to seasonal characteristics.

3. The study can benefit for government sector to planning and making decision in applying information to formulate economic policies which would reduce the air pollution problem for green economy by

3.1 Replacement of fuel by changing from the standard Euro 4 to Euro 5 or Euro 6.
3.2 Development of integrated urban planning by incorporating the initiative of reducing air pollution (PM2.5) to be part of urban planning.
3.3 Replacing all types of public transport vehicles with electric vehicles.
3.4 Promote travelling without engines by arranging to have non-motorized transportation which are practical and user friendly to encourage and change the habits into using transportation without engines while promoting the health of population.
3.5 Collect Eco tax by collecting environmental tax or frees according to the principle "Polluter Pays Principle" (PPP) which are pollution taxes and permit.

However, if there is more record data of PM2.5, it would increase the accuracy for this model. Moreover, to reduce the air pollution problem is not dependent on the government or local authorities, but it is the responsibility of everyone in society in order to live in safe and better environment in the long run.

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The Impact of Fiscal Decentralization on Income Inequality in Developing and Developed Countries

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Abstract

Within the context of sustainable development goals, income inequality becomes a topic of significant interest for academics and policymakers. This study builds on previous literature finding a way to reduce income inequality and fiscal decentralization is one factor affecting income inequality. This study collects data to investigate how fiscal decentralization affects income inequality and its asymmetric impact of fiscal decentralization on income inequality in developing and developed countries. In order to analyze the impact of fiscal decentralization, this study applies the dynamic panel threshold model contributing a threshold for fiscal decentralization to compare its effects in two regimes. The results indicates that the share of subnational government expenditure helps to alleviate income inequality when it is greater than threshold, while it increases income inequality when it is lower than threshold in developed countries. The results suggest that distributional effects of fiscal decentralization should be concerned before implementing a transferring power in terms of expenditure and revenue to local government since the impact of fiscal decentralization is asymmetric between developing and developed countries.

Keywords: fiscal decentralization, income inequality, impact of fiscal decentralization on income inequality, dynamic panel threshold model

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1. Introduction

According to According to the most recent UN Department of Economic and Social Affairs (DESA)'s World Social Report published in Jan 2020, a number of rising inequality countries increases and accounts for 71 percent of the world population. Generally speaking, countries and regions that stayed at low levels of inequality in 1990 have faced rising in Gini coefficient and many countries still suffer from high income inequality. In addition, the top of income distribution as the rich even in some countries that have seen declining in Gini coefficient. The share of income earned by the top 1 percent of the population rose in 59 out of 100 countries since 1990 to 2015.The richest 1 percent in 18 countries with the data earned more than 20 percent of income distribution including Brazil, Chile, India, the Russia Federation, Thailand, Turkey, the United Arab Emirates and the United States. Generally speaking, in the situation of post crisis macroeconomic growth, income inequality has increased and this becomes an interesting topic for policymakers to understand and solve it (Goerl and Seiferling, 2014). Simultaneously, fiscal decentralization is considered in many countries to raise the efficiency of government (Oates, 2006). Over several decades, many countries around the world have adopted fiscal and political decentralization that gives authority to sub-national governments. Decentralization is motivated by many different reasons. Many unitary countries in the past several years sought to decentralize in order to make the public sector more efficient in term of social welfare. In general, fiscal decentralization copes with how the public sector is organized and how to create opportunity for economic growth and well-being of people.

Fiscal decentralization is considered in many countries to raise the efficiency of government and decentralized government play a supportive role in income redistribution and macroeconomic policy as primary responsibilities (Oates, 2006) since subnational governments (SNG) are familiar to their constituencies and they also have a specialized knowledge of demands or preferences of people in their jurisdictions and local conditions (problems). According to OECD Regions and Cities at a Glance 2018, SNGs are significant actor for social inclusion as they provide a welfare benefits to individuals and households (old age, disability, health, education, poverty alleviation, etc.). SNG expenditure accounts for 40% of total public expenditure includes education, social protection, general public services, health, economic affairs or transport, environment, housing and community amenities, public order, safety and defence. These types of SNG investment can be differently weighted relied on a particular SNG decision and their authorities. To illustrate, issues of education and public services can be enhanced by SNG who know what their citizens are facing, then well-beings is improved as well as poverty alleviation or less income inequality.

This study identifies the impact of fiscal decentralization on income inequality whether it helps to reduce gap of income inequality or not. Additionally, this study contributes a threshold level of fiscal decentralization then the impact could be asymmetric between two regimes including the level of fiscal decentralization is lower than threshold value and the level of fiscal decentralization is greater than threshold value. Also, other control variables as gross domestic product, human development index, urbanization, trade openness, and corruption could influence income inequality differently relying on each regimes. Furthermore, this study can explain and compare the similarities and differences of its asymmetric impact of fiscal decentralization on

income inequality between developing and developed countries. This study applies the dynamic panel threshold model in order to explain different results from two regimes. Since the main purpose of this study is finding the impact of fiscal decentralization on income inequality. Government or public officer will get the benefit from this study because they get to know more whether the fiscal decentralization should be forced or not in order to reduce income inequality because the problem may be unsolved yet in many countries. Moreover, the fiscal decentralization might have a proper level to alleviate income inequality. Therefore, this study could inform government how many percentages they should decentralize in term of sub-national government expenditure and revenue.

1.1 Literature Review

1.1.1 Definition, types and measurements of fiscal decentralization

Decentralization refers to the process of transferring decision-making powers from central government to sub-national government (Schneider, 2003). Decentralization is divided into three dimensions: fiscal, administrative, and political.

Fiscal decentralization explains transferring fiscal responsibilities as well as distributing expenditure or raising revenues from national government to subnational governments; administrative decentralization explains transferring decision making autonomy or the right to act from central government to subnational governments; and political decentralization explains giving citizens in jurisdictions to participate in governance through electoral processes (Schneider, 2003).

1.1.2 Impact of fiscal decentralization on income inequality

Lessmann (2012) analyzed the impact of political and fiscal decentralization on income inequality by using data set at different stages of economic development. Decentralization reduces regional inequality. By the way, estimations also shows that the impact depends on the level of economic development. The findings show that rich countries benefit from decentralization, but decentralization leads to increase higher regional inequality in developing countries. Also, Cavusoglu and Dincer (2015) found the fiscal decentralization reduced income inequality in the richer states, but it turns to increase income inequality for poor states. In addition, Bojanic (2018) addressed the impact of fiscal decentralization on income inequality 12 countries of Americas. A result showed that the impact of fiscal decentralization on the Gini coefficient is clearer with the sample of countries in Americas. Two decentralization indicators are positive and statistically significant in several cases concluding that decentralization definitely contributes to reduce income inequality in developing countries in Americas in only some cases. In addition, the impact of decentralization on income inequality is not totally clear. According to Bojanic and Collins (2019) found that fiscal decentralization tended to make income inequality worse off as subnational expenditure as showed in positive and statistically significant coefficient in both OECD and non-OECD countries. Also, the subnational revenues indicator does. Cavusoglu and Dincer (2015) also found that the fiscal decentralization reduced income inequality in the richer states, but it turns to increase income inequality for poor states. Nevertheless, sub-national government expenditure was more effective than sub-national government revenue in

reducing income inequality. Distributional effects of decentralization should be concerned before implementing a transferring powers to local government.

Nevertheless, Torrisi (2011) found the greater fiscal decentralization contributes to a decrease of within region interpersonal inequality. A finding points that the impact of decentralization on interpersonal inequality is higher than expected. As the greater fiscal decentralization contributes to a decrease of within interpersonal inequality, the moderator of the relationship is the level of development of the region. In case of income rises, the productivity of fiscal decentralization is lower to reduce the within-region interpersonal inequality. The relationship is strongly affected by the level of wealth of the region to which budget and authority are decentralized. The findings are opposite to the views that worse off regions would be disadvantaged due to lack of capacity and budget constraints then the regions cannot afford the effective policies reducing interpersonal inequality. Less wealthy regions seem to benefit the most from greater fiscal decentralization on income inequality. (Tselios, Rodriguez-Pose, Pike, Tomaney and Torrisi, 2012)

The decentralization of government expenditure can contribute to achieve a more equal income distribution. Nevertheless, many conditions need to be accomplished; sufficient government size, comprehensive decentralization, expenditure and revenue decentralization (Goerl and Seiferling, 2014). In case of sufficient government size, Martinez-Vazquez (2010) explores the wide aspect of possible effects that fiscal decentralization policy might affect poverty and income inequality. In conclusion, the positive and statistically significant coefficient of fiscal decentralization represents that fiscal decentralization worsens income inequality. In contrast, decentralization and size of government are negative and significant coefficient for the interaction term represents that the worsening effect of decentralization diminishes with government size. Therefore, when the government reaches a sufficiently large size, fiscal decentralization definitely works to reduce income inequality. Moreover, Lessmann (2012) supported the theory of inverse-U shaped relationship between economic development and income inequality. Efficiency enhancing effects from decentralization, which may lead to regional convergence, tend to happen in developed countries because of better institutional environment. As mentioned above, poor countries seem to be suffered from decentralization, but rich countries benefit in term of regional inequality. Fiscal decentralization decreases income inequality in countries with good governance. In contrast, decentralization increases income inequality since the governance is poor. It can be implied that fiscal decentralization seems to increase income inequality in developing countries and it decreases in developed ones because wealthier countries tend to have better quality governments (Kyriacou, Muinelo-Gallo and Roca-Sagalés, 2015)

1.1.3 Economic development, Human development index and income inequality

The relationship between economic growth and income inequality is relatively positive. Ishak Shari (2000) examines the effect of economic growth on income inequality in Malaysia during 1971 to 1995. The objective is found that the rapid economic growth leads to poverty alleviation and decline of income inequality during the period. However, rapid economic growth during 1991 to 1995 starts to

increase the income inequality because the benefits of rapid growth spread unevenly across different groups of people. Some investigated the impact of economic growth on both income inequality and poverty and found that stimulating the current economic growth with policies may alleviate poverty but on the cost of widening the gap of income inequality (Mahesh, 2016; Niyimbanira, 2017). Amir Rubin and Dan Segal (2015) analyzed the relationship between economic growth and income inequality in US during 1953 to 2008. An empirical analysis is based on the idea that wealth and labor income are affected by both present and future growth. To illustrate, the sensitivity to economic growth of income resources, in the field of financial economics, may be different across income groups. Also, they find that both wealth and labor income change because of present or expectation about future growth. In fact, this study's contribution is to show multi-dimensional process of growth that may affect income distribution, but the concurrent growth rate is only one component which affects income inequality. The increased sensitivity happens for two reasons. First, the top income groups receive a large amount of income from wealth, which is more sensitive to growth than labor income. Second, the top income groups earn a large amount of their income from labor in term of pay-for-performance. In conclusion, the evidence showed the growth process leads to rising in income inequality in the US.

1.1.4 Urbanization and income inequality

The impact of urbanization on income inequality in Asia. Urbanization is explained by the rising share of urban population. Eventually, Kanbur and Zhuang (2013) found that the impact depends on a specific country. Urbanization leads to increase in inequality about 300% at the national level of Philippines, over 50% in Indonesia, lower than 15% in India, but it helps to reduce income inequality in the People's Republic of China. However, the PRC has passed the turning point that the urbanization will help reduce income inequality at the national level while others has not reached the turning point. Especially, India and Indonesia which are far away from the point, so the urbanization will lead to higher income inequality in both countries. In contrast, Wu and Rao (2017) focused on finding the main causes of income inequality. Therefore, they aimed to investigate the relationship between urbanization and income inequality indicating a strong inverted-U-shaped relationship between urbanization and income inequality. As the rate of urbanization reach 0.53, the implication showed that this rate of urbanization leaded to reduce income inequality. Furthermore, Ha, Le and Trung-Kien (2019) considered the impact of urbanization on income inequality in both short term and long term and found that urbanization leads to reduce income inequality in Vietnam in both short term and long term. However, policies to increase social welfare should be achieved to reduce the gap between rich and poor.

1.1.5 Trade Openness and income inequality

Trade openness is involved with more equal income distribution within countries. However, Policy makers might promote international trade to make income distribution more equal while compensating the group of people who lose their benefit from trade openness (Reuveny and Li, 2003). By the way, Mahesh (2016) observed the impact of trade openness on income inequality in the BRIC countries and he find that trade openness significantly affects income inequality in positive way. Moreover, the

researcher separately tested for the impacts of imports and exports and the results remain positive and significant and concluded increasing in trade openness worsen the income distribution in BRIC countries. Barro (2008) revisited the inequality and economic growth considering multi-dimensional determinants of economic growth, especially the international trades and a result showed Trade openness has significantly positive coefficient on income inequality as more trade worsens income inequality.

1.1.6 Corruption and income inequality

Broadly speaking, Corruption is found to be associated with income inequality positively (Brempong, 2002). The core functions of government are interfered by corruption in terms of allocation of resources, economic stabilization and redistribution of income. These functions with efficient enhancing can influence better income distribution and alleviation of poverty. Gupta, Davoodi and Alonso-Terme (2002) indicated that the increasing in corruption leads to higher income inequality and poverty. Additionally, Dincer and Gunalp (2008) investigated the impact of corruption on income inequality and they found a robust evidence that an increase in corruption increases Gini coefficient by 0.3 percentage points, the standard deviation of the logarithms by 0.6, the relative mean deviation by 0.5, the coefficient of variation by 1.4 which confirm an increase in corruption increases income inequality.

2. Methodology

This study used secondary data to identify the impact of fiscal decentralization on income inequality using the dynamic panel threshold model. In the estimation process, this study has two objectives including: (1) identify identifies the impact of fiscal decentralization on income inequality and quantify the threshold value of fiscal decentralization and its asymmetric impact on income inequality, and (2) compare the impact of fiscal decentralization on income inequality in developing and developed countries. The data and methodologies for the objectives are as follows.

2.1 Data

This study uses data during 2002-2017 period. All data from 3 countries divided into 12 selected developing countries consist of Armenia, Belarus, Costa Rica, El Salvador, Georgia, Honduras, Moldova, Paraguay, Peru, Russian Federation, Thailand, and Ukraine. And 21 developed countries are Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Iceland, Italy, Latvia, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, and United Kingdom.The data collected as annually data are taken from IMF's Government Finance Statistics (GFS), the World Bank as World Development Indicator (WDI), Transparency International, and OECD fiscal decentralisation database.

2.2 Regression analysis

The first purpose is investigating the relationship between fiscal decentralization and income inequality using dynamic panel threshold models. Initially, the dependent and independent variables must be checked the stationary of the data. The null hypothesis that the series is not stationary (there is a unit root), if the statistical

value is greater than the critical value, it indicates an acceptance of the null hypothesis. The Levin, Lin and Chu (2002) regression is defined as follows:

$$\Delta y_{it} = \delta y_{it-1} + \sum_{L=1}^{P_i} \theta_{iL} \Delta y_{it-L} + \alpha_{mi} d_{mt} + \varepsilon_{it}; \qquad i = 1, \ldots, N \tag{1}$$

where

Δy_{it} = the first difference of variables used in this study (Table2)

δ = the coefficient of lagged value of y_{it-1}

d_{mt} = the appropriate deterministic variables (an intercept or time trend)

α_{mi} = the coefficient of the deterministic variables

ε_{it} = error term

The lag order p_i is allowed to vary across individuals, in this study, we choose a maximum lag order $p_{\max}$ or add lag term until the data have no autocorrelation. Eq.(1) is estimated using Ordinary Least Square (OLS), then compare the result of t-statistic value to critical t-statistic. Following a principle, if the value of t-statistic exceeds the ADF t-statistic value, the null hypothesis will be rejected, it means the time series data is stationary. In contrast, if the value of t-statistic does not exceed ADF t-statistic value, the null hypothesis is accepted, it means that the time series data is non-stationary. While the null hypothesis and alternative hypothesis can be written as:

$H_0 : \delta = 0$ (y_{it} is non-stationary)

$H_1 : \delta \neq 0$ (y_{it} is stationary)

After that, this study utilize both non-dynamic and dynamic panel threshold models to investigate the impact of fiscal decentralization on income inequality considering two groups: All countries, developing countries, and developed countries. In case of non-dynamic panel threshold models, the empirical equations are presented as follow;

For developed countries;

$$\ln GINI_{it}^{DD} = \mu_{31} + \beta'_{31} \ln FIS_{it}^{DD} + \beta'_{32} \ln GDP_{it}^{DD} + \beta'_{33} \ln HDI_{it}^{DD} + \beta'_{34} \ln URB_{it}^{DD} + \beta'_{35} \ln OPN_{it}^{DD} + \beta'_{36} \ln COR_{it}^{DD} + e_{it}, \ln Fis_{it}^{DD} \le \gamma \tag{2}$$

$$\ln GINI_{it}^{DD} = \mu_{41} + \beta'_{41} \ln FIS_{it}^{DD} + \beta'_{42} \ln GDP_{it}^{DD} + \beta'_{43} \ln HDI_{it}^{DD} + \beta'_{44} \ln URB_{it}^{DD} + \beta'_{45} \ln OPN_{it}^{DD} + \beta'_{46} \ln COR_{it}^{DD} + e_{it}, \ln Fis_{it}^{DD} > \gamma \tag{3}$$

For developing countries;

$$\ln GINI_{it}^{dev} = \mu_{51} + \beta'_{51} \ln FIS_{it}^{dev} + \beta'_{52} \ln GDP_{it}^{dev} + \beta'_{53} \ln HDI_{it}^{dev} + \beta'_{54} \ln URB_{it}^{dev} + \beta'_{55} \ln OPN_{it}^{dev} + \beta'_{56} \ln COR_{it}^{dev} + e_{it} \ln Fis_{it}^{dev} \le \gamma \tag{4}$$

$$\ln GINI_{it}^{dev} = \mu_{61} + \beta'_{61} \ln FIS_{it}^{dev} + \beta'_{62} \ln GDP_{it}^{dev} + \beta'_{63} \ln HDI_{it}^{dev} + \beta'_{64} \ln URB_{it}^{dev} + \beta'_{65} \ln OPN_{it}^{dev} + \beta'_{66} \ln COR_{it}^{dev} + e_{it}, \ln Fis_{it}^{dev} > \gamma \tag{5}$$

In case of dynamic panel threshold regression, this study uses one lag of dependent variable since $GINI_{it}$ is considered as endogenous variable as $GINI_{it}$ is related to $GINI_{it-1}$ to avoid an overfit of instrumental variables that may lead to biased coefficient estimates.

For developed countries;

$$\ln GINI_{it}^{DD} = \mu_{31} + \beta'_{37} \ln GINI_{it-1}^{DD} + \beta'_{31} \ln FIS_{it}^{DD} + \beta'_{32} \ln GDP_{it}^{DD} + \beta'_{33} \ln HDI_{it}^{DD} + \beta'_{34} \ln URB_{it}^{DD} + \beta'_{35} \ln OPN_{it}^{DD} + \beta'_{36} \ln COR_{it}^{DD} + e_{it}, \ln Fis_{it}^{DD} \le \gamma \tag{6}$$

$$\ln GINI_{it}^{DD} = \mu_{41} + \beta'_{47} \ln GINI_{it-1}^{DD} + \beta'_{41} \ln FIS_{it}^{DD} + \beta'_{42} \ln GDP_{it}^{DD} + \beta'_{43} \ln HDI_{it}^{DD} + \beta'_{44} \ln URB_{it}^{DD} + \beta'_{45} \ln OPN_{it}^{DD} + \beta'_{46} \ln COR_{it}^{DD} + e_{it}, \ln Fis_{it}^{DD} > \gamma \tag{7}$$

For developing countries;

$$\ln GINI_{it}^{dev} = \mu_{51} + \beta'_{57} \ln GINI_{it-1}^{dev} + \beta'_{51} \ln FIS_{it}^{dev} + \beta'_{52} \ln GDP_{it}^{dev} + \beta'_{53} \ln HDI_{it}^{dev} + \beta'_{54} \ln URB_{it}^{dev} + \beta'_{55} \ln OPN_{it}^{dev} + \beta'_{56} \ln COR_{it}^{dev} + e_{it}, \ln Fis_{it}^{dev} \le \gamma \quad (8)$$

$$\ln GINI_{it}^{dev} = \mu_{61} + \beta'_{67} \ln GINI_{it-1}^{dev} + \beta'_{61} \ln FIS_{it}^{dev} + \beta'_{62} \ln GDP_{it}^{dev} + \beta'_{63} \ln HDI_{it}^{dev} + \beta'_{64} \ln URB_{it}^{dev} + \beta'_{65} \ln OPN_{it}^{dev} + \beta'_{66} \ln COR_{it}^{dev} + e_{it}, \ln Fis_{it}^{dev} > \gamma \quad (9)$$

However, there are two regimes relying on whether the threshold variable FIS_{it} is lower or higher than the threshold γ. Since this model builds on the cross-sectional threshold model, so it needs GMM estimator to deal with endogeneity.

The first objective can be solved by all equations and the threshold can be estimated by the minimizer of sum of squared residuals of dynamic panel data as

$$\hat{\gamma} = \arg\min_{\gamma \in \Gamma} S_n(\gamma).$$

where $S_1(\gamma) = e_{it}(\gamma)' e_{it}(\gamma)$, $e_{it}(\gamma) = Y - X(\gamma)\hat{\beta}(\gamma)$ and

$$Y = \{\ln GINI_{it}\}, X = \{\ln GINI_{it-1}, \ln Fis_{it}, \ln GDP_{it}, \ln HDI_{it}, \ln URB_{it}, \ln OPN_{it}, \ln COR_{it}\}$$

The estimation for threshold applies a grid search of 100 candidate change points until it achieves the smallest sum of squared error including eq.(2), (3), (4), (5), (6), (7), (8), (9).

The model with no threshold is

$$\ln GINI_{it} = \mu_i + \beta'_1 \ln Fis_{it} + \beta'_3 \ln GDP_{it} + \beta'_4 \ln HDI_{it} + \beta'_5 \ln Urb_{it} + \beta'_6 \ln Opn_{it} + \beta'_6 \ln Cor_{it} + e_{it}$$

The model with threshold presented in eq. (2), (3), (4), (5), (6), (7), (8), (9).

Once the results are obtained, we can compare the casual effects of fiscal decentralization on income inequality of developing and developed countries.

3. Results

Table 1 reports the corresponding main descriptive statistics of the variables in this study. To illustrate, the mean for $GINI_{it}$ is 34.15, with a standard deviation of 7.76. The minimum and maximum are 24 and 59.5, respectively. On the other hand, the mean and the standard deviation for $Fise_{it}$ are 28.3299% and 13.81, respectively. Its associated minimum is 2.89% and its maximum is 64.28%. The mean and the standard deviation for $Fisr_{it}$ are 16.30% and 11.29%, respectively. While its minimum is 1.4145% and its maximum is 49.83%. For control variables, the mean for GDP_{it} is 5.56E+11 with a standard deviation of 8.57E+11. The minimum and maximum are 1.66E+09 and 3.88E+12, respectively. HDI_{it} has the mean of 0.82 with a standard deviation of 0.09 and its minimum is 0.56 and its maximum is 0.95. The mean of $URB_{it}$is 70.42% with a standard deviation of 13.14%. its minimum and its maximum are 33.73% and 97.96%. On the contrary, the mean and the standard deviation for $COR_{it}$are 56.80 and 23.65, respectively. its minimum is 16 and its maximum is 97. The mean of $OPN_{it}$is 94.04% with a standard deviation of 33. While its associated minimum is 35.25% and its maximum is 188.13%.

Table 1. Descriptive statistic

Variables	Mean	Standard deviation	Maximum	Minimum
$GINI_{it}$	34.15515	7.756005	59.5	24
$Fise_{it}$	28.3299	13.8102	64.28	2.8869

Variables	Mean	Standard deviation	Maximum	Minimum
$FISr_{it}$	16.2985	11.2913	49.8328	1.4145
GDP_{it}	5.56E+11	8.57E+11	3.88E+12	1.66E+09
HDI_{it}	0.816436	0.092923	0.953	0.564
URB_{it}	70.42	13.14	97.961	33.734
COR_{it}	56.80019	23.64655	97	16
OPN_{it}	94.03904	32.99962	188.1313	35.24918

Table 2 shows the results of panel unit root tests. As can be seen, there is an absolute consensus with respect to all variables since there is a statistical significance evidence to reject the null hypothesis, this can be concluded that these variables are stationary. Therefore, the dynamic panel threshold model applied with this set of data can be accomplished.

Table 2. Panel unit root test

Variables	Levin Lin & Chu
$lnGINI_{it}$	-1.4277 (0.077)
$lnFise_{it}$	-17.417 (0.000)
$lnFISr_{it}$	-11.037 (0.000)
Variables	**Levin Lin & Chu**
$lnGDP_{it}$	-11.053 (0.000)
$lnHDI_{it}$	-9.664 (0.000)
$lnURB_{it}$	-11.427 (0.000)
$lnCOR_{it}$	-4.2867 (0.000)
$lnOPN_{it}$	-5.9161 (0.000)

Note: numbers in parenthesis are p-values.

The result of the threshold estimate applied with a grid search of 100 candidate change points until it reaches the smallest sum of squared error are represented in Table 3.

Table 3. Threshold estimate

Threshold estimate (γ)	**Coefficient**	**SE**	**SSR**
γ of FISe for developed countries	-1.183055	7.732622e-05	825.3539
γ of FISr for developed countries	-1.829139	0.00370134	14.84903
γ of FISe for developing countries	-1.842422	0.00482924	290.4253
γ of FISr for developing countries	-2.525609	0.0007877308	1568.374

Since the fiscal decentralization is divided into 2 factors; sub-national government expenditure and sub-national government revenue. Considering dynamic panel threshold model, the results show in Table 4, Table 5, Table 6, and Table 7, that share of subnational government expenditure is significantly associated with income inequality in developed countries divided into two aspects. Firstly, if the share of subnational government expenditure is lower than threshold value, then it will lead to higher income inequality. Second, if share of subnational government expenditure is greater than threshold value, it will lead to lower income inequality. This implies that the impact of fiscal decentralization as sub-national government expenditure helps to reduce income inequality when it reaches a point or a threshold.

The results from dynamic panel threshold model points out in case that share of sub-national government expenditure is lower than threshold value, GDP and trade openness are positively related to income inequality, while human development index and urbanization rate are negatively related to income inequality in developing countries. However, share of sub-national government expenditure and human development index are positively related to income inequality, but urbanization is negatively related to income inequality in developed countries. In case that share of sub-national government expenditure is greater than threshold value, human development index is positively related to income inequality in developing countries, also urbanization positively affects income inequality, but share of sub-national government expenditure and human development index negatively affect income inequality in developed countries. Nevertheless, the results explain in case that share of sub-national government revenue is lower than threshold value, human development index is negatively related to income inequality in developing countries, while Human development index is positively related to income inequality in developed countries. In case that share of sub-national government revenue is greater than threshold value, urbanization is positively related to income inequality in developing countries. By the way, GDP is related to income inequality, but human development index negatively influences positively income inequality.

This study is consistent to previous literatures find that there is a threshold level of income determining decentralization reduces income inequality fiscal decentralization reduced income inequality in richer states and sub-national government expenditure is more effective than sub-national government revenue in reducing income inequality

(Cavusoglu and Dincer, 2015) and subnational government expenditure is significantly negative to income inequality. (Torrisi, 2011; Goerl and Seiferling, 2014).

However, this study is contrast to many literatures because the impact of fiscal decentralization on income inequality is statistically insignificant with the sample in developing countries. Seemingly, the fiscal decentralization will cause income inequality in a positive way. To illustrate, if fiscal decentralization increase, income inequality increases in developing countries (Cavusoglu and Dincer, 2015; Bojanic, 2018). Additionally, Efficiency enhancing effects from decentralization tend to happen in developed countries because of better institutional environment. As mentioned above, poor countries seem to be suffered from decentralization, but rich countries benefit in term of regional inequality (Lessmann, 2012). Although many literatures implied the worse off regions would be disadvantaged due to lack of capacity and budget constraints then the regions cannot afford the effective policies reducing income inequality, but few literatures found that the greater fiscal decentralization contributes to a decrease of within interpersonal inequality, the moderator of the relationship is the level of development of the region. In case of income rises, the productivity of fiscal decentralization is lower to reduce the within-region interpersonal inequality (Tselios, Rodriguez-Pose, Pike, Tomaney and Torrisi, 2012).

Table 4. Fiscal decentralization variables and other variables affecting income inequality in developed countries

Variables	**GMM estimation**	
	FISe is lower than threshold value	**FISe is greater than threshold value**
FISe: share of subnational government expenditure	0.120. (0.059)	-0.273* (0.117)
GDP: gross domestic product	-0.033 (0.023)	-0.005 (0.025)
HDI: human development index	1.052** (0.263)	-1.131** (0.310)
URB: urbanization	-0.207. (0.096)	0.219* (0.093)
COR: corruption index	0.054 (0.046)	-0.011 (0.060)
OPN: trade openness	0.030 (0.040)	0.028 (0.041)
Lag of income inequality	-0.005 (0.003)	-0.005 (0.003)
SSE	830.8096	
AIC	2282.727	
AIC (Linear GMM estimation)	2328.039	
Observation	294	
R-square	0.9979227	

Note: Standard errors in parentheses (*** p<0.001, ** p<0.01, * p<0.05, . p<0.1)

Table 5. Fiscal decentralization variables and other variables affecting income inequality in developed countries

Variables	GMM estimation	
	FISr is lower than threshold value	**FISr is greater than threshold value**
FISr: share of subnational government revenue	-0.016 (0.036)	-0.047 (0.056)
Variables	**GMM estimation**	
	FISr is lower than threshold value	**FISr is greater than threshold value**
GDP: gross domestic product	-0.036 (0.022)	0.037. (0.020)
HDI: human development index	1.23* (0.442)	-0.770* (0.343)
URB: urbanization	-0.532 (0.536)	-0.327 (0.542)
COR: corruption index	-0.053 (0.058)	-0.008 (0.0446)
OPN: trade openness	-0.026 (0.041)	0.017 (0.032)
Lag of income inequality	0.004 (0.004)	0.004 (0.004)
SSE	15.33114	
AIC	941.2417	
AIC (Linear GMM estimation)	2242.777	
Observation	294	
R-square	0.995478	

Note: Standard errors in parentheses (*** p<0.001, ** p<0.01, * p<0.05, . p<0.1)

Table 6. Fiscal decentralization variables and other variables affecting income inequality in developing countries

Variables	GMM estimation	
	FISe is lower than threshold value	**FISe is greater than threshold value**
FISe: share of subnational government expenditure	-0.014 (0.015)	0.0192 (0.032)
GDP: gross domestic product	0.086** (0.024)	-0.025 (0.014)
HDI: human development index	-1.773*** (0.285)	0.465. (0.229)
URB: urbanization	-0.337* (0.131)	-0.040 (0.144)
COR: corruption index	0.025 (0.038)	-0.001 (0.023)

Variables	GMM estimation	
	FISe is lower than threshold value	FISe is greater than threshold value
OPN: trade openness	0.207*** (0.040)	0.002 (0.031)
Variables	**GMM estimation**	
	FISe is lower than threshold value	**FISe is greater than threshold value**
Lag of income inequality	-0.000 (0.004)	-0.000 (0.004)
SSE	290.3659	
AIC	1112.859	
AIC (Linear GMM estimation)	1549.321	
Observation	168	
R-square	0.9967009	

Note: Standard errors in parentheses (*** p<0.001, ** p<0.01, * p<0.05, . p<0.1)

Table 7. Fiscal decentralization variables and other variables affecting income inequality in developing countries

Variables	GMM estimation	
	FISr is lower than threshold value	FISr is greater than threshold value
FISr: share of subnational government revenue	-0.004 (0.014)	-0.071 (0.047)
GDP: gross domestic product	-0.020 (0.030)	-0.019 (0.029)
HDI: human development index	-1.885** (0.543)	-0.575 (0.453)
URB: urbanization	-0.171 (0.188)	-0.634* (0.227)
COR: corruption index	0.016 (0.066)	-0.015 (0.047)
OPN: trade openness	0.101 (0.057)	-0.019 (0.064)
Lag of income inequality	0.002 (0.006)	0.002 (0.006)
SSE	1570.235	
AIC	1436.924	
AIC (Linear GMM estimation)	1607.078	
Observation	168	
R-square	0.9955611	

Note: Standard errors in parentheses (*** p<0.001, ** p<0.01, * p<0.05, . p<0.1)

4. Conclusion and Discussion

This study investigates the impact of fiscal decentralization on income inequality in developing and developed countries using the dynamic panel threshold model to estimate threshold value of two variables describing the fiscal decentralization; share of sub-national government expenditure and share of sub-national government revenue. Additionally, this study focuses on the relationship between fiscal decentralization and income inequality, identify asymmetric impact of threshold value on income inequality, compare the impact of fiscal decentralization on income inequality in developing and developed countries.

The impact of fiscal decentralization on income inequality as measured by share of subnational government expenditure and share of subnational government revenue applied with dynamic threshold model to find a threshold of fiscal decentralization which is used to compare its asymmetric impact on income inequality. This study finds the asymmetric impacts of fiscal decentralization on income inequality between developing and developed countries.

The results are consistent with previous literatures that the share of subnational government expenditure is more effective than share of subnational government revenue in order to explain the relationship between fiscal decentralization and income inequality (Cavusoglu and Dincer, 2015). In developed countries, the impact of fiscal decentralization on income inequality is explained by share of subnational government expenditure in two regimes. The first regime is where fiscal decentralization is lower than the threshold, the results point that higher level of fiscal decentralization leads to increase income inequality. while the second regime is where fiscal decentralization is greater than the threshold, higher level of fiscal decentralization leads to reduce income inequality. Most of literatures find that rich countries or developed countries benefit from fiscal decentralization in term of income inequality (Lessmann, 2012; Goerl and Seiferling, 2014; Cavusoglu and Dincer, 2015; Bojanic, 2018). Additionally, human development index is positively significant to income inequality in the first regime and it becomes negatively significant to income inequality in the second regime. In developing countries, this study finds there is no significant relationship between fiscal decentralization and income inequality which is contrast to previous literatures because many literatures find poor countries are getting worse off from fiscal decentralization in term of income inequality (Lessmann, 2012, Cavusoglu and Dincer, 2015; Bojanic, 2018). However, human development index helps to reduce income inequality with low level of fiscal decentralization in developing countries, while it helps to reduce income inequality with high level of fiscal decentralization in developed countries.

Since this study finds that fiscal decentralization should be done in developed countries as a proper number so that it can alleviate income inequality. Also, the fiscal decentralization should not be done in developing countries because this study finds no significance between fiscal decentralization and income inequality. To illustrate, the government expenditure should be distributed to subnational government efficiently. Then it will lead to lower income inequality. By the way, Fiscal decentralization is partially referred to authority to make a decision of local government or subnational government to respond preferences of their citizen and also to solve a problem in their jurisdiction. Therefore, if an area in a local government jurisdiction has a problem such as environmental issue or economic issue, the local government will solve a problem

efficiently. However, the distributional effects of fiscal decentralization should be concerned before implementing a transferring power in term of expenditure and revenue to local government since the impact of fiscal decentralization is asymmetric between developing and developed countries.

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Analysis the Dependence Structure and Co-movement Between the Export of ASEAN members and Changes in China's Economy

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Abstract

Currently, the ASEAN countries have a stronger economic role, particularly in terms of merchandise exports to trading partners such as China, an economic superpower. The value of trade between China and ASEAN has recently expanded, leading ASEAN to become China's second-largest trading partner. Therefore, this research aims to analyze the relationship and dependence structure between China's economy and ASEAN countries' exports, such as Singapore, Indonesia, Malaysia, the Philippines, Thailand, and Vietnam during changes in China's economy affect ASEAN's export. The data used were the gross domestic product of China and the exports to China from 6 ASEAN countries by 1994 to 2018. The model of Markov Switching Autoregressive was utilized to separate the economic regimes corresponding to the different states (uptrends and downtrends), and a copula approach with R-Vine copula was employed to analyze the dependence and co-movement between 6 ASEAN's export and China's economy. The results of the study reveal that in both the uptrend and the downtrend periods, the movement will proceed in the same direction if one variable has a positive dependence on the other variables. In particular, the export to China from 6 ASEAN countries mostly have a positive dependence.

Keywords: Gross domestic product, Export, Dependence, Co-movement, Regimes

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1. Introduction

The Association of Southeast Asian Nations (ASEAN) is a grouping of regions that promotes economic, political, social, and security cooperation among the member; helping spearhead negotiations power in the world's largest free trade pact.

ASEAN was established on 8 August 1967 by Bangkok Declaration or ASEAN Declaration with five original member countries follows: Indonesia, Malaysia, the Philippines, Singapore, and Thailand. For common front against the spread of communism and promote political, economic, and social stability, which emphasizes mutual respect and non-interference in other countries 'affairs. The other memberships join by the end of the 1990s. Following by Brunei (1984), Vietnam (1995), Laos (1997), Myanmar (1997), and Cambodia (1999). (Albert and Maizland, 2019)

The purposes of the ASEAN declaration aims to expedite the economic growth, social progress, and cultural development in the region through joint efforts the equality and be a part of the foundations for peaceful communities, and to promote a sense of peace and stability in the region through respect and justice and rule of law in relationship between countries and attachment the principles of the United Nations Charter. (Nuclear Threat Initiative, 2019)

Gross Domestic Product (GDP) is the value of all the output or production by all firms, non-profit institutions, government, and households in each economy during a period. The estimated total GDP of all ASEAN states amounted to approximately 3.08 trillion U.S. dollars, a significant increase from the previous years. In fact, the GDP of the ASEAN region has been skyrocketing for a few years now, reflecting the region's thriving economy.

ASEAN has made significant progress economic integration and free trade area in the region. The ASEAN Free Tread Area was created with goals of setting single market, increasing amount of ASEAN trade and investments, and attracting foreign investment. It is the top fifth largest export markets, the product and goods be traded including electronics, automotive, rubber-based products, textiles and apparels, and agro-based products.

Most of ASEAN's economy is driven by the founding Countries of the ASEAN Community. The ASEAN-5 follow by Indonesia, Malaysia, Philippine, Singapore and Thailand. Furthermore, the Socialist Republic of Vietnam shipped an estimated US$348 billion worth of goods around the globe in 2020. That dollar amount reflects a 97.1% gain since 2016 and a 31.5% increase from 2019 to 2020. So, Vietnam is the one of mainly share of the gross domestic product value and share of the export value also.

The largest external markets for ASEAN exports were China. ASEAN countries have jumped to be the number one trading parter with China in 2020, with the trade volumes hitting 731.9 billion U.S. dollars , making ASEAN and China are the largest trading partner for the first time. China and ASEAN countries are geographically neighbors. The long-standing good neighborhood relationship has laid a solid foundation for their mutual economic development and greater potential for trade cooperation. And two sides have increased benefits of areas such as trade and tourism.

Economic relations between China and ASEAN have strengthened considerably over the past two decades, resulting in trade-in rapidly growing bilateral trade and investment flows. Currently, China is an upper-middle-income country and the world's second-largest economy. The continuous high growth of China's economy has had a significant impact on the world economy, particularly the regional economy, including

the ASEAN namely, Indonesia, Malaysia, the Philippines, Singapore, Thailand, including Vietnam.

The relationship between 6 ASEAN economy and China economy have a long established friendly relationship, for example Singapore is top trading partner of China. Bilateral economic ties between Singapore and China have strengthened over and developed rapidly in recent year since 1990. Singapore and Chinese government have been working together. Next, Malaysia economy in 2014-2015 was the one of most competitive in Asia. Mostly of the income came from export in goods and services Malaysia has turned a production structures aim to mass production. Malaysia and China bilateral, Malaysia is one of China's trade partner. Malaysia emphasizes exporting electrical appliances products and High-new-tech products to China. While, the Philippine primary exports include semiconductors and electronic products, transport equipment, garments, copper products, coconut oil. One of major trading partner is China. The economy of Philippine rose rapidly and its local industries developed to satisfy the rising demand. The bilateral trade between the Philippines and China, China is one of trading partners. Trade relations between Indonesia and China since the ACFTA in 2010, trade between China and Indonesia has been on the rise. China is one of the key majority trading partners in exports and imports market. Then, China is Thailand's second largest export market and China also Thailand's largest importer of goods. China has singed for China-ASEAN Free Trade Agreement (CAFTA). Lastly, China has been Vietnam's largest trading partner. Import and export between China and Vietnam have been growing rapidly and the trade scale has achieved a salutatory rising. As the total volume of imports and exports has been growing, however, Vietnam's trade deficit with China has been constantly expanding. Vietnam's exports to China are mainly resource consuming products and agricultural products. All of these countries are an important trading partner to China economy.

This study aims to analyze the changes in the China's economy during the uptrend and downtrend that effect to the exports of the ASEAN members. Then, study the relationship between gross domestic product of China and export of each country in ASEAN proceed rising and fall. And to study the dependence structure and co-movement between the exports of the ASEAN members and the China's economy, For general person and investors to understand and making a decision with the changes in China's economy during uptrends and downtrends are impact to ASEAN's export. Moreover, a government sector can use it as a plan or making decision in applying information to formulate economic policies, which would stimulate the exportation.

1.1 Literature Review

1.1.1 ASEAN Export

Intra-ASEAN trade has continuously accounted for the largest share of ASEAN, the ASEAN top three trading partners. The largest external markets for ASEAN export were China, the EU, the USA, and Japan. (ASEANstats, 2019). This causes the ASEAN-5 (Indonesia, Malaysia, the Philippines, Singapore, and Thailand) to be the main share of the gross domestic product value of ASEAN. Moreover, in 2018 Singapore was the largest exporter in the region, with a share of 28.8% of the ASEAN total exports, followed by Malaysia, Vietnam, and Thailand.

1.1.2 The ASEAN Member Countries

Several researchers study ASEAN countries in many kinds of knowledge. For example, in 2014 Prawitrawong studies the impacts of exports on Gross Domestic Product in ASEAN Economic Community Member Countries by using panel data including exports gross domestic product. This study showed that exports and gross domestic product are related. The impact of exports was when the exports had changed because the gross domestic product changes in the same direction. Moreover, in 2015 there is a study about an analysis of the relationship for the ASEAN index, China and Hong Kong by applying the Markov-Switching Vector Autoregressive Model (MS-VAR) and the MS-VAR intercepted regime dependent model. The model can analyze the trend of the rising index effectively but cannot analyze the falling index precisely. Therefore, the investors should analyze and predict the yield index fluctuation among ASEAN, China, and Hong Kong Index with the governing period of each Thai party. Plus, the investors should also analyze the cycle of an index (Napasin,2015). Sun and Li (2018) studied the trade margins of Chinese agricultural exports to ASEAN and their determinants by developing an augmented gravity model of international trade. The study found that the main growth source of Chinese agricultural exports to ASEAN had shifted from the extensive margin before the formal establishment of CAFTA (China–ASEAN Free Trade Area) in 2010 to the intensive margin since the formal establishment of CAFTA, but changed in Chinese agricultural exports to ASEAN had always mainly depended on the intensive margin Since the formal establishment of CAFTA, the evolution pattern of Chinese agricultural exports to ASEAN had shifted from “more varieties, low price, and small quantity” to “less varieties, high price, and large quantity”. Relative economic scale, relative population scale, the capacity of agricultural export, trade integration, global financial crisis, and common border significantly affected the trade margins of Chinese agricultural exports to ASEAN.

1.1.3 Markov Switching Autoregressive model & Vine Copula approach

There are 2 interesting models in this study which are Markov Switching auto-regressive model and Vine Copula approach. The Markov Switching model described the marginal distribution of the time series. Therefore, in 2012 Ailliot and Monbet were proposed to describe wind time series. As a result, found a more sophisticated trend model that will help future weather, because it was allowed to produce simulations that were consistent with climate change. Another model that is related to the study is the Vine Copula model to describes the structure of dependency levels of variables and becomes the standard tool for modeling the dependent level of variables in time series. In economics, there are many applications of Copula Econometrics to Analyses of some Economic issues. Moreover, in 2013 the Dynamic’s Co-movement toward among capital markets in ASEAN exchanges from 2012 to 2013 found that the C-D Vine copula approach in Elliptical distribution based was cleared for dynamics co-movement among of them. ASEAN Stock Exchanges collaborate achieved through creating ASEAN investment promotion for more investors and protection investment. ASEAN countries had strengthened the economic opportunities and opened the formation of economic securities in an ASEAN Stock Exchanges. (Sriboonchitta & Chaiboonsri,2013) In 2014, modeling dependency in tourist arrivals to Thailand using a copula approach. The study used the C-vine copula and the D-vine copula structure model to analyze the dependence between the growth rate of arrivals

of tourists from China, Korea, and Japan. The results found that it was a weak positive dependence in each pair of copular. Furthermore, the result showed that the growth rate of China tourist arrivals influences the dependency between the growth rate of arrivals from Korea and Japan (Puarattanaarunkorn ,2014). Furthermore, BenSaïda use the Contagion Effect in European Sovereign Debt Markets: A Regime-switching Vine Copula Approach. In this paper brought a regime-switching vine copula approach used in the test, a tractable Markov regime-switching C-vine and D-vine were developed under the symmetrized Joe-Clayton copula. The model selection criteria (AIC and BIC) indicated that C-vine copula more efficient D-vine both a single-regime and a two-regime state. The superiority of the regime-switching models strongly suggested the presence of a contagion effect – defined as a significant change in the dependence structure after a shock – between Eurozone bond markets, with a transmission path from core countries (Netherlands, Belgium, Austria, France, Finland, and Germany) to other stressed countries (Spain, Ireland, Italy, Portugal, and Greece). The smoothed probabilities detected different turmoil periods with high contagion, which remained in a high state since the global financial crisis. On another hands, there is a study on efficient information base on a new goodness-of-fit test for regular vine (R-vine) copula models, a flexible class of multivariate copulas based on a pair-copula construction (PCC). The test arises from the information matrix ratio and assumes fixed margins. The corresponding test statistic is derived, and its asymptotic normality is shown. The test's power is investigated and compared to 14 other goodness-of-fit tests, adapted from the bivariate copula case, in a high-dimensional setting. The extensive simulation study on the copula level shows the excellent performance with respect to size and power as well as the superiority of the information matrix ratio-based test against most other goodness-of-fit tests. The best performing tests are applied to a portfolio of stock indices and their related volatility indices validating different R-vine specifications. There is another example of stock index portfolio. Zhang study on Forecasting VaR and ES of stock index portfolio by using a Vine copula method. The study interested in risk measurement that has both theoretical and practical significance in risk management. Using daily sample of 10 international stock indices, firstly this paper models the internal structures among different stock markets with C-Vine, D-Vine and R-Vine copula models. Secondly, the Value-at-Risk (VaR) and Expected Shortfall (ES) of the international stock markets portfolio are forecasted using Monte Carlo method based on the estimated dependence of different Vine copulas. Finally, the accuracy of VaR and ES measurements obtained from different statistical models are evaluated by UC, IND, CC and Posterior analysis. The results show that the VaR forecasts at the quantile levels of 0.9, 0.95, 0.975 and 0.99 with three kinds of Vine copula models are sufficiently accurate. Several traditional methods, such as historical simulation, mean-variance and DCC-GARCH models, fail to pass the CC back testing. The Vine copula methods can accurately forecast the ES of the portfolio on the base of VaR measurement, and D-Vine copula model is superior to other Vine copulas.

2. Methodology

In analyzing the dependence structure and co-movement under 6 ASEAN's export andChina's economy, measured by the secondary data of export by Singapore, Malaysia, Thailand, the Philippines, Indonesia, and Vietnam, and the data of China's

Gross domestic product by using Markov Switching Autoregressive Model and R-Vine Copula structure as following steps:

2.1 Growth Rate

Convert the date of the Gross Domestic Product of China and the exports to China from each country to growth rates.

Growth rate of gross domestic product:

$$GGDP_{G,t} = \left(\frac{y_t - y_{t-1}}{y_{t-1}}\right) \times 100 \quad (1)$$

Where

$GGDP$ = Growth rate of China's gross domestic product (CHAGDP) at time t

y_t, y_{t-1} = Growth of China's gross domestic product (CHAGDP), t and t-1

The growth rate of exports to China from 6 ASEAN countries:

$$GEXP_t^i = \left(\frac{EXP_t^i - EXP_{t-1}^i}{EXP_{t-1}^i}\right) \times 100 \quad (2)$$

Where

$GEXP$ = Growth rate of 6 ASEAN's export (SGPEX, MYSEX, THAEX, PHLEX, IDNEX, VNMEX) at time t

y_t, y_{t-1} = Growth of 6 ASEAN's export (SGPEX, MYSEX, THAEX, PHLEX, IDNEX, VNMEX), t and t-1

2.2 Unit Root Test

Philips-Perron Test (PP-Test) is a non-parametric statistics method for determining the stationary data, which is used to control serial correlation in time series data.

$$\Delta Y_t = \alpha + \beta Y_{t-1} + \varepsilon_t \quad (3)$$

Where

ΔY_t = First-order self-regression values of CHAGDP, SGPEX, MYSEX, THAEX, PHLEX, IDNEX, and VNMEX

Y_{t-1} = Time series data for residual values of CHAGDP, SGPEX, MYSEX, THAEX, PHLEX, IDNEX and VNMEX

α, β = Constants or coefficients of variables

ε_t = Random deviation

Hypothesis testing Phillips-Perron Test as follows:

H_0 : The time-series data of the variables studied at time t is non-stationary.

H_1: The time-series data of the variables studied at time t is stationary.

If the test statistic from Phillips-Perron Test (PP-Test) is higher than the Mackinnon Statistics, the null hypothesis is rejected by the key assumptions. In conclusion, the time-series data of the variables at time t is stable (stationary). On the other hand, if the test statistics from Phillips-Perron Test is less than the Mackinnon

Statistics, the null hypothesis is accepted the key assumptions as the time-series data of the variables at time t is unstable (non-stationary).

2.3 Markov Switching Autoregressive Model (MS-AR)

Describe econometric time series by a mixture of several autoregressive processes the regimes corresponding to the different states of the economy, MS-AR models are pairs of discrete-time stochastic processes.

The data was separated into 2 regimes; uptrends and downtrends by set regime 1 as the uptrend of data and set regime 2 as downtrend of data.

If the model has 2 regimes, (k = 2), both represented by first-order autoregressive ($m1 = m2 = 1$), the equation is as follows:

$$y_t = \begin{cases} a_{1,s_t} + b_{1,s_t} y_{t-1} + e_{1t} & ; Regime1 \\ a_{2,s_t} + b_{2,s_t} y_{t-1} + e_{2t} & ; Regime2 \end{cases} \quad (4)$$

Where

y_t = The data of China's gross domestic product (CHAGDP) and 6 ASEAN's export (SGPEX, MYSEX, THAEX, PHLEX, IDNEX, VNMEX)

2.4 Vine Copula

The residual in 2 regimes from MS-AR was used to test the R-vine copula approach.Vine copulas are a flexible tool for describing multivariate copulas through the graphical model. The multivariate copulas are constructed from a cascade of bivariate copulas.

An R-vine is a special case of the vine (nested series of connected trees), $V = T1, \ldots, Tn$ 1 in which two edges in tree Tj are linked by an edge in $Tj+1$ only if these edges in Tj share a common node. Each edge of the R-vine is related to a particular pair-copula in a given PCC and the edges of a tree Tj form the nodes for tree $Tj+1$ where $j = 1, \ldots, n$ 1.

The density functions of R-vine copula:

$$f(x_1, x_2, \ldots, x_d) = \prod_{k=1}^{d} f_k(x_k) \times \prod_{i=1}^{d-1} \prod_{e \in E_i} c_{C_{e,a} C_{e,b} | D_e} \quad (5)$$

$$\left[F_{C_{e,a} C_{e,b} | D_e}\left(x_{C_{e,a}} | x_{1_{De}}, \ldots, x_{n_{De}}\right), F\left(x_{C_{e,b}} | x_{1_{De}}, \ldots, x_{n_{De}}\right) \right] \quad (6)$$

Where

f_k are the marginal densities $k = 1, \ldots, n$

$C_{e,a} C_{e,b} | D_e$ is the copula density of B_e for edge $e = \{a, b\}$ and $x_{i_{De}} \in D_e$ for $i = 1, \ldots, n$. Joe (1996) describes the strategy to obtain the conditional distribution $F_{C_{e,a} C_{e,b} | D_e}\left(x_{C_{e,a}} | \bullet\right)$ and $F_{C_{e,a} C_{e,b} | D_e}\left(x_{C_{e,b}} | \bullet\right)$

2.5 Autocorrelation test and data distribution by Lagrange Multiplier (LM-Test) and Kolmogorov-Smirnov (KS-Test)

Test the Lagrange Multiplier (LM-Test) and Kolmogorov-Smirnov (KS-Test). The residual in 2 regimes from the R-vine copula was used to test the autocorrelation data distribution.

Correlation problems can be tested using the Breusch–Godfrey Serial Correlation Lagrange Multiplier (LM Test). If the P-value is less than the significance level, the null hypothesis be rejected, indicating that there is a correlation problem. On the other hand, will be accepted the null hypothesis when the P-value is higher than the significance level, showing that there is no correlation problem.

$$y_t = \sum_{i=1}^{k} x_{it}\beta_i + u_t \;\; ; \; t = 1,2,\dots,n \tag{7}$$

And

$$u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + \cdots + \rho_p u_{t-p} + e_t \tag{8}$$

Where

y_t	is a dependent variable
x_{it}	is an independent variable
β_i	is coefficient
ρ_p	is coefficients of the error estimation equation
u_t	is the error at time t
u_{t-p}	is the error at time $t - p$
e_t	is the error of the estimation equation

Hypothesis for testing Breusch–Godfrey Serial Correlation LM Test is as follows:
$H_0 : \rho = 0$ (No Serial Correlation)
$H_1 : \rho \neq 0$ (Serial correlation)

The distribution of populations can be tested using the Kolmogorov-Smirnov Test (KS Test), which does not use parameters to test the data. The study used the KS test to determine the data for a uniform distribution. If the asymptotic significance is higher than the significance level, the null hypothesis is accepted, indicating that there is a uniform distribution. On the other hand, will be rejected the null hypothesis when the asymptotic significance is less than the significance level, showing that there is no uniform distribution. The Kolmogorov - Smirnov test had statistics.

$$D = |F(x) - S(X)| \tag{9}$$

Where

$F(x)$	is the expected proportion of data with scores less than or equal to X
$S(X)$	is relative of cumulative frequency observed in the sample

Hypothesis for testing Kolmogorov – Smirnov (KS Test) is following:
H_0 : The data follow a specified distribution
H_1 : The data do not follow the specified distribution

3. Results

3.1 Unit Root Test

The study uses time series data which needs to apply the unit root test to test the stationary of the data by using Phillips-Perron test 2 level which is neither (None) and constant and linear trend (Trend and Intercept). Where China's GDP was non-stationary in constant and linear trend (Trend and Intercept). Therefore, the study uses

neither (None) instead. However, the other 6 ASEAN's export is stationary in a constant and linear trend (Trend and intercept). The result of the test shown in table 1 which China's GDP are Neither (None) and 6 ASEAN's export are constant, and trend (Trend and intercept) have the critical value 10% (0.10) so that rejected the null hypothesis of non-stationary.

Table 1. Results of data stability test using Phillips-Perron (PP Test)

Variables	CHAGDP	SGPEX	MYSEX	THAEX	PHLEX	IDNEX	VNMEX
None	0.0875	-	-	-	-	-	-
Trend and intercept	-	0.0109	0.0547	0.0000	0.0728	0.0373	0.0000

Source: computation.

Table 1 shows the results of data tested by the Phillips-Perron test at levels with intercept. The tests found that all data for GDP of China and Export of Singapore, Indonesia, Malaysia, the Philippines, Thailand, and Vietnam were stationarity at I(0) with a 90% confidence level.

3.2 Markov Switching Autoregressive Test

After the unit root test, the model of Markov Switching Autoregressive was utilized to separate the economic in 2 regimes to uptrend and downtrend of China's GDP and 6ASEAN's export by set regime 1 as the data of uptrend and set regime 2 as the data of downtrend.

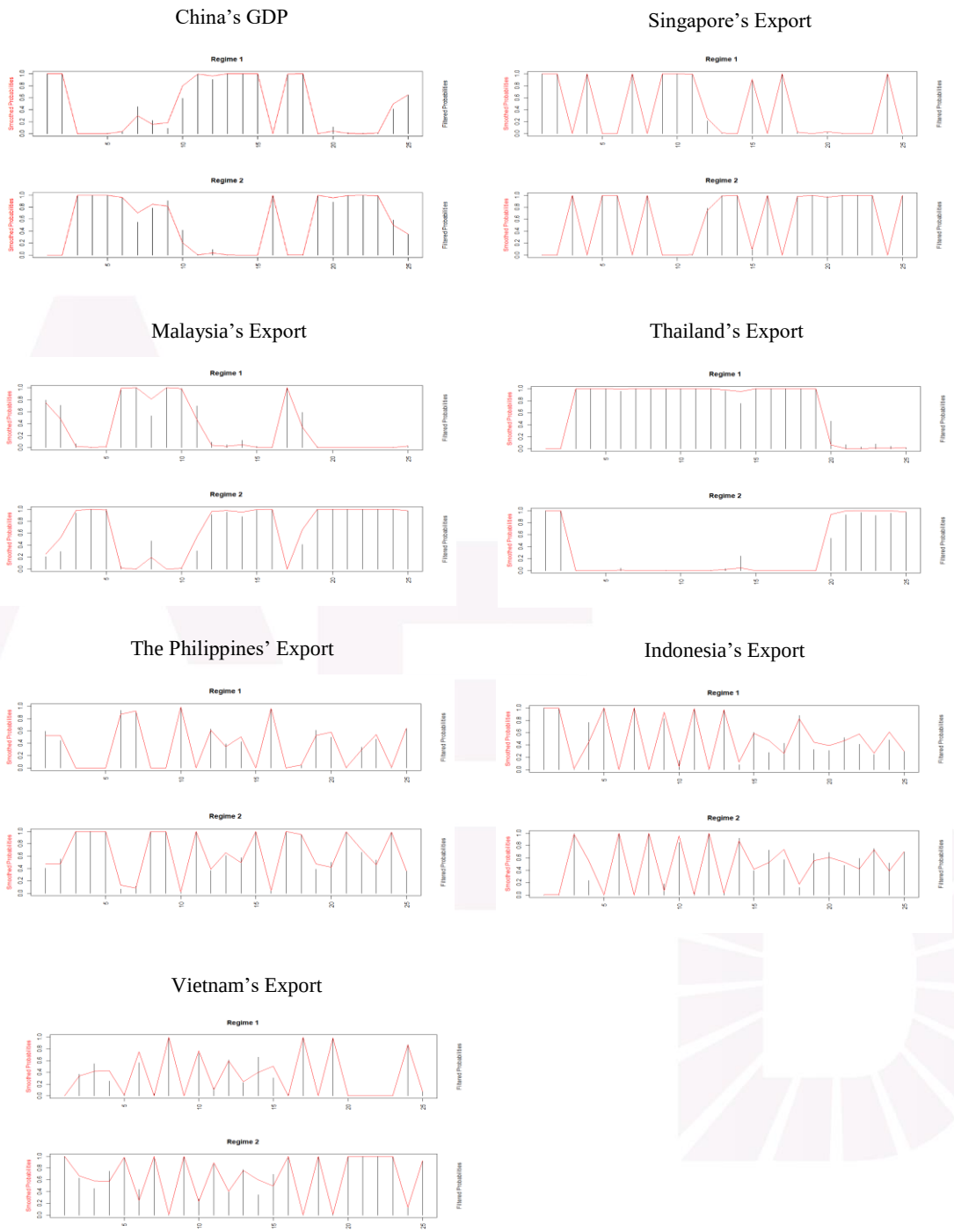

Figure1 Result of Markov Switching Autoregressive in 2 regimes
Source: computation.

Figure1 shows the data of China's gross domestic product and 6 ASEAN's export were separated in significant 2 stage of regime during rising and fall.

Table 2. Results of Markov Switching Autoregressive in 2 regimes

Variables	CHAGDP	SGPEX	MYSEX	THAEX	PHLEX	IDNEX	VNMEX
	Year of observations						
Regime1	11	10	10	17	9	9	12
Regime2	14	15	15	8	16	16	13
	25	25	25	25	25	25	25

Source: computation.

Table 2 shows the amount of significant regime that occurs in regime 1 and regime 2 from 25 year of observations of China's GDP, Singapore's export, Malaysia's Export, Thailand's Export, the Philippines' Export, Indonesia's Export, and Vietnam's Export.

3.3 Lagrange Multiplier Test

Testing the residual values are independent of each other or not by The Breusch-Godfrey Serial Correlation LM-Test had a hypothesis that H_0 = Non – Serial Correlation from the probability part of the hypothesis test.

3.3.1 Lagrange Multiplier Test

Table 3. Results of Serial Correlation LM Test

F-statistic 253.5333				**Prob. F(2,16)** 0.0000			
	CHAGDP	SGPEX	MYSEX	THAEX	PHLEX	IDNEX	VNMEX
First Lag of LM test							
Prob.	0.0120	0.3401	0.8594	0.0027	0.2453	0.0373	0.5909

Source: computation.

Table 3 shows the results of the serial correlation problem were examined from the residuals obtained from the Breusch-Godfrey Serial Correlation LM Test. China's GDP and Thailand's export are less than 0.05 that rejected the null hypothesis, that mean they have a serial correlation, while the probabilities of the others are greater than 0.05 were accepted the hypothesis (H_0), that the residuals are independent (Non-Serial Correlation).

3.4 Kolmogorov-Sminov Test

3.4.1 Kolmogorov-Sminov Test

Table5. Shows the result of population distribution tested by the Kolmogorov-Smirnov (KS-Test) method

	Kolmogorov-Smirnov		
	Statistic	df	Sig
CHAGDP	0.331	25	0.200*
SGPEX	0.370	25	0.096
MYSEX	0.386	25	0.200*
THAEX	0.168	25	0.111

	Kolmogorov-Smirnov		
	Statistic	df	Sig
PHLEX	0.339	25	0.200*
IDNEX	0.366	25	0.200*
VNMEX	0.300	25	0.200*

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

From table 5 shows the error value of all countries has a significant value, that the value of Singapore's export as 0.096 and the value of Thailand's export equal to 0.111, while the others has a significant value as 0.200, which all of countries are greater than the statistical significance value of 0.05. Therefore, the null hypothesis was acceptable that the residuals of these countries have a uniform distribution.

3.5 Recgular Vine Test (R-Vine)

Use the data of the residuals in 2 regimes of each country in MS-AR to test the R-Vine copulas structure. This study presents the R-vine copulas in 7-dimensional.

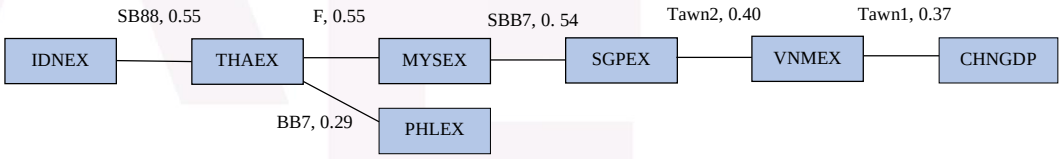

Figure2 Tree1 of dependence structure with R-Vine copula in regime1
Source: computation.

The diagram shows the relationship between China's GDP and ASEAN's Export variables and show the copula family and Kendall's tau, a coefficient between 0 and 1 show the coefficient of dependence between the variables; China's GDP, Singapore's export, Indonesia's export, Malaysia's export, the Philippines' export, Thailand's export, and Vietnam's export. If a value approach 1, the pair variables are extremely dependent. And if the value is close to 0, it means that each variable is less dependent. Figure 2 shows the dependence of regime 1, that IDNEX with THAEX and THAEX with MYSEX were extremely dependent, while THAEX with PHLEX were quite moderately dependent, but MYSEX and SGPEX were quite highly dependent same level as SGPEX and VNMEX, and VNMEX and CHNGDP had a moderately high dependent.

Table6. The results of the analysis of the dependence structure of the data from the R-vine copula model in Regime1.

Variable in Regime1	Copula Family	par1	par2	Upper	Lower	tau
(VNMEX, CHAGDP)	rotated Tawn1_180	2.77	0.49	-	0.44	0.37
(SGPEX, VNMEX)	rotated Tawn2_180	5.23	0.45	-	0.44	0.40
(MYSEX, SGPEX)	rotated BB7	2.73	0.49	0.25	0.71	0.54
(THAEX, MYSEX)	Frank	6.84	0.00	-	-	0.55
(THAEX, PHLEX)	BB7	1.63	0.11	0.47	0.00	0.29
(IDNEX, THAEX)	rotated BB8	6.00	0.74	-	-	0.55

Source: computation.

From table 6 shows the copula families including rotated Tawn type 1, rotated Tawn2, rotated BB7, Frank, BB7 and rotated BB8. The parameter estimation of the R-vine structure shows parameter 1 (par1) is 2.77, 5.23, 2.73, 6.84, 1.63 and 6.00, respectively, and the second parameter (par2) is 0.49, 0.45, 0.49, 0.00, 0.11 and 0.74, respectively. Kendall's tua's test found that THAEX with MYSEX, and IDNEX with THAEX had a dependence value equal to 0.55, which means the result of Thailand's export with Malaysia's export and the result of Indonesia's export with Thailand's export had the strongest positive dependence. While THAEX, PHLEX had a dependence value equal to 0.29, which means less positive dependence with both Thailand and the Philippines' export.

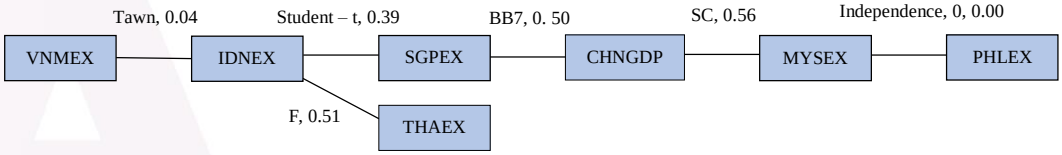

Figure3 Tree1 of dependence structure with R-Vine copula in regime2
Source: computation.

Figure 3 shows the dependence structure in regime2, that VNMEX with IDNEX had less positive dependence that the Kendall's tau at 0.04, but IDNEX with SGPEX had more dependently at 0.39 tau, and INDEX and THAEX were quite highly dependent same level as SGPEX and CHNGDP. While, the variables had the most strongest positive dependence is CHNGDP with MYSEX, but MYSEX with PHLEX was independent because the tau is equal to 0.00.

Table7. The results of the analysis of the dependence structure of the data from the R-vine copula model in Regime2.

Variable in regime2	Family copula	par1	par2	Upper	Lower	tau
(MYSEX, PHLEX)	I	-	-	-	-	0.00
(CHAGDP, MYSEX)	Rotated Clayton	2.60	0.00	0.77	-	0.56
(SGPEX, CHAGDP)	BB7	2.48	0.42	0.68	0.19	0.50
(IDNEX, SGPEX)	Student-t	0.57	30.00	0.01	0.01	0.39
(IDNEX, THAEX)	Frank	5.97	0.00	-	-	0.51
(VNMEX, IDNEX)	Tawn1	20.00	0.04	0.04	-	0.04

Source: computation.

From table 6 shows the copula families including Independence copula, Rotated Clayton, BB7, Student-t, Frank, and Tawn type 1 copula. The parameter estimation of the R-vine structure shows parameter 1 (par1) is 2.60, 2.48, 0.57, 5.97 and 20.00, respectively, and the second parameter (par2) is 0.00, 0.42, 30.00, 0.00 and 0.04, respectively. The Kendall's tua test found that CHAGDP, MYSEX had a dependence value equal to 0.56, which mean China's GDP and Malaysia's export had strongly positive dependence, and THAEX, PHLEX had a dependence value equal to 0.04, which means less positive dependence between Vietnam's export and Indonesia's export. While MYSEX, PHLEX had a dependence value equal to 0.0 which means

there are no positive and negative dependence(independence) between Malaysia's export and the Philippines' export.

4. Conclusion and Recommendation

According to the estimating result of the dependence between China's GDP and exports of 6 ASEAN countries: Singapore, Indonesia, Malaysia, the Philippines, Thailand, and Vietnam during the uptrends and downtrends. It was found that when China's GDP goes up or down, the exports of ASEAN countries in the same copula family, which are dependent on China's GDP, will have the same effect. Using the MS-AR approach to divide the data of China's GDP and the exports to China from 6 ASEAN countries into two regimes to see the co-movement between China's GDP and 6 ASEAN's export, explain that the uptrend period, the China's GDP is not the main relationship with the exports of 6 ASEAN countries, but they have a significant dependence on each other. Both Thailand's export with Malaysia's export and Indonesia's export with Thailand's export are the strongest dependence, describe that during periods of economic go up, when Malaysia can expand the export to China, the value of Thailand's export will go up in the same direction. Identically, when the value of Indonesia's export to China is increase, the value of Thailand's export also change in the same direction. In the downtrend economy, was found that the China's GDP and Malaysia's export had the strongest positive dependence. It could be explained that when China's GDP decreases, the value of Malaysia's exports will also decline, as significant dependence on each other. Meanwhile, Malaysia's export and the Philippines' exports are independence, there are no relationship neither positive dependence nor negative dependence. Both the uptrend and the downtrend periods revealed that the dependence of the mostly data are positive dependence, that move by the same direction. However, policy makers and investors should concentrate and cautious in administration, the number of export value of each ASEAN country is quite similar. For example, the decline in export of Indonesia to China will have an impact on Thailand's exports to China.

The results of this study can benefit investors who aim to invest in exports can use the data to forecast or calculate the value of the future risk value and to determine the correct investment proportion. And can be utilized to make recommendations to those in charge of developing a policy for country export value, as it aids in the comprehend the dependence relationship, which one country's export of goods that will have an impact on the other.

In addition, the government of each ASEAN countries should issue appropriate export policies with with environmental concerns, for example, an uptrends economy should encourage trade and export tax policies, but ESG should also be considered. During downturns economy, it can be determined from the result that describes the relationship of each country's exports, for example, when China is in a downturn, the pair countries with strong dependence should should find measures to sustain commodities exported to China. Environmentally awareness in the part of the export for ecological economy associated with the transition to a green economy. International trade of the ASEAN that mostly is developing countries can increase exports to respond to international demand such as agriculture, fisheries, forests, manufacturing, energy and tourism. It is crucial to promote the export good and service, together with the green economy policy that can strengthen ASEAN capacity to benefit.

The economy policy recommendation such as, promote the industrial sector that has action process on recycle, reuse, and reduce by reducing taxes and control of heavy industries by using border tax. Next, Control and promote disclosure for industrial firm such as promote production sector that has their own clearly disclosure ESG. Lastly, Prioritize trading partner who follow the concept of green economy by support fund for private sector who trade with their trading partner.In a part of an international policy, The ASEAN regional set up an international ESG for ASEAN to establish a common policy a common policy at regional level include industrial strategy for the use of energy sources in the heavy industry in order to reduce pollution emissions.

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Analysis of Value at Risk between US Stock Market and Emerging Asian Stock Markets during the COVID-19 Pandemic

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Abstract

The world is currently experiencing an unprecedented spread of COVID-19 causing a huge impact on financial markets. Due to global economic volatility exposing the spread of risks across global financial markets helps to understand transmissions in more extreme market conditions. In this article, we analyze the volatility and risk value during the COVID-19 pandemic. The study was divided into two sub-segments: pre-COVID-19 epidemic (22 January 2018 - 17 January 2020) and during the COVID-19 epidemic (21 January 2020 - 28 May 2021). The objectives of the study are divided into 2 parts: The first thing is to analyze volatility. and the risk value between the US stock market indices and the stock exchanges of emerging economies. The study used the DCC-GARCH model to analyze the volatility overflow between the US stock exchange index and the emerging market index. It also uses Value at Risk (VaR) to analyze the risk value of the stock market index. The study reveals that the risk outflow intensifies as COVID-19 spreads around the world, where during the time of COVID-19, emerging economies are at higher risk than the United States. which further analyzes the risk value Demonstrates the level of stock market risk during COVID-19. Additional analysis on Value-at-Risk shows risk levels of stock market in the spread of COVID-19. This study presents practical implications for supervisors, policy makers, and portfolio risk managers during the uncertainty during COVID-19.

Keyword: DCC-GARCH, VaR

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1.Introduction

The world is currently affected by the COVID-19 epidemic. The World Health Organization (WHO) has defined COVID-19 as a type of communicable disease which is an emerging disease that humans are unable to cope with the rapid spreading with its origins in Wuhan, China in December 2019, and has continued until now. This has also affected the global economy and has also affected investment due to uncertainty in the economy, including the stock market.

An uncertainty in stock markets results in dramatic risk expanding causing damage in the financial stability system. This is caused by adverse events related to economic and financial factors. (For example; Asian Financial Crisis in 1997-1998, Global Financial Crisis in 2007-2008, and European Debt Crisis in 2010-2013)

The spread of COVID-19 has affected many aspects, especially the economy. This is a result of the volatility of the global economy. As a result, concerns about the outlook for the economy have been raised and most economic activities have been halted. In addition, financial markets have experienced a sharp decline in stock markets in Asia, Europe and the Americas (Rudden, 2020).

According to a World Bank report (2021), the COVID-19 outbreak has caused the economy's worst contraction in 60 years since 1870. The volatility has hit emerging-market countries and developing countries. The forecast of global GDP trend in 2021 is that the global economy is expected to grow by 4 percent in 2021, down from the level expected in the previous report in June 2020. Meanwhile, global economic growth in 2020 contracted by 4.3 percent. The World Bank reported that although economic activity suffered less than expected, the COVID-19 outbreak is still affecting the recovery that will be sluggish. If the situation is deteriorating to its peak, the global economy may grow only 1.6 percent this year, especially as the outbreak continues and there is slow vaccines distribution. While the global economy in 2021 tends to decrease of 3.8 percent and COVID-19 will continue to affect investment and employment. For the economic growth of superpowers such as the US, the World Bank is projected to grow 3.5 percent in 2020, down from its previous forecast of 4.0 percent. On the other hand, its competitor like China tends to have further expansion which is increases 7.9 percent this year, up from 6.9 percent. The Eurozone was forecast to grow by 3.6 percent, Japan by 2.5 percent, and emerging and developing economies in Asia could grow by 3.4 percent.

The COVID-19 outbreak has caused volatility in all sectors, especially in the stock market. As stock markets have rarely experienced severe price volatility from the outbreak compared to the epidemic of COVID-19 making forecasting the impact in economic and financial terms difficult. Therefore, investors are faced with unprecedented challenges and have to come up with new investment strategies to help increase returns and reduce risk when securities are volatile. The health crisis from the COVID-19 epidemic has highlighted the need for an in-depth analysis of the joint movement of stock exchanges to assess dependencies and infections to identify the impact on financial stability and financial market.

From the spread of COVID-19, there has been a review of the literature on the impact of the COVID-19 outbreak on financial markets. For instance, the research of Liu et al. (2020) that studied the impact of COVID-19 epidemic on financial markets in 21 countries. The study found that the impact will be severe during the spread of

COVID-19. In addition, Abuzayed, et al. (2021) also found that the spread of systemic risks between global stock markets and the stock markets of countries affected by COVID-19 has intensified during the COVID-19 pandemic, causing volatility in stock market prices. Additionally, Yousfi et al. (2021) investigated volatility of benefits from diversification and hedging ratios between US stock markets and different financial and commodity variables using US stock market indices (S & P500) and VIX, OVX volatility index, oil prices, gold prices, spot interest rates on non-coupon bonds, Dow Jones Islamic, and Bitcoin before and during the spread of COVID-19 using daily data and a multivariate GARCH model. The study found that the risk exposure reached its highest during the COVID-19 outbreak comparing to before COVID-19 happened. This means the spread of COVID-19 leads to the risk of leakage between the US stock market and other assets. Hedging analysis has shown that the Dow Jones Islamic is the most effective hedging agent either before or during the outbreak of the COVID- 19. In the past, it can prevent uncertainty caused by unpredictable risks such as the COVID-19 outbreak which has research that has been interested in the impact of the COVID-19 epidemic; (Wang et al.,2016; Gamba-Santamaria et al.,2017; Takyi et al.,2020; Akhtaruzzaman et al., 2020; Aloui et al., 2020; Sharif et al., 2020; Afees and Vo, 2020; Al-Awadhi et al., 2020; Badar, 2020; Dutta et al., 2020; Bouri et al., 2020; Nguyen et al., 2021; Ozili and Arun, 2020; Shahzad et al., 2021). A review of the literature finds that there is still a lack of proof on how the COVID-19 epidemic has triggered intense synergies between U.S. stock markets and emerging economies which has implications for stock market stability.

From literature reviewing, most researchers utilize DCC-GARCH model as aiming to find a matrix of conditional correlation values that can change over time (Time-Varying) Guesmi et al. (2019) stated that DCC-GARCH is the most appropriate model for the co-dynamic modeling of different financial variables. Therefore, this study applied DCC-GARCH in analyzing volatility of risks between US stock indexes and emerging economies in Asia, and the method of determining the risk value by using Value at Risk to determine the value of the risk. (Abuzayed, 2021)

The remainder of this research can be divided as follows: section 2 presents methodology, section 3 presents the data used in the study, section 4 presents the results, section 5 presents a discussion of the results, and section 6 provides conclusions and recommendations.

2. Methodology

The methodology of this study includes 3 steps initiating with Unit Root Test, followed by joint distribution of country pairs estimation using DCC-GARCH, ending with a country risk valuation analysis using Value at Risk (VaR) This allows the researcher to determine the risk value of each country.

2.1 Unit root test

Unit Root Test is a data test before using that data for an analysis since the data to be estimated must be stationary first. If unstable data is used to estimate, spurious regression can occur. To do the unit root test of the data, the researcher will use Philips-Perron test (PP-Test) which has the following equation form.

$$\Delta Y_t = \alpha + \beta Y_{t-1} + \varepsilon_t$$

Where Y_t is a variable at the time t
Y_{t-1} is a variable at the time $t-1$
α, β is parameter value
ε_t is random error

Hypothesis to conduct unit root test by Philips-Perron Test (PP-Test) are as follows;

$H_0 : \beta = 1$ Unit Root (Not Stationary)
$H_1 : \beta < 1$ No Unit Root (Stationary)

2.2 DCC-GARCH

Risk evaluation using DCC-GARCH (Engle, 2002) is a model that used to explain volatility in the return of the stock market index Under Conditional Correlation Volatility Dynamics. The DCC-GARCH correlation estimation method is commonly used to determine the correlation and volatility of time series variables developed from CCC-GARCH assuming the return of the security is vector, which qualifies Conditionally Multivariate Normally Distributed having a mean of 0 and a covariance matrix, which can be written as follows:

$$y_t | \Omega_{t-1} \square N(0, H_t)$$

Under the DCC-GARCH assumption, a matrix of variance can be written. Participate on a timely basis as follows:

$$H_t = D_t R_t D_t$$

where H_t is $n \times n$ matrix of the conditional variance of the error values. D_t is $n \times n$ diagonal matrix of the conditional standard deviation of ε_t at time t

$$D_t = \begin{bmatrix} \sqrt{h_{1,t}} & 0 & \cdots & 0 \\ 0 & \sqrt{h_{2,t}} & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & 0 & \sqrt{h_{n,t}} \end{bmatrix}$$

where R_t is $n \times n$ matrix of the time-varying correlation which can be expressed as a matrix as follows:

$$R_t = \begin{bmatrix} 1 & \rho_{12,t} & \rho_{13,t} & \cdots & \rho_{1n,t} \\ \rho_{12,t} & 1 & \rho_{23,t} & \cdots & \rho_{2n,t} \\ \rho_{13,t} & \rho_{23,t} & 1 & \ddots & \vdots \\ \vdots & \vdots & \ddots & \ddots & \rho_{n-1,n,t} \\ \rho_{1n,t} & \rho_{2n,t} & \cdots & \rho_{n-1,n,t} & 1 \end{bmatrix}$$

where R_t can be written in the following equation

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1}$$

To assure that H_t has to be a Positive Definite, conditions for parameter values need to be assigned which is $a \geq 0, b \geq 0$ and $a + b < 1$, and initial value of Q has to be a positive definite which can be written in a general format of DCC-GARCH (M, N) as follows,

$$Q_t = (1 - \sum_{m=1}^{M} a_m - \sum_{n=1}^{N} b_n)\bar{Q}_t + \sum_{m=1}^{M} a_m (\xi_{t-1}\xi'_{t-1}) + \sum_{n=1}^{N} b_n Q_{t-1}$$

The value of DCC-GARCH estimation is calculating by Log-Likelihood Function. Engle (2002) mentioned under the assumption of $\varepsilon_t | \Omega_{t-1} \sim N(0, H_t)$ can be calculated by

$$L = -\frac{1}{2} \sum_{t=1}^{T} (k \log(2\pi)) + 2\log|D_t| + \log|R_t| + \xi_t' R_t^{-1} \xi_t$$

2.3 Value at Risk

Value at Risk comes from Denis Weatherstone, CEO of J.P. Morgan as he had to recognize the company's risks arising from changes in market prices with an estimate that if the market moves in a condition that will result in the company having a loss questioning how much this loss will be worth. Therefore, the concept of Value at Risk came up and became popular all over the world. The calculation of VaR is based on the assumption that the rate of return has a Normal Distribution. To determine the risk value can be found as follows.

$$VaR = \mu_r - (Z_\alpha * \sigma_r)$$

where Z_c is the Standard Score at the specified confidence level. μ is the average of the rate of return and σ is the Standard Deviation of the rate of return.

3. Data

In this analysis of the risk overflow between the US stock market and the stock markets of emerging economies in Asia during the COVID-19 pandemic, secondary data from stock market indices of 10 countries was used including United States Stock Index (S&P 500), Stock Exchange of Thailand (SET), South Korea Stock Index (KOSP), China Stock Index (SHCOMP), India Stock Index (SENSEX), Malaysia Stock Index (FMMKLCI), Philippines Stock Index (PSEI), Taiwan Stock Index (TWSE), Indonesia Stock Index (JCI) and Pakistan Stock Index (KSE). This study uses daily data from 22 January 2018 to 31 May 2021 for 845 days excluding data on holidays or other reasons. The stock index price is the same as the previous day's trading prices.

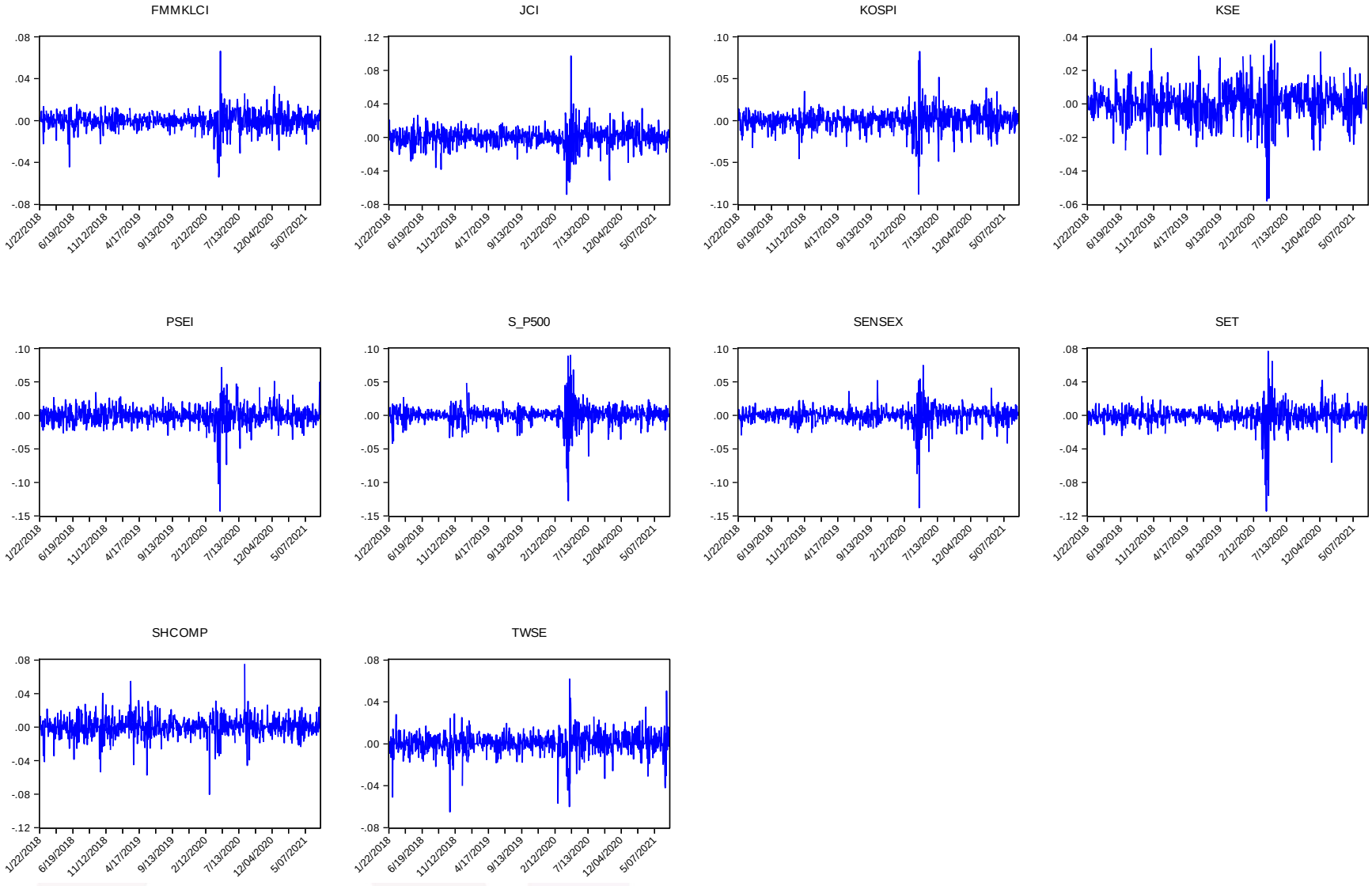
FMMKLCI
JCI
KOSPI
KSE
PSEI
S_P500
SENSEX
SET
SHCOMP
TWSE
1/22/2018
6/19/2018
11/12/2018
4/17/2019
9/13/2019
2/12/2020
7/13/2020
12/04/2020
5/07/2021

Figure 1 shows the daily change in yield data for US stock indexes (S&P 500) and emerging Asian economies: Thailand (SET), South Korea (KOSP), China (SHCOMP), India index (SENSEX), Malaysia (FMMKLCI), Philippines (PSEI), Taiwan (TWSE), Indonesia (JCI) and Pakistan (KSE). From Figure 1, it can be seen that the returns of the US stock price indexes and emerging economies in 2020 onwards have been extremely volatile due to the COVID-19 epidemic which has caused the slowdown in the economy and affects the stock market.

4. Result

4.1 descriptive statistic

From the table, it can be seen that the average yield of the stock price index (Mean) ranges from -0.0003 percent (PSEI) to 0.0005 (TWSE). The standard deviation ranges from 0.0085 percent (FMMKLCI) to 0.0145 (PSEI) This means when considering the standard deviation, the country with the highest index risk is the Philippines (PSEI) and the lowest is Malaysia (FMMKLCI). Skewness shifted to the left because it is negative, and Kurtosis of all indexes is greater than 3 indicating that the stock index's yield is not a normal spread.

Table 1. Descriptive statistic

Variable	Mean	Maximum	Minimum	SD.	Skew.	Kurt.	JB	Sum
FMMKLCI	-0.0002	0.0663	-0.0540	0.0085	-0.3379	12.4927	3188.7330	-0.1395
JCI	-0.0001	0.0970	-0.0681	0.0117	-0.0289	12.2108	2987.1470	-0.1057
KOSPI	0.0003	0.0825	-0.0877	0.0124	-0.2331	11.3140	2441.3600	0.24249
KSE	0.0001	0.0377	-0.0580	0.0104	-0.5847	6.6898	527.4808	-0.0108
PSEI	-0.0003	0.0717	-0.1432	0.0145	-1.6168	20.1497	10723.3100	-0.2934
S&P500	0.0005	0.0897	-0.1277	0.0143	-1.0154	19.3370	9542.1700	0.39474
SENSEX	0.0004	0.0749	-0.1379	0.0128	-1.9322	25.1851	17854.6300	0.29898
SET	-0.0002	0.0765	-0.1143	0.0118	-1.9869	26.4939	19989.7300	-0.1424
SHCOMP	0.0001	0.0755	-0.0804	0.0121	-0.3973	8.9164	1254.6530	0.028
TWSE	0.0005	0.0617	-0.0652	0.0108	-0.7870	10.1083	1866.2360	0.40687

Source: Author's calculate

Note: The descriptive statistics are for daily returns from January 22, 2018 to May 28, 2021

4.2 Result of unit root test

Philips-Perron test (PP test) was applied conducting this unit root test. From the results in Table 2, it was found that the stock price index rejected the main assumption. Therefore, it can be concluded that the data are all certain at the First difference level.

Table 2. Unit root test

Variable	None	Constant	Constant & Trend
FMMKLCI	-29.6029***	-29.5959***	-29.5844***
JCI	-27.5619***	-27.5481***	-27.5373***
KOSPI	-30.26***	-30.2569***	-30.3139***
KSE	-26.0578***	-26.0444***	-26.009***
PSEI	-30.5395***	-30.538***	-30.5339***
S_P500	-36.7006***	-36.7096***	-36.7759***
SENSEX	-30.0751***	-30.0801***	-30.148***
SET	-31.9381***	-31.9261***	-31.9298***
SHCOMP	-29.384***	-29.3668***	-29.4382***
TWSE	-29.5424***	-29.5636***	-29.6491***

Source: Author's calculate

Note: a: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1% and (no) Not Significant

4.3 Result of DCC-GARCH

DCC-GARCH is an analysis of the transmission of volatility between the US stock index and emerging economies. The analysis is divided into 2 periods, before the outbreak of COVID-19 and during the outbreak of COVID-19 as shown in Table 3 and 4.

Table 3. The results of the estimation of the multivariate DCC-GARCH in model parameters pre COVID-19 Pandemics.

Parameter	Estimate	Std. Error	P-Value
$\omega_1(S\&P500)$	0.0001	0.0001	0.3812
$\alpha_1(S\&P500)$	0.2159	0.1006	0.0318
$\beta_1(S\&P500)$	0.7409	0.0457	0.0000
$\omega_2(KSE)$	0.0001	0.0001	0.0000
$\alpha_2(KSE)$	0.1186	0.0132	0.0000
$\beta_2(KSE)$	0.7664	0.0302	0.0000
$\omega_3(SENSEX)$	0.0001	0.0001	0.1495

Parameter	Estimate	Std. Error	P-Value
$\alpha_3(SENSEX)$	0.1585	0.1286	0.2177
$\beta_3(SENSEX)$	0.5837	0.2510	0.0200
$\omega_4(KOSPI)$	0.0001	0.0001	0.0004
$\alpha_4(KOSPI)$	0.0001	0.0006	0.8741
$\beta_4(KOSPI)$	0.9972	0.0001	0.0000
$\omega_5(FMMKCI)$	0.0001	0.0001	0.0000
$\alpha_5(FMMKCI)$	0.1180	0.0111	0.0000
$\beta_5(FMMKCI)$	0.6988	0.0354	0.0000
$\omega_6(SET)$	0.0001	0.0001	0.0000
$\alpha_6(SET)$	0.0737	0.0060	0.0000
$\beta_6(SET)$	0.8243	0.0174	0.0000
$\omega_7(TWSE)$	0.0001	0.0001	0.0001
$\alpha_7(TWSE)$	0.1395	0.0259	0.0000
$\beta_7(TWSE)$	0.7896	0.0350	0.0000
$\omega_8(PSEI)$	0.0001	0.0001	0.6224
$\alpha_8(PSEI)$	0.0107	0.0016	0.0000
$\beta_8(PSEI)$	0.9869	0.0012	0.0000
$\omega_9(SHCOMP)$	0.0001	0.0001	0.0000
$\alpha_9(SHCOMP)$	0.0428	0.0060	0.0000
$\beta_9(SHCOMP)$	0.9186	0.0138	0.0000
$\omega_{10}(JCI)$	0.0001	0.0001	0.9816
$\alpha_{10}(JCI)$	0.0266	0.4027	0.9473
$\beta_{10}(JCI)$	0.9609	0.4627	0.0378
θ_1	0.0040	0.0047	0.3979
θ_2	0.5413	0.4281	0.2061

Source: Author's calculate

Table 4. The results of the estimation of the multivariate DCC-GARCH in model parameters during COVID-19 Pandemics.

Parameter	Estimate	Std. Error	P-Value
$\omega_1(S\&P500)$	0.0001	0.0001	0.8906
$\alpha_1(S\&P500)$	0.3027	0.8928	0.7346
$\beta_1(S\&P500)$	0.6801	0.5140	0.1857
$\omega_2(KSE)$	0.0001	0.0001	0.9105
$\alpha_2(KSE)$	0.1741	0.1525	0.2538
$\beta_2(KSE)$	0.7951	0.2635	0.0025
$\omega_3(SENSEX)$	0.0001	0.0001	0.0000
$\alpha_3(SENSEX)$	0.1374	0.0359	0.0001
$\beta_3(SENSEX)$	0.8151	0.0490	0.0000
$\alpha_4(KOSPI)$	0.0001	0.0001	0.3466
$\alpha_4(KOSPI)$	0.2859	0.2104	0.1742
$\beta_4(KOSPI)$	0.5233	0.3752	0.1631
$\omega_5(FMMKCI)$	0.0001	0.0001	0.0000
$\alpha_5(FMMKCI)$	0.1155	0.0190	0.0000
$\beta_5(FMMKCI)$	0.7845	0.0334	0.0000
$\omega_6(SET)$	0.0001	0.0001	0.0000
$\alpha_6(SET)$	0.1152	0.0271	0.0000
$\beta_6(SET)$	0.8365	0.0482	0.0000
$\omega_7(TWSE)$	0.0001	0.0001	0.0206
$\alpha_7(TWSE)$	0.1668	0.0666	0.0123
$\beta_7(TWSE)$	0.5099	0.1433	0.0004
$\omega_8(PSEI)$	0.0001	0.0001	0.0174
$\alpha_8(PSEI)$	0.1668	0.0747	0.0255
$\beta_8(PSEI)$	0.7836	0.0503	0.0000
$\omega_9(SHCOMP)$	0.0001	0.0001	0.0000
$\alpha_9(SHCOMP)$	0.0442	0.0081	0.0000
$\beta_9(SHCOMP)$	0.8886	0.0237	0.0000
$\omega_{10}(JCI)$	0.0001	0.0001	0.0126
$\alpha_{10}(JCI)$	0.2917	0.1046	0.0053
$\beta_{10}(JCI)$	0.6560	0.0742	0.0000

Parameter	Estimate	Std. Error	P-Value
θ_1	0.0257	0.0109	0.0183
θ_2	0.4385	0.1831	0.0167

Source: Author's calculate

From table 3 and 4 When taking θ_1 and θ_2 written into the DCC-GARCH equation, the following equation will be formed;

$$Q_{before} = 0.4547\overline{Q} + 0.0036(\varepsilon_{t-1}\varepsilon_{t-1}^{T}) + 0.5412Q_{t-1}$$
$$Q_{during} = 0.5358\overline{Q} + 0.0258(\varepsilon_{t-1}\varepsilon_{t-1}^{T}) + 0.4384Q_{t-1}$$

From the above equation, it is an equation indicating fluctuation where Q_{before} is the volatility equation during the pre-COVID-19 outbreak. Q_{during} is the volatility equation during the COVID-19 outbreak. This shows that there is a volatility transmission between the US stock index and the stock market indices of emerging economies during the COVID-19 outbreak which more than the pre-epidemic period as observed from $\overline{Q}$ of both equations.

4.4 Result of Value at Risk

From the DCC-GARCH estimation, it shows that there is a volatility between the US stock indices and emerging market economies. Investors need to know how much risk each country has. Thus, results of estimation of the risk value (Value at Risk) are shown in Table 5.

Table 5. The results of the estimation of Value at Risk.

Variable	Before	During
S&P500	-0.0160	-0.0317
KSE	-0.0153	-0.0212
SENSEX	-0.0123	-0.0311
KOSPI	-0.0153	-0.0253
FMMKLCI	-0.0113	-0.0171
SET	-0.0117	-0.0301

Variable	Before	During
TWSE	-0.0152	-0.0218
PSEI	-0.0167	-0.0218
SHCOMP	-0.0201	-0.0192
JCI	-0.0150	-0.0224

Source: Author's calculate

Table 5 shows the risk values of the stock market indices of all 10 countries. Before the outbreak, the country most at risk of the stock market index is China (SHCOMP) as the ongoing trade war has put China at risk of investing. On the other hand, the risk value of each country has increased dramatically during the COVID-19 outbreak. The country most at risk of stock market indices is the United States (S&P500), the main reason affecting the increase in risk value is the impact of the COVID-19 outbreak in the United States. In contrast, China has a lower risk value as China has planned policies to reduce the spread of COVID-19 and has developed treatment plans and vaccines to prevent COVID-19 before any other affected countries have.

5. Discussion

From the study, the researcher found that the risk value of each country was high in the pre-COVID-19 outbreak as a result of the US-China trade war affecting imports, exports, trade. Also, industrial sectors have been slowed down. After that, the spread of COVID-19 has increased the risk value of all 10 countries as the epidemic is widespread and affecting many countries around the world, resulting in economic slowdown due to country lockdown. It is obvious that the risk value before the outbreak of COVID-19 is less than the risk value during the COVID-19 outbreak due to the lockdown measures of many countries resulting in tourism, freight, and the interruption of the production of industrial products. This causes the economy to slow down, affecting the stock price index of each country and the disadvantage of investment under uncertain risk. Therefore, the value of the risk is important to study in order to benefit investors in choosing to invest in risky countries during unexpected events.

6. Conclusion and Recommendation

In this study, the researcher aims to compare the risk value of US stock indexes and emerging market indexes in Asia before and during the spread of COVID-19. In order to achieve the objectives of this research, the sub-phases were divided into two periods: before the outbreak of COVID-19 (22 January 2018 - 17 January 2020) and during the outbreak of COVID-19 (21 January 2020 - 28 May 2021). The study used the DCC-GARCH model to look at the transmission of volatility in stock indices across 10 countries.

The stock indices studied are: New York Stock Index (S&P 500), Stock Exchange of Thailand (SET), South Korea Stock Index (KOSP), China Stock Index (SHCOMP), India Stock Index (SENSEX), Malaysia Stock Index (FMMKLCI), Philippines Stock Index (PSEI) Taiwan Stock Index (TWSE), Indonesia Stock Index (JCI) and Pakistan Stock Index (KSE). The study found that volatility occurred before the outbreak of COVID-19, but intensified as the epidemic became more severe. When COVID-19 is escalating, the risk value will increase as the risks faced by each country are higher from various measures to prevent the spread of COVID-19. As a result, the economy slowed down, and affected the stock market index, and affected investors in losing benefits from investing in the stock market or various financial markets. Therefore, being aware of the risks that you will receive makes it possible to formulate strategic planning. In addition, the policy should be set to prevent risks that may arise from the investment of investors.

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Willingness to Pay for Longan Crop Insurance in Chiang Mai province

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Abstract

Crop insurance is insurance that provides coverage for damage or loss to insured crops caused by the perils specified in the policy. Insurance in agriculture is directly aligned with SDG1 (No Poverty) and SDG13 (Climate Action). By stabilizing farm incomes through insurance payoffs, it can help in reducing poverty and promoting climate initiatives. However, crop insurance is not as successful in Thailand as it should be. Only 1,053 farmers or 2.15% of total in-season longan farmers participated in this crop insurance. The objectives are to study the willingness to pay (WTP) for longan crop insurance and factors affecting the WTP for longan crop insurance in Chiang Mai province. The data were collected from 400 longan farmers in Chiang Mai by using questionnaires. First, the average of WTP for longan crop insurance premium value was 198.55 baht/rai/year whereas the current premium of insurance company was 300 baht/rai/year. The factors affecting the WTP the longan insurance premium were gender, educational level, longan planting area, proportion of non-agricultural income on total income, income from longan planting, number of household members, farmers' grouping, satisfaction in the amount of coverage, awareness of the importance of longan crop insurance scheme and loss from natural disasters affecting longan production. Therefore, the government should publicize and educate farmers on the benefits of crop insurance. The greater number of participants will lead to lower insurance premiums and incentivize new farmers to join the program.

Keywords: WTP, Crop Insurance, Longan, Chiang Mai

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1. Introduction

Crop insurance is insurance that provides coverage for damage to insured crops caused by the perils stated in the policy which may determine protection for all kinds of disasters or may impose protection for specific disasters such as floods, droughts, windstorms, hailstorms, etc. depending on the area and the type of plants that will cause different damage. Generally, protection is given to only natural disasters which are those that are beyond human control. The person who will ensure the crops must be the person who produces that crop by himself and owning the product. However, crop insurance will predetermine the period of protection, and this coverage period will correspond to the period of cultivation of each plant. Therefore, insurance must be made before the start of the planting period of each type of crops (Office of the Insurance Commission, 2016). For example, cocoa insurance in Nigeria. Insurance can reduce the impact of damage or loss of agricultural products caused by natural disasters. Insurance takes into account how to effectively manage risks and uncertainties. For the benefit of agriculture now and in the future, it can help maintain agricultural stability and improve the overall economy. Therefore, agricultural insurance is a necessary part of the institutional infrastructure necessary for the development of agriculture, which is largely a high-risk enterprise **(**Falola, et al., 2013).

Agriculture is one of the most affected by climate change, including droughts, floods, and crop damage, farmers lack income, loss of ability to pay debt. These effects are often exacerbated by the lack of access to insurance for hedging (Carter and Barrett, 2006). Agriculture in tropical areas is highly weather dependent and is affected by periodic droughts and floods (Akhtar, et al., 2019). Unmanaged drought and flood risks put farmers at high risk and affect their livelihoods, leading to a shrinking of agricultural funds from loss of profits. As a result of the damage, agricultural productivity will remain low during subsequent production periods (Hellmuth et al.,2019). To help farmers manage risk effectively and sustainably, reduce informal debt borrowing. Agricultural crop insurance is being used more and more (Dercon, 2002 and Mechler, 2006).

Crop insurance in Thailand, the government has designated crop insurance as one of the key measures used as a tool to assist farmers in organizing their financial system. To protect the cost of production in the event of a natural disaster, to cover reduced production volumes, and to protect the volatility of the price of produce, which will contribute to income stability and occupational security for farmers. For example, rice insurance. It is an insurance that covers loss or damage to the rice planting area caused by natural disasters, fires, pests or epidemics. This type of insurance is suitable for rice farmers. The insured rice insurance policy provides coverage for rice grown in the insured farmland and the insurer agrees to pay the insured compensation (Office of the Insurance Commission, 2016).

Longan is one of the important economic fruits of Thailand (Office of Agricultural Economics, 2012). The main planting sites are in the northern part of Thailand, such as Chiang Mai, Lamphun, Lampang, Phrae, Nan, Chiang Rai, and Mae Hong Son. It has an area of 72.94% of the total area yielding products in the country. However, the quality of the produce is reversed. Because the weather is quite variable by the beginning of the season during the flowering period (January-February) or, water shortage and drought in fruit set and fruit development period (March-June), resulting in the longan not growing fully, it is small, cracks and falls. Therefore, longan quality

and quantity in the Northern region are quite different from the Eastern region particularly Chanthaburi and Sa Kaeo province which the weather is quite stable, and farmers are not difficult to cope. In addition, most of the farmers in Chanthaburi are experienced farmers, conduct commercial agriculture, produce quality longan, therefore yielding better than northern area (Office of Agricultural Economics, 2020).

Table 1. Area, production, and yield per rai by region of longan in 2020

Region	Planted area (Rai)	Harvested area (Rai)	Production (Rai)	Yield per rai (Kg)
North	1,287,625	1,155,258	816,830	707
Northeast	34,117	30,965	18,314.56	591
Central	408,126	397,224	347,103.28	847
South	431	373	214.49	575
Total	1,730,299	1,583,820	1,182,462.33	747

Source: Office of Agricultural Economics,2020
Note: Central region is a province located in the central region with provinces in the east.

Table 1 presents the longan area, production, and yield per rai by region of longan in 2020. The Northern region of Thailand has harvesting area 72.94% of total areas, whereas the yield per rai is lower than the central region. Chiang Mai province has the number one longan planted area in the Northern of Thailand with 451,723 rai, accounting for 35.08% (Table 2) due to the climate suitable for the growth of longan. However, at present there is a climate change in this area. The extreme heat and drought, water shortage, and sunburn causes the longan to fall, not beautiful longan skin, and cracked longan skin, which is not desired by the market, resulting in some of the produce being unsellable.

Table 2. Area, production, and yield per rai of Chiang Mai province 2016-2020

Year	Planted area (Rai)	Harvested Area (Rai)	Production (Ton)	Yield per rai (Kg)
2016	402,869	372,278	246,109.00	661
2017	407,769	385,417	310,506.00	806
2018	410,786	395,746	357,563.00	904
2019	431,887	401,108	335,675.00	837
2020	451,723	406,183	342,543.00	843

Source: Office of Agricultural Economics,2020 (Data as of December 2020)

Basically, agriculturist or farming career depend on unstable weather conditions causing farmers to always take risks from drought, floods, and pests interfere with the growth of crops. In addition, farmers must bear the price risk that may arise from the produce that is not of the quality that the market needs. As a result, farmers have insufficient income for consumption and investment in the next crop cycle. At present, the world's climate has changed to global warming in many areas, in which Thailand has experienced more severe natural disasters. Whether it is drought, floods, windstorms, mudslides causing damage to life. Agricultural property and crops. Crop insurance is one way to alleviate farmers' distress from disasters. Farmers can reinvest the compensation received from crop insurance for a new crop cycle. This is for farmers to be protected in the event of drought and production damage. It helps to create

alternatives in risk management and to build immunity according to the Sufficiency Economy Philosophy.

The longan insurance scheme in Thailand is the world's first longan crop insurance scheme and it uses drought index measured by satellites for micro insurance as a damage assessment criterion. The goal of the program is to provide insured longan farmers with protection against drought damage that damages their crops, to offer alternative risk management options, and to create immunity based on the philosophy of sufficiency economy. In 2019, the government has set a target area of 100,000 rai of 24 districts of Chiang Mai province, but since the longan insurance program has a short publicity period and farmers lacked knowledge and understanding, only 1,053 from 48,890 longan farmers in Chiang Mai or accounted for 2.15% participating in this crop insurance. Therefore, this insurance scheme covered less actual cultivated area than the target area. The insurance companies (Sompo Insurance (Thailand) Public Company Limited, and Thaivivat Insurance Public Company Limited) earned only 540,429.79 baht of insurance premiums but had 3.41 million baht in compensation for the farmers who insured, which was much higher than the insurance premiums received. Consequently, both companies suffered losses from crop insurance. Although the insurance in 2019 suffered a loss, both insurers continued to underwrite the longan insurance in 2020 to ensure continuity of the project and to make the insurance system a tool for risk management for longan farmers.

In 2020, the Office of Insurance Commission has collaborated with the Bank for Agriculture and Agricultural Cooperatives, Sompo Insurance (Thailand) Public Company Limited, and Thaivivat Insurance Public Company Limited continued to drive the longan crop insurance program by accelerating public relations and creating knowledge and understanding for Thai longan farmers in applying for longan crop insurance as a tool for managing risks that may arise from natural disasters. In addition, the area for longan insurance was increased from 24 districts of Chiang Mai province to 5 provinces in the northern region, namely Chiang Mai, Chiang Rai, Phayao, Nan and Lamphun, to order to cover approximately 69% of the country's longan planted area.

However, there has no be detailed baseline field studies about WTP for fruit crop insurance in Thailand. In order to insured farmers to continue to benefit and succeed there must be the study of the WTP for insurance coverage of longan farmer. The objectives of this research are to study the value of WTP longan insurance premiums and factors affecting WTP longan insurance premiums of farmers in Chiang Mai province. The study will generate information on farmer’s WTP for insurance. The information generated will be useful to policy makers and insurance providers. The rest of the paper is structured as follows: the next section presents the literature review. Section 3 describes model employed by the study. Section 4 is empirical results and discussion. The final section is conclusion and policy recommendations.

2. Literature review

In the literature, the WTP concept for crop insurance were applied in many agricultural communities, and many techniques, and many countries. Early research on WTP for crop insurance goes back to Patrick (1988), Miranda (1991), and Fraser (1992). In recent decades, crop insurance was accepted as a financial instrument for risk management against the uncertainties and financial loss presenting in agriculture

(Malini & Malini (2021), Çukur et al. (2021), and Pane et al. (2021)). In addition, insurance in agriculture is directly pertinent with SDG1 (No Poverty) SDG2 (Zero Hunger), SDG8 (Decent Work and Economic Growth), SDG13 (Climate Action) and SDG17 (Partnership for the Goals) (Wanczeck et al. (2017), Ankrah et al. (2021), and UN, (2021)).

In South Africa region, Falola et al. (2013) studied the WTP for insurance of cocoa farmers in Nigeria. The average WTP for this insurance was $69.85 per hectare. The positive factors affecting to the WTP were the size of the farm, level of education of the head of the household, comments on insurance policies, experience of the head of the household and access to various insurance related services. But the negative factors are household size and income in the agricultural sector. Anang et al. (2021) found that farmers preferred to pay an average of ₵215.59 GH₵ per year for crop insurance. Majority 96.7% of the respondents partook in crop insurance. The important factors influencing readiness to be involved crop insurance were age, marital status, access to extension service and experience in cocoa farming. Maganga et al. (2021) studied various socio-economic factors that influence farmers' purchase of index insurance for staple food in rural Malawi, and found that gender, previous record of climate shocks, extension contact, and access to remittances influence to willingness-to-pay for weather index insurance.

In Asia, Pant et al. (2019) gauged the average of WTP for the insurance of banana farmers in Chitwan, Nepal was $30. The factors that influencing to WTP for insurance were age of household head, gender, number of years of education, agricultural income, agricultural training, group membership, cooperative membership, inexperienced member relocating, type of farmer. Chander et al. (2021) evaluated the average value of food-grain crop insurance scheme of Rs. 3,193 per acre in Haryana, India and found that awareness, lack of premium paying capacity, low co-operation from bank employee were the main reasons for failure to adopt of crop insurance scheme. Gulseven (2020) studied the factors influencing WTP for crop, fruit and livestock insurance in the Turkish capital and shown that education level income in agriculture, non-agricultural income, household size and membership influence the WTP.

In Southeast Asia, Pane et al. (2020) calculated the farmers' expected average WTP (EWTP) value was 71,011 IDR/ha/growing season or 142,022 IDR/ha/year for rice farming insurance (AUTP) program in Deli Serdang District, Indonesia. Kurniaty et al. (2021) evaluated the average WTP for livestock insurance in the Kulon Progo district, Indonesia was 45,660 Rp per person per year which is higher than the assessed value of insurance premiums. The factors influencing to farmers' WTP are the number of family dependents and their variable income. In case of shrimp, Nguyen et al. (2021), found that the average insurance premium is $0.15 per kg of shrimp and farmers who participated in a training program, low-income farmers and those with high total and chemical costs were willing to pay a high insurance premium.

In case of Thailand, Fiscal Policy Office (2010) studied the development of financial tools for farmers especially crop insurance with weather indices to suggest crop insurance development by using questionnaire and field survey. The results showed that 80.9 percent of farmers were satisfied with the insurance premium rate and from the evaluation of experienced farmers in the virtual insurance trial, it was found that 86.4 percent of the farmers agreed that the compensation payment was consistent with the real damage caused. These farmers are interested in getting insurance in the

dry season because they recognized that insurance is a good tool for managing risks against production costs. Recently, the Office of Agricultural Economics (2018) studied WTP for in-season rice insurance. The WTP for the rice insurance premium was the highest at 71 baht per rai with the maximum compensation amount of 1,111 baht per rai. The factors affecting the WTP were the proportion of ownership of the in-season rice planting land, rice cultivation experience, the location of the area (in irrigated or non-irrigated areas), the proportion of outside agriculture income to total income, damage from natural disasters in the past 3 years and the number of members who plant rice annually.

3. Model and Data

3.1 Model

The analysis of factors influencing WTP premiums for longan and factors affecting participation in insurance program by ordinary least squares regression method. The explanatory variables consisted of gender, age, education, experience in longan cultivation, size of longan planting area, planting area characteristics, proportion of non-agricultural income to total income, income from longan cultivation, number of household members, group integration of farmers, coverage limit, awareness of longan insurance project, and damage from natural disasters. The literature reviews for these explanatory variables and relationship direction hypotheses are shown in the Table 3. The WTP model can be written as follows:

$$WTP_i = \beta_0 + \beta_1 Gen + \beta_2 Age + \beta_3 Edu + \beta_4 Exp + \beta_5 Size + \beta_6 Loca + \beta_7 Inp + \beta_8 Inc + \beta_9 Hom + \beta_{10} Inte + \beta_{11} Cov + \beta_{12} Info + \beta_{13} Damage + \varepsilon \quad (1)$$

where *WTP* is the willingness to pay (Baht), *Gen* is gender (0 = female 1 = male), *Age* (years), *Edu* is education level (1 = uneducated, 2 = primary school, 3 = secondary school, 4 = high school, 5 = vocational certificate, 6 = vocational certificate high, 7 = Bachelor's degree, 8 = Master's degree), *Exp* is experience in longan cultivation (years), *Size* is size of longan planting area (rai), *Loca* is characteristics of the longan planting area (0= in the irrigation area, 1= outside the irrigation area), *Inp* is proportion of non-agricultural income to total income(Baht), *Inc* is income from longan(Baht), *Hom* is number of household members (person), *Inte* is the integration of farmers (0 = no integration of farmers, 1 = there is a gathering of farmers), *Cov* is protection limit (0 = not satisfied with the coverage limit, 1 = Satisfied with the amount of protection), *Info* is perception about the insurance longan, and *Damage* is damage from natural disasters in the past 5 years (times). The WTP for longan crop insurance premiums will be estimated by using the ordinary least squares regression with Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors.

Table 3 Review of the literature on factors affecting to WTP

Variable	Fiscal Policy Office (2010)	Office of Agricultural Economics (2018)	Alexander (2006)	George (2013)	Falola et al. (2013)	Gulseven (2014)	Pant et al. (2019)	Anang et al.(2021)	Maganga et al.(2021)	Kurnaity et al.(2021)
Age							+	+		
Gender		+					-		+	
Education level			+	+	+	+	+			
Income in agriculture		+	+		-	+	+			+
Non-agricultural income		-	-			+				
Dissatisfaction with insurance conditions										
Ignorance of insurance										
The initial bid price of the insurance premium	-	-								
Protection limit	+		+							
The credibility of the intermediary	+									
number of household members		+		+	-	-				-
Cultivating area size		+	+	+	+					
Location characteristics of the area		-								
land ownership proportion		+		+						
Cultivation experience		+			+			+		
farming model				+						
Being affected by disaster		+	+							
Getting help from the government			-							
Cooperative membership					+	+	+			
Agricultural Training							+			
Type of farmer							+			
The previous record of climate shocks									+	
Extension contact									+	
Access to remittances									+	

This study measured WTP premiums for longan using the Contingent Valuation Method. CVM is a willingness-to-pay valuation approach by asking farmers directly which is a method that uses survey questions to show the willingness-to-pay value that farmer is willing to pay. It is a series of questions that allow respondents to state the degree of benefit or harm in terms of value to an upcoming or fictitious environmental change. For example asking how much are you willing to pay the most (FAO, 2000)?

Figure 1 explains the contingent valuation method and process based on CVM. Case 1 set the price of insurance premiums starting at 300 baht per rai. The question is, *Are you willing to pay a premium of 300 baht per rai*? If the farmer answered that he was willing, he would ask the same question again, setting the next bid up by 50%. If the farmer answered that he was willing to pay, he would ask if the farmer could pay more? If farmers say they are willing to pay, specify the price they are most willing to pay. Case 2 set the price of insurance premiums starting at 300 baht per rai. The question is, *Are you willing to pay a premium of 300 baht per rai*? If farmers say they are not willing to pay, ask the same question with the price reduced by 50%. If the farmer answered that he was willing to pay, he would ask if the farmer could pay more? If farmers say they are willing to pay, specify the price they are most willing to pay.

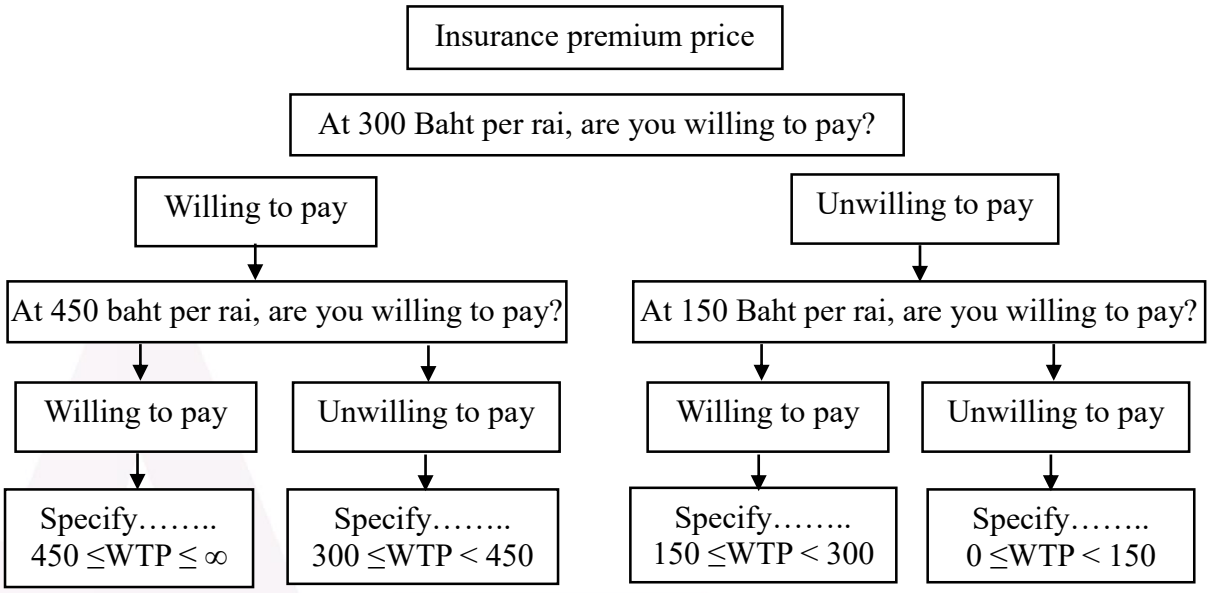

Figure 1 Evaluation process based on contingent valuation method

3.2 Data collection

The total longan farmer population in Chiang Mai province is 46,406 household (Department of Agricultural Extension, 2019). The total sample size was calculated by Taro Yamane's formula (Yamane, 1973). Given the allowable error at 5%, the total sample size was 396.58. Thus, the number of samples was adjusted to be suitable for 400 samples. After that, sampling in each subdistrict was calculated with multistage sampling technique with the weight calculated from the size of the number of farmers in each district, with details as follows:

Table 4. Number of registered longan planters in 2019 at district level.

District name	Farmers (Household)	Percentage of longan farmers	Number of samples
Chomthong	7,486	16.13	64
Chiang Dao	1,849	3.98	16
Mae Taeng	2,516	5.42	22
Mae Rim	1,224	2.64	11
Fang	1,497	3.23	13
Phrao	4,644	10.01	40
San Pa Tong	4,530	9.76	39
Sansai	1,410	3.04	12
Hang Dong	3,210	6.92	28
Hot	2,872	6.19	25
Doi Tao	4,696	10.12	40
Saraphi	5,123	11.04	44
Mae Wang	2,432	5.24	21
Doi Lo	2,917	6.29	25
Total	46,406	100.00	400

Source: Department of Agricultural Extension,2019

The instrument for interviewing farmers used in this study was a questionnaire. It consisted of open-ended questions and closed-ended questions. The questionnaire was divided into 4 parts as follows: Part 1 is the preliminary information of farmers, gender, age, educational level. number of household members, Longan cultivation experience, annual household net income. Part 2 is information on longan cultivation of farmers, namely the proportion of ownership of longan planting land, characteristics of longan planting area, awareness of information about the crop insurance project, and satisfaction of the protection limit. Part 3 is information about the nature of disasters experienced in the past 5 years. Part 4 is This is information about the willingness to pay for longan insurance using the insurance premium set by the insurance company as a starting point, offering a price to buy longan insurance at 300 baht per 1 unit of coverage.

3. Empirical Results

3.1 General information of the respondents.

Table 5, the average age of the sample was 44.58 years. The average number of longan farmer households was 3.12. The average income from only longan cultivation was 54,688.58 baht per year. The average income of all agriculture was 57,652.13 baht per year. The average of non-agricultural income was 31,887.97 baht per year. The average longan cultivation experience of respondents was 11.36 years. The average planted longan area was 4.97 rai. The average yield of longan was 4,361.63 kg. The production was damaged by natural disasters on average 1.53 times. The study shown that the WTP for longan insurance premiums of farmers in Chiang Mai on average was 198.55 baht per rai.

Table 5. General information of the respondents.

Variables	Average	SD
Age (years)	44.58	8.85
Number of household members(person)	3.12	0.89
Income from longan cultivation (baht per year)	54,688.58	93,140.64
Total agricultural income (baht per year)	57,652.13	90,224.33
Total non-agricultural income (baht per year)	31,887.97	31,376.66
Longan cultivation experience (years)	11.36	2.90
Size of Longan Cultivated Area (Rai)	4.97	5.91
Longan yield (kg)	4,361.63	8,214.65
The amount of damage from natural disasters (times)	1.53	1.62
Value of WTP longan insurance premiums (baht per rai)	198.55	84.47

Source: from the survey.

3.2 Value of WTP premiums for longan. Classified according to the factors used in the study.

Gender of farmers head proved to be positive related to willingness to pay for longan crop insurance. Gender was a dummy variable with male coded 1 and female coded 0. This means that male farmers have a higher willingness to pay premiums than female farmers. Male farmers have an average willingness to pay premiums at 204.84 baht per rai and female farmers have an average willingness to pay premiums at 181.95 baht per rai.

Table 6. The value of WTP the average longan insurance premium classified by gender.

Gender	Frequency	Percentage	Average WTP
Male	290	72.5	204.84
Female	110	27.5	181.95
Total	**400**	**100**	**193.40**

Source: from the survey

The level of education was positively correlated with the willingness to pay for longan insurance premiums. It was shown that farmers with higher education levels were aware of the risks of damage to longan yields and were able to analyze the cost-effectiveness of longan insurance. Therefore, emphasis should be placed on publicizing the details, the process of joining the program and the benefits that will be gained from participating in the Longan Insurance Program for farmers with low education and farmers who are not educated. This will help farmers understand the longan insurance program and be willing to pay more.

Table 7. The value of WTP the average longan insurance premium classified by level of education.

Education level	Frequency	Percentage	Average WTP
uneducated	20	5	132.38
primary school	31	7.75	194.84
junior high school	24	6	158.33
high school	166	41.5	207.20
diploma	56	14	186.43
Bachelor's degree	102	25.5	215.25
Master's degree	1	0.25	300
Total	**400**	**100**	**199.20**

Source: from the survey

In Table 8, it was found that the characteristics of longan planting areas were not related to the value of farmers' willingness to pay insurance premiums. This means that regardless of whether the longan planted area is in the irrigated area or not in the irrigated area, there will be no difference in the willingness to pay the premium. Farmers who planted longan in irrigated areas had an average willingness to pay at 192.65 baht per rai, and farmers who planted longan outside irrigated areas had an average willingness to pay at 199.76 baht per rai.

Table 8. The value of WTP the average longan insurance premium Classified by the nature of the planting area.

Planting area	Frequency	Percentage	Average WTP
irrigation area	68	17	192.65
outside the irrigation area	332	83	199.76
Total	**400**	**100**	**196.21**

Source: from the survey

In Table 9, Farmer inclusion was positively correlated with the value of willingness to pay premiums. This means that farmers who are grouped will have a

higher willingness to pay premiums than those who do not join. Therefore, the government should suggest guidelines for the grouping of farmers, such as large-scale grouping, etc.

Table 9. The value of WTP the average longan insurance premium Classified by the grouping of farmers.

Farmer's gathering	Frequency	Percentage	Average WTP
be a cooperative member	67	16.75	268.66
not a member of the cooperative	333	83.25	184.44
Total	**400**	**100**	**226.55**

Source: from the survey

It shows that some farmers are not satisfied with the amount of insurance. This makes the value of willingness to pay premiums low. Therefore, the government or private sectors involved in the longan insurance program should expedite finding guidelines or policies to provide additional assistance to farmers, for example, the government helps pay insurance premiums to several farmers, etc. Satisfied farmer have an average willingness to pay premiums at 259.27 bath per rai. and Not satisfied farmer have an average willingness to pay premiums at 120.49 bath per rai.

Table 10. The value of WTP the average longan insurance premium classified by satisfaction of the coverage limit.

Satisfaction of the protection limit	Frequency	Percentage	Average WTP
satisfied	225	56.25	259.27
not satisfied	175	43.75	120.49
Total	**400**	**100**	**189.88**

Source: from the survey

In Table 11, the longan insurance scheme is not widely known. Some farmers do not know about the longan insurance scheme and do not know the difference between insurance and non-insurance of longan. As a result, the value of willingness to pay insurance premiums is lower. Therefore, government agencies should publicize the details of the longan insurance program and the benefits of insurance to incentivize farmers to make insurance decisions and be willing to pay more for longan insurance premiums.

Table 11. The value of WTP the average longan insurance premium classified by information perception.

News awareness	Quantity	Percentage	Average WTP
receive news	156	39	250.58
not aware of the news	244	61	165.29
Total	**400**	**100**	**207.94**

Source: from the survey

In Table 12, Farmers damaged by natural disasters have a higher willingness to pay premiums than farmers who are not damaged by natural disasters. Therefore, the public and private sectors should focus on educating about natural disasters that affect longan production so that farmers are aware of the damage caused by natural disasters

that will result in farmers finding ways to reduce their risks. The longan insurance program can help alleviate the damage in terms of expenses. As a result, farmers decide to take longan insurance and have greater value for their willingness to pay longan insurance premiums.

Table 12. The value of WTP the average longan insurance premium classified by damage.

Damage	Quantity	Percentage	Average WTP
damaged	227	56.75	230.64
not damaged	173	43.25	156.45
Total	**400**	**100**	**193.55**

Source: from the survey

3.3 The results of a study of factors affecting the WTP for longan insurance premiums of farmers in Chiang Mai Province.

A study of factors influencing the value of farmers' WTP longan insurance premiums in Chiang Mai Province by using an estimation of factors affecting the WTP premiums for longan by using multiple regression analysis model. The results showed that the R Squared value was 0.7375 and the model accuracy used to predict was 73.75%. Factors Affecting Value of WTP Longan Insurance Premiums of Farmers in Chiang Mai Province at the significance level 0.01 is size of longan planting area, ratio of non-agricultural income to total income, income received from longan planting, satisfaction with coverage limit and damage of longan production from natural disasters in the past 5 years and the statistical significance level was 0.05 is gender, education level, number of household members, farmer's inclusion and awareness of longan insurance program.

Table 13. The results of a study of factors affecting the WTP for longan insurance premiums of farmers in Chiang Mai Province.

Variable	Ordinary Least Squares		
	Coefficient	**SD.**	***p*-value**
Gender	4.1724	84.06	0.0122**
Age(years)	0.0661	84.63	0.4838
Education level	1.3999	83.47	0.0369**
Experience in longan cultivation (years)	-0.8979	84.55	0.2574
Size of longan planting area (rai)	0.9478	74.74	0.0000***
Characteristics of the longan planting area	-0.9090	84.66	0.6459
Non-agricultural income to total income	-0.2828	73.04	0.0000***
Income from longan cultivation (baht)	0.0941	73.44	0.0002***
Number of household members (person)	3.9246	80.89	0.0157**
Farmer's gathering	14.8581	78.60	0.0228**
Satisfaction in the coverage limit	103.3081	49.07	0.0000***
Perception about the insurance longan.	6.2715	73.71	0.0247**
Damage of longan products from natural disasters in the past 5 years (times)	7.3172	72.04	0.0000***
Number of obs = 400 R^2 = 0.7375			

Source: from the survey
Note: Statistical significance level 0.01***, 0.05**, 0.1*

4. Discussion

The study found that gender variable was positively correlated with value of willingness to pay for longan insurance which was different from Pant et al. (2019) that gender variable was negatively correlated. Because the sample is different, it may result in different willingness to pay values. The number of family members was positively correlated with the willingness to pay for longan insurance, which was different from the reslaearch by Falola et al. (2013) that was negatively correlated with the willingness to pay for longan insurance. Other variables were associated with the same value of willingness to pay premiums as the other researchers.

5. Conclusion and Recommendation

5.1 Conclusion

This research is to study the factors influencing the WTP for longan insurance premiums of farmers in Chiang Mai Province. The data were analyzed by OLS method and averaged was used to determine the WTP for longan insurance premiums among farmers in Chiang Mai. The results of the study can be summarized as follows.

5.1.1 Factors Influencing the Value of WTP Longan Insurance Premiums of Farmers in Chiang Mai province.

From the study, it was found that the factors influencing the average WTP were sex, education level, size of longan planting area, proportion of non-agricultural income to total income, income from longan cultivation, number of household members. Longan plantation, farmers' grouping, satisfaction in the coverage amount, information about the longan insurance program and the damage of longan production from natural disasters in the past 5 years.

5.1.2 The value of WTP insurance premiums for longan farmers in Chiang Mai.

The results showed that Farmers in Chiang Mai had an average WTP longan insurance premium of 198.55 baht per rai, with the highest WTP longan insurance premiums at 450 baht per rai and the lowest WTP longan insurance premiums at 50 baht per rai.

Table 14. Value of WTP longan insurance premiums (baht per rai)

Value of WTP longan insurance premiums	Price (baht per rai)
Maximum value of WTP longan insurance premiums	450
Average value of WTP longan insurance premiums	198.55
Minimum value of WTP longan insurance premiums	50

Source: from the survey

5.2 Policy recommendations

5.2.1 government sector

Crop insurance is an important financial tool that should be pushed to increase risk management efficiency for Thai farmers, especially in accommodating climate variability based on current state policies. The government should encourage

competition among the private sector to develop a variety of policy forms, respond to the needs of farmers in each area. which the development and expansion of insurance dimensions. The government sector may consider using a cooperative approach between the public and private sectors. The government has formulated a crop insurance development plan, encouraging the private sector and the state to subsidize some of the insurance premiums for farmers.

5.2.2 private sector

Policy currently sold If the sum insured is adjusted to be close to the actual production cost of the farmers The insurance premium rates are at a level that farmers can afford, thereby increasing the incentives for farmers to take insurance. Communicating to farmers in the policy is an important factor affecting the sustainability of crop insurance. Creating a systematic database and having a central agency will help the private sector insurance providers to be able to extend and develop policy forms faster and better meet the needs of farmers.

5.3 Suggestions for the next study

5.3.1 This study is only a study of the WTP premiums for longan insurance of only 400 samples of farmers in Chiang Mai as a result, the data may not cover the opinions of all Chiang Mai farmers and may not explain their behavior clearly. In the next study, more samples should be collected. and expand more samples in each district especially in the district where there are many longan farmer households.

5.3.2 In the study, the study authors collected data by accidental Sampling without dividing farmers who produce longan in season and off season. Most off-season longan farmers have their own water sources such as ponds, artesian wells, etc. This makes them less affected by drought. Different farmers who produce longan in the season that relies mainly on rainwater. In the next study, separate groups of farmers should be collected to see how the insurance decisions and the WTP premiums for longan insurance between the two groups are similar or different.

5.3.3 This study revealed factors affecting willingness to pay longan insurance premiums. The researchers expected that such variables would affect farmers' willingness to pay longan insurance premiums in other provinces that are important longan producing areas of Thailand. Therefore, this research can be used as a reference in the next study.

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