

# Journal of Global Business and Trade

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## Impact of the Perceived Uncertainty on the Re-use Intention in the Medical Service: Relationship Immersion Adjusting Effect

Seong-Jin Kim<sup>a</sup>

<sup>a</sup>*Business Administration, Seoil University, South Korea*

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### ABSTRACT

**Purpose** – This study aims to understand the importance of relationship immersion to eliminate the perceived uncertainty that may be a hindrance to the growth of medical services, and to present strategies based on affective immersion and calculative immersion.

**Design/Methodology/Approach** – For this purpose, the hypothesis was established by considering prior research and social phenomena, and the survey was conducted via a specialized research company, and the subject was limited to medical service users. An analysis of the data collected to verify this was conducted through SPSS 24.0. When medical services were selected over the Internet, we wanted to uncover whether the customer was aware of the perceived uncertainty about the medical service and the impact it had on relationship immersion and re-use intention, and whether it was linked to re-use through relationship immersion.

**Findings** – The results showed that perceived uncertainty affects re-use intention, and that relationship immersion plays an adjusting role in the re-use intention of medical services. While it is generally common for consumers to have some knowledge of the medical information available on the Internet and visit the medical institution, in fact, the communion with the medical staff is a more important factor in their re-use intention.

**Research Implications** – Through this study, medical service research and assessment of satisfaction resulted in improved medical service quality and alternatives, as well as increased hospital management profitability. As a result, many people find and use medical institutions directly over the Internet, rather than through oral communication. Many consumers have easy access to medical services over the Internet, but on the other hand, they often visit medical institutions with some uncertainty.

**Keywords:** commitment, medical services, perceived uncertainty, revisit intention, service marketing

**JEL Classifications:** I15, N75

### I. Introduction

Currently, the medical service has a growing market size and countries are placing great

importance on that sector by the reason that human attention is focused on health and happy life. The Korean government is also trying to satisfy the needs of medical service consumers by creating appropriate medical and welfare policies. These changes in the environment have led to the creation of medical

<sup>a</sup>E-mail address: [nudeface@naver.com](mailto:nudeface@naver.com)

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services that meet consumer standards, perspectives and values, and consumer satisfaction has become a natural requirement. Therefore, research into various medical services and evaluation of satisfaction with them is a decision made by hospital management to improve medical services and prepare for the future. In addition, it is proportional to the hospital's management profits. In this background, each medical institution is focusing on medical service marketing. For example, the institution provides services that make it easy for consumers to find a medical institution or to get a voucher on the Internet or mobile. Many people use the Internet to find and use medical institutions instead of using the traditional way, oral communication. However, there is a speciality in the field of medicine that has a high level of involvement in trust in any case. Medical failures cause a speciality that results in more risk than general products in other areas. Therefore, consumers can easily access medical services through the Internet, but consumers always visit the medical institution with uncertainty about the medical service. Depending on the relationship between consumers and medical service providers, it is important how these uncertainties change into confidence and re-use. The purpose of this study is to understand that the relationship with the medical workforce is very important because consumers should visit the medical institution and meet with them, and how this relationship affects consumer re-use. This is a self-help measure that each medical institution hopes to survive in the increasingly competitive medical service market, which requires strengthening service to consumers and increasing service quality. For this purpose, agencies must establish and improve their marketing strategies. This study was conducted with a hypothesis that the perceived uncertainty affects medical institution's human service satisfaction, and therefore the consumer will be able to increase their re-use and loyalty through the oral communication. However, the prior researches was mainly consist of studies of perceived uncertainty

and satisfaction. And research into which factors have a huge impact on consumer satisfaction is generally insufficient. Therefore, this study attempts to validate and analyze how relationship between medical staffs and consumer can cause which adjusting effect in revisit intention if consumers visit hospitals with perceived uncertainty. In addition, the research implications are presented through this process, and the academic implications are to repeatedly emphasize the importance of the variables of immersion in the marketing of medical services. It also aims to create new practical implications for the competitiveness of medical services which is by the impact of health service relationship marketing and consumer revisit. Since medical services are the result of human beings, the implications and consequences of relationship immersion will have a huge impact on the marketing of medical services.

## II. Theoretical Background

### 1. Perceived Uncertainty

Bell (1982) said that most consumers would regret finding that another method of not choosing was better after making decisions under uncertainty. Morgan and Shelby (1996) generally demonstrated a consumer behavior model that is largely in an environment of uncertainty in brand attitudes, and Mathieu (1990) said that at this risk probability level, it is well-known how people usually make decisions, but they are not well aware of the decision-making process under uncertainty caused by unfamiliar information. Uncertainty in most Internet transactions can be distinguished by uncertainty in quality and uncertainty in the transaction process (Kim, 2017). Kim (2017) noted that an environment made up of the service provider's opportunism, consumer individual knowledge, and service-only characteristics was the beginning of this uncertainty. This divided into the service provider uncertainty, the

service purchaser uncertainty, and the uncertainty of the service product itself. Consumers looking to have the best trade performance here have two strategic alternatives in this uncertain trading environment. The first is a strategy to reduce uncertainty and the second is a strategy to acknowledge uncertainty. This means that consumers make decisions through the necessary information and reduce uncertainty. And it can be aimed at reducing the negative side of the risks by uncertainty. Consumers over the Internet are aware of various uncertainties, Lee (2006) emphasized that the uncertainty factor that leads to Internet purchase delays is the importance of social psychological risks. Because of these social and psychological risks, Internet consumers perceive psychological uncertainty. Seo (2011) classified consumer risks due to uncertainty in transactions as follows: Uncertainty related to the product (product function, whether product quality is consistent with personal expectation, whether price is appropriate, whether the product is well-composed), Uncertainty related to purchase method (feeling difficult to make comparison), Uncertainty related to delivery, refund and return (whether the product will arrive without damage or error, whether refunds and returns will be netted), Uncertainty related to payment and transaction information such as credit card information (Lee, 2006).

Through these prior studies, this study present that there are three sub-factors: information uncertainty, preference uncertainty, and psychological uncertainty.

### *1.1. Information Uncertainty*

Information uncertainty is the uncertainty that causes an imbalance in information. This is divided into external uncertainty and internal uncertainty, and external uncertainty is a long-predictable, uncontrollable and macro-environmental factor. This is because the economic entity is not aware of all the information and means the uncertainty that is created

here (Roseman, 1984). Buhr and Douglas (2002) said that consumers with insufficient endurance about uncertainty are stressed when information in the general market is usually uncertain and is not materialized. No matter how small the experience of wrong purchase is, consumers remember. They try to avoid uncertainty, and they find it difficult to get things going in there.

### *1.2. Preference Uncertainty*

Preference uncertainty is a situation in which consumers cannot accurately determine which alternative is best to achieve their goals among the options given. The less differences are in attractiveness among alternatives, the more preference uncertainty is for consumers (Kim, 2017). Preference uncertainty is also measured as a difference in quality, and Kim (2017) found that product that is more difficult to know the quality at the time of purchase than other products.

### *1.3. Psychological Uncertainty*

Psychological uncertainty is the sense of risk that an internet shopping process may lead to a wrong purchase, or uncertainty about what fits the consumer's social status or image through the process of selecting a product. This psychological uncertainty extends to feeling in the social environment, and perceived risks in Internet shopping can also cause uncertainty in the consumer purchasing decision-making process. De and Lilien (2008) stated that the concept of uncertainty as a psychological condition is a source of variability in perceptions of uncertainty, taking into account attitudes to consumers' environment, the individuals' cognitive processes, and diversity and social expectations of personal experience.

## **2. Relationship Immersion (Commitment)**

Relationship immersion is an essential element for the establishment of successful relational exchanges,



and immersion between the two stakeholders acts as a strong indicator of relationships (Orpen, 1994). In the scope of service marketing, Morgan and Hunt (1994) defined this immersion in relationships as a belief that it is important to make the utmost effort to maintain a lasting relationship with others as an exchange partner. This refers to the continuous process of relationship immersion, and is a positive assessment of this relationship. This means that the parties involved think it is worth while trying to keep the relationship going. Mathieu and Zajac (1990) divided these immersions into affective immersion and calculative immersion and said that different incentives exist to maintain and proceed with the relationship in immersion. In this context, the members who were led by affective immersion were defined as having a desire to continue these relationships because they liked these relationships and liked their partners, and thus the members had a sense of loyalty. Calculative immersion, on the other hand, is the extent to which each member has to maintain a relationship because of the cost of dissociating the relationship, the cost of a fairly serious break-up or transition that follows these expectations. It is an expense that includes an assessment by investments made in these relationships and the availability of alternatives to compensate or replace existing investments. And the resulting benefits are presented in a sober calculation. However, it is basically the same content, so it is divided into affective immersion and calculative immersion here.

### 3. Behavioral Intention and Re-Use Purchase

Behavioral intention is divided into economic behavior and social behavior (Bendall-Lyon, Dawn, & Powers, 2004). Economic behavior is a transformative behavior that affects the financial aspects of an entity, such as customer repurchase behavior, premium payment intent, and social behavior refers to behavior such as customer dissatisfaction behavior (Park, 2014) or negative oral communication that affects the

opinions of potential customers in a firm. Among economic actions, customer satisfaction of repurchase behavior plays an important role in making future consumer behavior, especially in making repeat purchase decisions (Kim & Lee, 2012), and Jeon (2003) said that it is a customer's response to unsatisfactory purchase experience, and Han and Seong (2007) said that consumers who are generally disappointed and betrayed greatly represent complaints or oral communication behavior to third parties. In addition, behavioral intention is a comprehensive concept of the intention to repurchase and communicate in oral goods or services and, depending on experience or recognition, is divided into the intention of repurchase, revisit, and the intention of oral communication (Zeithaml, Berry, & Parasuraman, 1996). In terms of oral communication, it is referred to as informal WOM performed by the information providers without thinking of an increase in their commercial interests (Rusbult, 1983), and the reliability of information has a direct positive effect on the purchase intention and online oral communication (Kim & Jung, 2009). Understanding oral communication is very important, and Anderson (1994) emphasized the importance of oral communication, saying that consumers who are satisfied with the service are the best salespeople. The effects of oral communication play a strong role in the product or service purchase, as they tend to actively propagate consumers' own experience (De Bruyn & Lilien, 2008). Wong and Kwong (2004) said that the oral communication increases the potential customer's revisit intention with the recommending effect (Hui et al., 2007). When satisfied with the service experience, a halo effect on the enterprise is created for the consumer to trust the enterprise (Lee, 2006), and the trust in here is defined as an intention for the individual to positively communicate to others based on overall experience through active actions. Hospital services are human, physical, and system services, so there are too many factors that determine the quality of the actual

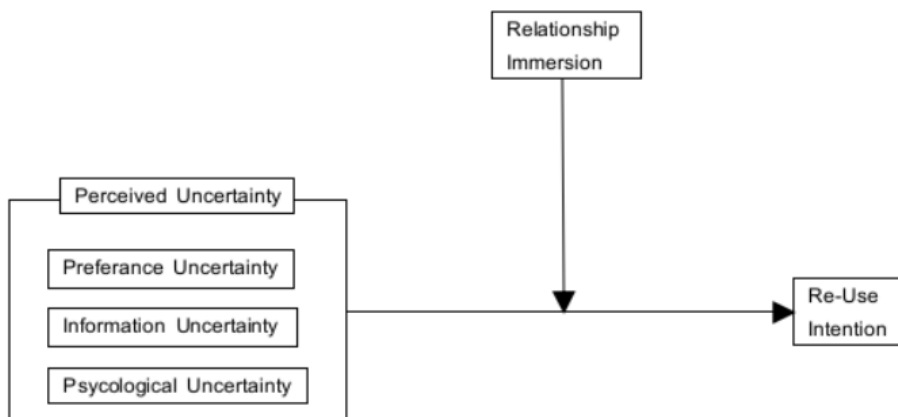
services. The usage assessment of the complex services offered is conducted through the problem identification phase, and the consumers evaluate the hospital through their personal experience, surrounding acquaintances and media, resulting in the selection of a specific hospital. These choices result in the re-use behavior. In particular, the Internet is where the off-line communication has been transferred to mobile online communication, so the speed of the word transfer is faster than before. Re-use behavior is the behavioral intention that consumers feel to purchase a service or product over and over again after consuming that. This re-use behavior is an important factor that continues to generate corporate profits or outcomes from a long-term perspective, is a measure of customer maintenance, and is the most important concept in marketing. Jeong and Park (2004) defined the repurchase intention as talking about the possibility that customers will continue to use current services or goods over and over again in the future. It can also be viewed as an intention for the customer to re-use the service or good later on the basis of past experience and expectations about the future (Kim & Oh, 2002). In the research of behavioral and re-use intention, the customer satisfaction is treated importantly and, is also considered as a prior factor of re-use intention.

### III. Research Methodology

#### 1. Research Model

The purpose of this study, in various marketing activities of medical institutions to gain competitive advantage, is to understand the perceived uncertainty of medical consumers caused by Internet advertising or coupons, the immersion in relationship between the medical staffs and the re-use intention. We will also look at whether medical institutions have formed relationships to reduce perceived uncertainty of medical consumers. Three factors for measuring perceived uncertainty were divided into preference uncertainty, information uncertainty, and psychological uncertainty. Relationship immersion was simplified into two factors: affective immersion and calculative immersion. The re-use intention of patients was measured by frequency of purchase and oral communication. Based on these, a research model Fig. 1 was established to find out the intention of revisiting the medical institution for consumers of medical services. This research model is designed to examine the causal relationship between perceived uncertainty (preference, information, psychology), relational immersion and re-visit intention of medical service users, and to analyze the adjusting effect of relationship immersion.

Fig. 1. Research Model



## 2. Research Hypothesis

### 2.1. Relationship between Perceived Uncertainty and Re-Use Intention

The uncertainty consumers perceive in the purchasing decision-making process refers to situations in which they lack knowledge or are unsure of the outcome of a decision (Das & Teng, 2004), and because e-commerce is done through the use of electronic means and technology and is not done directly in real-world space, there is greater uncertainty than traditional transactions (Lee, 2002). Consumers realize uncertainty when they are aware of incomplete information about the market or cannot predict the seller's attitude (Nam & Roh, 2010), and highly perceived uncertainty has an important effect on purchasing behavior (Wong, 2004).

These prior studies have enabled us to create the following research hypotheses.

H1: The Perceived Uncertainty will affect the Re-Use Intention.

H1-1: The Preference Uncertainty will affect the Re-Use Intention.

H1-2: The Information Uncertainty will affect the Re-Use Intention.

H1-3: The Psychological Uncertainty will affect the Re-Use Intention.

### 2.2. Relationship between Perceived Uncertainty and Relationship Immersion

A Study on the perceptuality of environmental uncertainty and relationship maintenance of the franchise Oh (2016) showed that the impact of trust-based control on relationship satisfaction at the franchise who is highly aware of environmental uncertainty becomes greater as the duration of the relationship lasts longer.

These prior studies have enabled us to create the following research hypotheses.

H2: The Perceived Uncertainty will affect the Relationship Immersion.

### 2.3. Research Hypothesis about Adjusting Role of the Relationship Immersion

(Kim, 2017), who studied the fairness of medical service quality and the impact of immersion in relationships on loyalty, said that the relation immersion is a full medium and has a significant impact on consumers' loyalty to medical services.

Based on these prior studies, the following study hypotheses were established.

H3: The Relationship Immersion has the Adjusting Effect in relationship between the Perceived Uncertainty and Re-Use Intention.

## 3. Research Model

### 3.1. Operational Definition of Variables

#### 3.1.1. Perceived Uncertainty

The perceived uncertainty was determined by modifying the items of (Kim, 2013), composed of preference certainty, information uncertainty, and psychological uncertainty. The total of 16 questions have been prepared.

- a) I sometimes think that future medical technology may develop further and that there will be a good cure.
- b) I once did not like the medical service that was determined through online information.
- c) I prefer hospitals that are as safe as possible in selecting medical institutions.
- d) I want to know by comparing the medical expenses of other medical institutions that perform selected medical procedures.
- e) I'd like to know the amount of discount for medical treatment and the existing medical expenses that I visited through a coupon or a acquaintance recommendation.
- f) I'd like to know if I can get similar treatment at lower prices.
- g) I want to compare the selected medical services with other hospitals.

- h) The chosen medical service is more disturbing because it cannot be seen in practice.
- i) Medical services such as packaged goods are difficult because I don't know what to choose.
- j) It is difficult to assess the medical cost and quality of a selected medical technology or service.
- k) I don't think the level of my expertise in medicine is that high.
- l) I can't believe the medical staff at the health service that advertised online.
- m) I'm not sure about choosing a medical institution, so I also look for an alternative one.
- n) I prefer a safe hospital if possible in choosing a medical institution.
- o) I want to be sure before I choose a medical institution.
- p) It is difficult to assess the medical services provided by the medical institution due to advertising search.

On a five-point Likert scale (1=not at all, 3=normal, 5=very much so)

### 3.1.2. Relationship Immersion

The items in Fullerton (2005) and Robson and Coates (2014) were modified according to our research progress, resulting in a total of twelve questions of affective immersion (6), and calculative immersion (6).

- a) The medical institution is operated by thinking patients first.
- b) I have a good relationship with this medical institution.
- c) The counselor of this hospital and I feel the same bond as a family.
- d) This hospital is willing to invest in providing the best environment for its customers.
- e) If I don't keep a good relationship with the counselor at this hospital, I'm afraid I'll suffer some losses.
- f) I have a feeling that there won't be much difference between a counselor at another hospital and the one at this hospital.
- g) Due to loyalty, I think I'll have to communicate with the medical team for a while.

- h) In the same hospital, I feel sorry to do business with other medical staffs not with those who took charge of me.
- i) I feel sorry if I cut off my relationship with the counselor right now.
- j) It's not easy to do business with other medical personnel as I like.
- k) It's not easy for me to do medical product deals with other counselors as I like.
- l) I am attached to my staff who consulted me.

On a five-point Likert scale (1=not at all, 3=normal, 5=very much so)

### 3.1.3. Re-use Intention

The re-use intention was to organize the four questions based on the study of (Rosman et al., 2013).

- a) I conveyed a positive message to others about this medical institution.
- b) If medical services are needed again, this medical institution will be the first to visit.
- c) I will continue to use this medical institution in the future.
- d) Next time I'm going to re-use this medical service.

On a five-point Likert scale (1=not at all, 3=normal, 5=very much so)

## 4. Data Collection and Analysis Method

### 4.1. Data Collection

This study was conducted by an online professional research company to verify the previous research theory, and the survey was conducted for medical service users. The period was seven days from June 3 to June 10, 2018 and a total of 350 questionnaires were collected. A total of 322 copies of the collected questionnaire were used for the final analysis, excluding those of poor responses.

### 4.2. Analysis Method

The analysis of data collected in this study was analyzed through SPSS 24.0. First, frequency analysis was performed to identify demographic characteristics of the case subjects. Second, technical statistical analysis of each measurement item is conducted, and the value of the Cronbach's Alpha was measured to verify the reliability, which means internal consistency. Third, unnecessary variables were removed and the Exploratory Factor Analysis (EFA) was conducted to verify the validity of the measured items. Fourth, we conducted a Pearson Correlation Analysis to check the correlation and multicollinearity between each variable. Fifth, the causal relationship between each variable was verified. Path analysis was performed with SPSS 24.0.

## IV. Results of Empirical Analysis

### 1. Sample Characteristics

Demographic characteristics are shown in Table 1. Of the total respondents, 158(52.3%) were men, and 144(47.7%) were women. Seventy-four(24.5%) aged 18-29; 117(38.7%); 114(35.4%) aged 30-39; and 111(36.8%) aged 40 or older. High school graduates were 26(8.6%), university students and graduates were 241(79.8%) and postgraduate school students and more were 35(11.6%). About medical institutions with visiting experience, 147(48.7%) people visited the dentist, 91(30.1%) visited the dermatology department, 15(5.0%) visited the plastic surgery hospital and 49(16.2%) visited the ophthalmology department.

Table 1. Sample Characteristics

		Frequency	Percent	Accumulated Percent
Sex	1) Male	158	52.3	52.3
	2) Female	144	47.7	100.0
Level of Education	1) Highschool(or less)	26	8.6	8.6
	2) University	241	79.8	88.4
	3) More	35	11.6	100.0
Medical Institution	1) Dentist	147	48.7	48.7
	2) Dermatology	91	30.1	78.8
	3) Plastic Surgery	15	5.0	83.8
	4) Ophthalmology	49	16.2	100.0
Age	1) 18-29	74	24.5	24.5
	2) 30-39	117	38.7	63.2
	3) 40 or more	111	36.8	100.0
	Total	302	100.0	

### 2. Feasibility Analysis

#### 2.1. Factor Analysis and Reliability Analysis

About the factor analysis, among the perceived uncertainty, the preference uncertainty consisted of 6 questions, the psychological uncertainty consisted of 4

questions and the information uncertainty consisted of 4 questions.

The factor analysis about the relationship immersion consisted of 12 questions, and about the behavioral intention consisted 4 questions.

Reliability analysis is the process of checking how reliable a factorial analysis is. The results of reliability analysis using Kronbach Alpha showed that the factor 5 was 0.624.

2.2. Correlation Analysis

Table 2 is a correlation analysis that verifies whether the relationship between the independent variables is significant. In other words, it is intended to

identify the relationship between the quantitative variables. They were analyzed by Pearson’s method. Pearson’s coefficient of correlation has a value from 0 to 1. The closer it is to zero, the less the corelationship is, and the closer it is to one, the more the corelationship is. The highest correlation was the relationship between information uncertainty and preference uncertainty, and the correlation coefficient of .588\*\* is represented. And the lowest correlation was the relationship between information uncertainty and relationship immersion, representing a correlation coefficient of .046\*\*. This shows that unknown medical institution information is not preferred. It means that information providing can lead to marketing effects.

Table 2. Correlation Analysis

	<b>Relation Immersion</b>	<b>Preference Uncertainty</b>	<b>Information Uncertainty</b>	<b>Psychological Uncertainty</b>	<b>Re-Use</b>
Relation Immersion	I				
Preference Uncertainty	0.115	I			
Information Uncertainty	0.046	0.588	I		
Psychological Uncertainty	0.145	0.493	0.309	I	
Re-Use	0.282	0.164	0.003	0.405	I

3. Hypothesis Verification

3.1. Regression Analysis

The description of Table 3 is as follows. The effect of the perceived uncertainty on the re-use intention was found to be less than .05 with a significance of .000 in the regression equation. That is to say, the perceived uncertainty as a whole has been shown to affect the re-use intention. The regression model was found to have

the explanatory power of .182. Durin-Watson’s figure is also 1.851, which is almost independent. However, if we look at this in detail, the significance probability of the hypothesis that the preference uncertainty will affect the re-use intention was 0.554, larger than 0.05. The probability of information uncertainty is 0.017 which appears to be less than 0.05. The psychological uncertainty was shown at .000. It was adopted because it was smaller than 0.05. It appears to have an effect.

Table 3. Regression Analysis

Model	Nonstandardization		Standardization		t	Significance Probability	Durbin-Watson	R <sup>2</sup>	Significance F Variation
	Coefficient		Coefficient						
	B	Standard Error	β						
(Constant Value)	1.802	0.302			5.971	0.000			
1 Preference Uncertainty	0.052	0.088	0.042		0.592	0.554	1.851	0.182	0.000
Information Uncertainty	-0.178	0.074	-0.156		-2.400	0.017			
Psychological Uncertainty	0.520	0.073	0.432		7.176	0.000			

Note: Dependent Variable - Re-use Intention.

Table 4. Verification of the Adjusting Effect of the Relationship Immersion

Model Summary										
Relation Immersion Control	R	R2	Modified R2	Standard Error of Estimated Value	R2 Variations	Statistics Variations				Durbin-Watson
						F Variations	Freedom Degree1	Freedom Degree2	Significance Probablity F Variations	
Preference- > Re-Use	.164a	( I )0.027	0.024	0.70978	0.027	8.280	1	300	0.004	1.861
	.311b	( II )0.097	0.091	0.68494	0.070	23.158	1	299	0.000	
	.311c	( III )0.097	0.088	0.68608	0.000	0.004	1	298	0.949	
Information- > Re-Use	.003a	( I )0.000	-0.003	0.71951	0.000	0.003	1	300	0.959	1.851
	.282b	( II )0.079	0.073	0.69151	0.079	25.788	1	299	0.000	
	.283c	( III )0.080	0.071	0.69250	0.000	0.142	1	298	0.707	
Psychology- > Re-Use	.405a	( I )0.164	0.161	0.65785	0.164	58.880	1	300	0.000	1.853
	.464b	( II )0.215	0.210	0.63861	0.051	19.349	1	299	0.000	
	.474c	( III )0.224	0.216	0.63586	0.009	3.585	1	298	0.059	

### 3.2. *Verification of the Adjusting Effect of the Relationship Immersion*

To see the adjusting effect, you can check the change in the R2 value, which is a significant regression description, by checking the change in the significant probability F variation from model I to model III where the interaction variables are entered, and by checking the amount of R2 variation between the models. The description of Table 4 is as follows. The adjusting effects of the relationship immersion between preference uncertainty and re-use intention can be seen as improved explanatory power from model I to model III. Especially in the input of interaction variables that check the adjustment effect, we can see that the R2 value increases, although it is a small value. Therefore, it can be interpreted that the

control effect of relationship immersion has a positive adjusting effect (+).

Secondly, verification of the relationship immersion of the adjusting effects in the effect of the information uncertainty on the re-use intention can be found to have improved the explanatory power from 0.000 to 0.080. In other words, it can be interpreted that there is an adjustment effect of (+) of the relationship immersion. Finally, verification of the adjusting effects of relational immersion in the effects of psychological uncertainty on the re-use intention is as follows. It can be seen that the explanatory power increased from 0.164 in the model I to 0.224 in model III. As a result, all perceived uncertainties can be seen as increased explanatory power in input to the adjustment variable. In other words, it can be interpreted that the relationship immersion has an adjusting effect of (+).

## V. Conclusion

The purpose of this study is to identify the importance of relationship immersion, which may eliminate the perceived uncertainty that is a hindrance to the growth of medical services, and to present strategies that can be based on affective and calculative immersion. For these purposes, hypotheses were established based on prior research and social phenomena, and empirical analysis was conducted to verify them. If medical services were selected through coupons or SNS, we wanted to find out whether the customer using them was aware of the perceived uncertainty about the medical service and the impact it had on the relationship immersion and re-use intention, and whether it was linked to re-use through relationship immersion. As a result, first, the perceived uncertainty has been shown to affect the re-use intention. Preference uncertainty, information uncertainty, and psychological uncertainty have been shown to affect the re-use intention. Second, it has been shown that the relationship immersion plays an adjusting role in the re-use intention of medical services. The perceived uncertainty is an important

impediment to medical service and has a positive impact on the re-use intention through relationship immersion between medical personnel and consumers. Since medical services have very distinct service characteristics, communication with the clinical workforce is important, no matter what perceived uncertainty there is. Although it is common for patients to know a certain amount of medical information in advance and visit the institution, the communion with the medical staff is a more important factor in their re-use intention. The first hypothesis, the perceived uncertainty will affect the re-use intention about medical institutions, has all been adopted. Second, the customer considers re-use through relationship immersion. Therefore, immersion in a relationship is very important as the adjusting effect. In other words, this relationship immersion creates strong customer loyalty among patients. Based on these findings, we would like to suggest that, in order to reduce the perceived uncertainty, a training for communicating with customers should be conducted on staffs. With the development of medical technology, medical equipment and systems continue to develop, and the tendency to rely more on the accuracy and technical skills of the



equipment than on the skills of the medical staff is being strong. Innovative services should be studied and applied. This is also an important factor in gaining competitive advantage. Based on the above-mentioned problem consciousness, we intend to emphasize the importance of a practical and efficient recovery strategy for the service problems of medical facilities, and to present effective measures favored by patients. If communication with the medical staff is not available, patients will leave for other medical facilities or find ways to treat them without using medical services. Because the treatment information environment is rapidly being built, customers can more easily obtain treatment information and book it at a lower cost. This study collected the data needed to suggest ways to maintain a lasting relationship with customers. In addition, the hospital service was reviewed, the concept of uncertainty behavior perceived by the customer was studied empirically, and the relationship of the behavioral intention to maintain the customers and lasting growth was verified. The implications and future research tasks of the study are as follows. This study intended to study the success strategy of

maintaining long-term and favorable relationship with patients by solving anxiety of patients who experience unpleased circumstances due to service problem occurrence during treatment and converting dissatisfied customers into satisfied customers. We tried to present the recovery strategy through the study of service recovery fairness by analyzing the impact relationship between the service recovery process, customer satisfaction, trust and the behavioral intention. This planning of medical services is becoming an important task in medical management. In addition to the above theoretical implications, the following are the implications of practical measures to ensure the competitiveness of medical institutions' services. Presently, reservation tendency is gradually shifting from visits, phone consultations, and PC reservations to mobile reservation. The impact of a ubiquitous mobile environment can help you navigate faster, up-to-date information. Thus, medical institutions must provide individual care services tailored to changing customer preferences, more convenient mobile reservation systems, and the latest treatment information to ensure continued satisfaction and trust from patients.

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## Profitability Analysis of Irradiated Carrageenan as a Biostimulant in Small-Scale Rice Farming in Selected Provinces in the Philippines<sup>\*</sup>

Rachelle A. Mariano<sup>a</sup>

<sup>a</sup>*Department of Agribusiness Management and Entrepreneurship, College of Economics and Management, University of the Philippines Los Baños, Philippines*

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### ABSTRACT

**Purpose** – This study aimed to assess the farm profitability of using the irradiated carrageenan as a biostimulant in small-scale rice production in selected provinces in the Philippines.

**Design/Methodology/Approach** – Rice production data with and without the use of the irradiated carrageenan were collected from a purposively selected 117 farmers during the 2017 dry season. Descriptive statistics, gross margin analysis, and profitability ratios were employed.

**Findings** – Results showed that the farmer respondents were, on average, 57 years old, males, reached high school, members of farmer groups, and held farms around 1.6 hectares. The average yield of farms increased from 3.5 MT/ha to 4.4 MT/ha, on average, when the farmers used the biostimulant. Consequently, the rice farmers earned an average increase in gross margin of Php 17,000 per ha. The computed benefit-cost ratio was also higher at 3.04 when the carrageenan biostimulant was applied to the rice farm.

**Research Implications** – This study is the first to quantify the economic benefits of using a biostimulant in small-scale rice production. With positive results, farmers should be encouraged by rice scientists, development workers, extensionists, and policy makers to use more environmentally and human friendly agricultural technologies, such as the irradiated carrageenan biostimulant, in rice production. Since this particular biostimulant is not yet available on the market, concerned government institutions should ensure the future availability of such in areas where demand has already been created. Lastly, more research should be done on increasing the variety of biostimulants available in the market.

**Keywords:** biostimulant, gross margin, irradiated carrageenan, profitability, rice

**JEL Classifications:** Q12, Q16

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<sup>a</sup>E-mail address: [rache.acda@yahoo.com](mailto:rache.acda@yahoo.com); [ramariano2@up.edu.ph](mailto:ramariano2@up.edu.ph)

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## I. Introduction

The continuing increase of the global population poses a large threat to food security as agricultural land lessens over time. In the Philippines, the population has reached 101 million, requiring 11 million metric tons of rice (Philippine Statistics Authority, 2016). With this, it is imperative that agricultural productivity should be improved significantly to meet the rising demand for food. The food demand in the country has been met with the use of modern rice varieties and greater usage of chemical fertilizers that have raised crop yields, in addition to rice importation. The country continues to be highly dependent on chemical fertilizers, importing a peak of 2.3 million MT of fertilizers in 2014 (Fertilizer and Pesticides Authority, 2014). However, growing concerns of too much reliance on chemical fertilizers and pesticides are emerging as this practice results in contamination of soil, drinking water, and food, as well as poisoning and damage to non-target organisms such as bees, beneficial insects, fish, birds, and other organisms (Leach & Mumford, 2008). The indiscriminate use of chemical inputs has made crops more prone to pests and diseases, and has reduced soil fertility (Mahanty et al., 2017). Hence, the negative effects of the excessive use of chemical inputs resulted in increased production costs, inevitable damages to the environment, and health threats to humans. Given the hazardous effects of chemical inputs, the use of biostimulants is being considered a safer, sustainable, and eco-friendly alternative to flourish agricultural productivity (Mahanty et al., 2017). Biostimulants are substances and microorganisms derived from biological or natural sources that primarily enhance crop growth (Calvo, Nelson, & Kloepper, 2014). Among the various types of biostimulants, the use of seaweed extracts has a good potential in the Philippines. The *Eucheuma* seaweed, a red algae, is abundantly grown on farms in Eastern Visayas and Mindanao, Philippines (FAO, n.d.). When processed, the *Eucheuma* seaweed produces carrageenan (FAO, n.d.). It has many applications in consumer and industrial products, such

as an ingredient in food, pet food, personal care, cosmetics, and medicines (Naeem et al., 2015). While the country is among the top producers of seaweeds and carrageenan in the world (FAO, n.d.; Abad et al., 2014), it should maintain its competitive advantage by continuously researching and developing emerging and diversified applications of carrageenan. Radiation technology, on the other hand, has become an environmentally-friendly, convenient, and commercially viable technology that has many possible applications in sustainable agriculture (Abad et al., 2014; Machi, 2004; Sarma, 2004). Carrageenan, when subjected to radiation processing, can be an effective biostimulant as illustrated by research that proved its effectiveness in improving nutrient absorption and enhancing the growth and production of crops (Khan et al., 2009; Relieve et al., 2000; Shukla et al., 2016). Therefore, the use of biostimulants such as the irradiated carrageenan is a potentially beneficial move to counter the negative effects of the excessive use of chemical fertilizers and pesticides. The Philippine Nuclear Research Institute (PNRI) and the Department of Science and Technology (DOST), and the Philippine Council for Agriculture, Aquatic and Natural Resources Research, and Development (PCAARRD) continues to pursue studies on radiation modification of carrageenan and its various potential applications in agriculture. In line with this, the National Crop Protection Center of the College of Agriculture and Food Science of the University of the Philippines Los Baños (NCPC-CAFS-UPLB) have started to conduct field testing in selected provinces in the Philippines.

However, it is not clear whether the carrageenan biostimulant is economically attractive enough to trigger wider adoption. If using such offers better crop and human health and safety, but does not offer better income to the majority of farmers, its potential to be adopted by more farmers will remain untapped. For this reason, this study aimed to determine farmer profitability associated with the use of the carrageenan biostimulant in small scale rice production in the Philippines. In addition, the effect of using irradiated carrageenan on the profitability of rice farms has an

important implication for development recommendations not just in the Philippines but also in most developing countries where the farm sector is still dominant. An improvement in the understanding of its profitability can assist policy makers in creating enabling policies and assessing the efficacy of past and present programs and research projects.

## II. Literature Review

Plant biostimulants are diverse substances and microorganisms, obtained from natural sources, that are used in agriculture to stimulate plant growth (Calvo et al., 2014). They function primarily to improve plant growth, stress tolerance, and quality (Calvo et al., 2014).

The scientific literature defines 'biostimulant' as any substances that are beneficial to crops without being nutrients or pesticides. Unlike fertilizers, Kauffman et al. (2007) defined biostimulants as materials that promote plant growth and are applied in low quantities. Kauffman et al. (2007) also attempted to summarize the types of biostimulants mainly according to their ingredients, source, and content. The main groups that are widely accepted by the scientific community and industry stakeholders are humic substances, hormone containing products (such as seaweed extracts), and amino acid containing products (Calvo et al., 2014; du Jardin, 2015; Halpern et al., 2015).

The first category is the humic substances. These are natural components of soil organic matter, which are derived from decomposed plant, animal, and microbial residues (du Jardin, 2015). The effectiveness of humic substances as biostimulants depend on whether the interaction between organic matter, microbes, and plant roots is optimized, resulting in inconsistent but globally positive results on plant growth (du Jardin, 2015; Rose et al., 2014). The application of humic substances result in increased root length and root biomass, thereby increasing root foraging capacity and enhancing nutrient use,

consequently increasing crop yield, the saving of fertilizer, and reducing losses to the environment (du Jardin, 2015).

The second category is amino acid containing products that are "obtained by chemical and enzymatic protein hydrolysis from agroindustrial by-products, from both plant sources (crop residues) and animal wastes (e.g., collagen, epithelial tissues" (Calvo et al., 2014; du Jardin, 2015; Halpern et al., 2015). When applied to crops and the soil, these protein compounds increase the biomass and activity of microbes, soil respiration, and soil fertility (du Jardin, 2015). There are reports of high but inconsistent increases in yield and quality traits when these protein compounds were applied in agricultural and horticultural crops (Calvo et al., 2014).

The third category is seaweed extracts and botanicals. There is increasing interest in the commercial use of seaweed extracts in agriculture because of the recent discovery of their biostimulant effects. Most of the seaweed species belong to the phylum of brown algae, but carrageenans come from red seaweed. This seaweed extract acts on both plant and soil when applied in hydroponic solutions or in foliar treatments (du Jardin, 2015; Craigie et al., 2008; Craigie, 2011; Khan et al., 2009). These seaweed extracts promote plant growth promoting bacteria and pathogen antagonists in the soils. In addition, they have nutritional effects by providing nutrients ('biofortification') of plant tissues, improving nutrient utilization, and enhancing soil aeration and structures that stimulate root growth (du Jardin, 2015). Furthermore, they have hormonal effects that result in enhanced seed germination, plant establishment, and further growth and development (du Jardin, 2015). Lastly, they also have anti-stress effects like anti-oxidants (Calvo et al., 2014).

Botanicals are those substances derived from plants and are more commonly used in pharmaceuticals, cosmetics, as food ingredients, and sometimes as plant protectors (Seiber et al., 2014). Compared to seaweed, less is known about their biostimulant usage. However, there is increasing attention to their pesticidal

properties and possible biostimulant uses (Ertani et al., 2013; Ziosi et al., 2012).

A biostimulant that has a good potential to be manufactured and marketed in the Philippines and its neighboring countries is that made from carrageenan. These are polymers that make up the structural polysaccharides of red seaweed (Relieve et al., 2000). The Philippines is one of the top producers of carrageenans (FAO, n.d.), which are primarily used as thickeners and gelling agents in some consumer goods (Relieve et al., 2000). Due to the biodegradability and availability at low cost of carrageenans, researchers became interested in its non-food applications, especially in agriculture. Through gamma irradiation, the carrageenans' structures and physicochemical properties can be modified, then the irradiated carrageenan can be used as foliar sprays in agriculture (Abad et al., 2014; Naeem et al., 2015). The irradiated carrageenan has been found to stimulate biological activities such as anti-microbial, plant growth promotion, suppression of metal stress (Relieve et al., 2000), and as elicitors of defense against pests and disease (Shukla et al., 2016). Numerous studies have found beneficial effects such as early seed germination and establishment, improved crop performance and yield, improved resistance to pests and disease, and enhanced shelf-life (Blunden 1991; Beckett & van Staden 1989; Hankins & Hockey 1990; Khan et al., 2009; Norrie & Keathley 2006). Carrageenans improved plant growth by regulating activities such as photosynthesis, ancillary pathways, cell division, and metabolic pathways, and induced plant defense responses against viruses, bacteria, fungi, and insects (Shukla et al., 2016). The plant growth promoting effect of carrageenan was observed in various crops such as chickpeas and maize (Bi et al., 2011), *Pinus radiata* (Saucedo et al., 2015), *Eucalyptus globulus* (Gonzalez et al., 2013a/2013b), and rice and mungbeans (Abad et al., 2014). The role of carrageenan in plant defense was also seen in tobacco (Castro et al., 2012; Ghannam et al., 2013; Muñoz et al., 2011; Nagorskaya et al., 2008; Vera et al., 2012), potatoes (Nagorskaya et al., 2010), *Arabidopsis*

*thaliana* (Sangha et al., 2010), and tomatoes (Sangha et al., 2015). In addition, such seaweed extracts improve nutrient uptake by the roots, which results in root systems with better water and nutrient absorption, consequently enhancing plant growth (Crouch et al., 1990). Carrageenans were also found to improve soil health by affecting the physical, chemical, and biological properties of the soil through the enhancement of the moisture-holding capacity and promotion of the growth of beneficial soil microbes (Khan et al., 2009). Lastly, carrageenans improve crop resistance to environmental stresses, both abiotic and biotic stresses (Khan et al., 2009).

Aside from carrageenan biostimulants, those made from humic substances and amino acids have been reported to promote growth and yield in rice. The use of biostimulants comprising of humic substances was reported to have increased the length and dry weight of upland rice roots (Mulyatni, Praptana, & Santoso, 2018). The humic acid biostimulant increased the root length by 11 to 22% (Mulyatni, Praptana, & Santoso, 2018). An amino acid biostimulant with seaweed extract was also tested in rice and recoded maximum values of grain yield of 2.67 metric tons ha per hectare and straw yield of 4.19 metric tons ha per hectare (Verma & Abraham, 2018). However, there is no study in the scientific literature, to the knowledge of the author, to have explicitly computed for the profit boosting potential of biostimulants in rice.

The assessment of profitability is one of the most commonly accepted indicators of economic activity in an enterprise or business. However, its definition and how it is calculated varies depending on the objective of the research as well as the methodology used. Still, profitability studies provide meaningful information on the consequences of choosing and using an agricultural technology on the farm or in a system as a whole (Nemes, 2009). Computing for production costs is fundamental in assessing farm profitability (Boelje & Eidman, 1984; Olukosi & Erhabor, 1987). Production costs usually include the operating or variable costs (including all production practices), fixed costs that include the cash overhead (land rental and taxes, etc.),

and non-cash costs (depreciation, opportunity costs, etc.) (Boelje & Eidman, 1984; Olukosi & Erhabor, 1987). There is no universal definition of which are considered variable or fixed costs because this depends on the aim of the research (Nemes, 2009). To measure profitability in rice production, there are studies that took into account only the variable costs to compute for the gross margin (Ammani, 2015; Kolawole, 2006; Oehme et al., 2007; Takele, 2010), while others included fixed costs to calculate the net returns per hectare (Gibbon & Bolwig, 2007; Nemes, 2009; Takele, 2010; Wynen 2001). These profitability studies generally examined the farmer's gains and efficiency in rice production, but very few tackled the profit gains in using a particular agricultural technology or innovation. In addition, while irradiated carrageenan's benefits for crops have been well documented, there is no literature discussing farm profitability when the biostimulant is applied to a rice crop. Therefore, this study aims to highlight the profit gains in using irradiated carrageenan in small scale rice production at the farm level. Doing so would encourage more

farmers to engage in sustainable agriculture through the use of biostimulants such as irradiated carrageenan.

### III. Methodology

#### 1. The Study Area

The Philippines is located at 12.8797° N latitude and 121.7740°E longitude, with a land area of about 300,000 square kilometers. The study was conducted in three major rice producing provinces in the Philippines during 2017 dry season cropping (between December and April). The location and sample size drawn from each province is presented in Table 1. The three major rice producing provinces in which this study was conducted were Bulacan, Nueva Ecija, and Isabela. The prevalent cropping pattern in the study area was rice-rice. These provinces were the same sites of research projects on irradiated carrageenan by the Philippine DOST and UPLB.

Table 1. Location and Sample Size of the Three Major Rice Producing Provinces Selected

Province	Location	Sample Size
Bulacan	14.9968°N, 121.1710°E	86
Nueva Ecija	15.5784°N, 121.1113°E	28
Isabela	16.9754°N, 121.8107°E	3
Total		117

#### 2. Data Collection and Analysis

A total of 117 rice farmers who had used irradiated carrageenan in their rice crops for more than one cropping season were purposively selected in the above-mentioned rice farming provinces. It was assumed that by using irradiated carrageenan for more than one cropping, the farmer would have passed the trial stage and had experience with and knowledge of irradiated carrageenan. These farmers were asked about their rice production input and output data when they used irradiated carrageenan in rice production in

the 2017 dry season. To minimize variations in production data due to typhoons in the wet season, the study focused on the collection of data during the dry season. These farmers were also asked to recall their production input and output data with their usual practice of no biostimulant or irradiated carrageenan application. The quantities and prices of production inputs such as seeds, fertilizers, pesticides, and labor were collected. Paddy output and market prices were also obtained. Using this data, the profitability of the rice farms before and after the use of irradiated carrageenan was assessed by computing for the gross



margin and gross ratio, which is common in farm management references such as Boelje and Eidman (1984) and Olukosi and Erhabor (1987). The economic

feasibility of using irradiated carrageenan in rice farms was assessed by computing the benefit-cost ratio (Gittinger, 1982).

Table 1. Sociodemographic Profile of the Farmer Respondents, n=117

Characteristics	Mean	Frequency	Percentage (%)
Farm Area	1.62		
Age	57		
Less than 30		0	0
30-39		9	8%
40-49		14	12%
50-59		43	37%
60 and above		45	38%
Highest Education (years)	9		
Elementary		47	40%
High school		37	32%
Vocational		4	3%
College		26	22%
Post-graduate		1	1%
Farm Experience (years)	29		
Less than 10		16	14%
10-20		29	25%
More than 20		70	60%
Household Size	4		
1-5		76	65%
6-10		35	30%
More than 10		4	3%
Sex			
Male		93	79%
Female		24	2%
Attendance of Training			
Yes		87	74%
No		30	26%
Membership in a Rice Based Organization			
Yes		86	74%
No		31	26%
Use of any Plant Growth Promoter Before			
Yes		0	0%
No		117	100%

Source: Field Survey of 2017.

The gross margin was calculated by deducting the variable expenses from the farm income or expected benefits (Boelje & Eidman 1984; Nemes, 2009; Olukosi & Erhabor 1987). The variable expenses included were costs from seeds, fertilizers, chemicals, and labor. The formula for computing the gross margin was expressed as:

Gross margin (GM) = Farm Income (B) – Total Variable Costs (TVC)

Where Farm Income (B) = PQ, P= Price of paddy (Php), Q= Output of paddy (Kg); Total Variable Costs (TVC) = seed costs + fertilizer costs + chemical costs + labour costs.

The Gross Ratio (GR) was computed by:

$$GR = TVC / GM$$

Where TVC= total variable cost, and GM= gross margin.

The formula employed for the benefit-cost ratio (BCR) was:

$$BCR = B / TVC$$

Where B= revenue, and TVC= total variable cost.

The farm's profitability was then compared with the farmers' usual practice of not using irradiated carrageenan and using irradiated carrageenan as a biostimulant in the rice crop.

## IV. Results and Discussion

### 1. Sociodemographic Characteristics of the Farmer Respondents

The results of the farmers' sociodemographic characteristics revealed that on average, the farmers were 57 years old, high school graduates, mostly (79%) male, with four household members, and 1.6 hectares of land. Most were members of a farmer association (74%) and had attended training (74%). With farming experience of more than 20 years, they were very

knowledgeable in the field. However, none had used any biostimulants in rice production before.

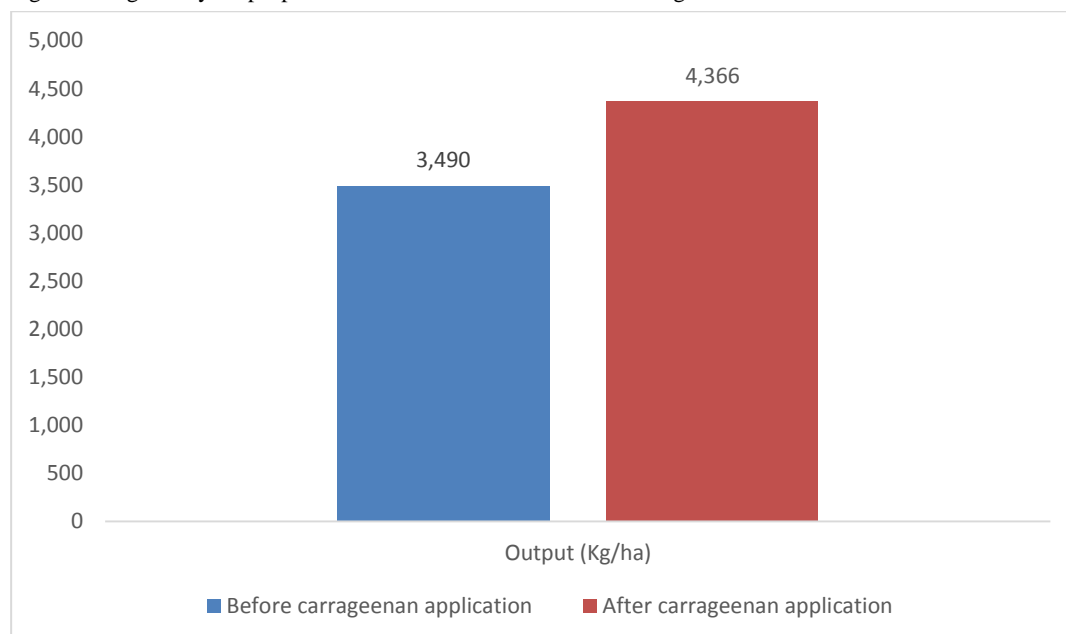
Age is often attributed to the level of openness in learning and adopting new technologies (Barry et al., 1995; Batte & Johnson, 1993). In addition, education affects the potential to improve comprehension on technologies and the willingness to innovate (Barry et al., 1995; Batte & Johnson, 1993). Even though the farmer respondents were aging, most (72%) finished only elementary and high school and had more than 20 years of farm experience (60%); they were open to try new agricultural technologies such as the carrageenan biostimulant. In addition, a farmer's membership in farmer groups had a positive influence in the usage of new agricultural technologies (Amaza & Kwacha, 2008). The farmers' memberships in associations and their attendance of training might have given them access to information about the carrageenan biostimulant; thus, this influenced them to use it on their crop.

### 2. Paddy Output and Input Use

#### 2.1. Paddy Output and Yield

The average yield in metric tons (MT) per hectare before and after the application of the irradiated carrageenan were 3.5 MT/ha and 4.4 MT/ha, respectively (Fig. 1). Before irradiated carrageenan, the yield was below the national average of 4.38 MT/ha (PSA, 2017). When the farms used the biostimulant, their yields increased and were on par with the national average. In 2017 dry season, when this study was conducted, there were no reported pest and disease outbreaks at the study sites, nor any extreme weather conditions that could have damaged the crop. Therefore, the potential benefit of using irradiated carrageenan as a biostimulant became evident.

Fig. 1. Average Paddy Output per Hectare before and after Irradiated Carrageenan



## 2.2. Production Inputs

In the study areas, farmers used 126 kg of seeds per hectare. They did not change their seeding rates when they applied irradiated carrageenan on their farms. Still, their seeding rate is higher than the recommended seeding rate of 40-80 kg for certified inbred seeds (Philippine Rice Research Institute, 2010a). Aside from certified and hybrid seeds, farmers still use low quality seeds, such as good and farmer seeds.

In terms of fertilizer application, the farmers' usual practice when using no biostimulants was applying 140 kg of N, 42 kg of P, and 25 kg of K. With carrageenan, farmers applied less fertilizer at 100 kg N, 30 kg of P, and 18 kg of K. The fertilizer application rate is dependent on the fertility of the soil; hence, the recommended rate of fertilizer application varies (Philippine Rice Research Institute, 2010b).

The carrageenan biostimulant is applied at almost 7 liters per hectare. This is less than the recommended rate of 9 liters per hectare. Irradiated carrageenan is recommended to be applied at 3 liters per ha at 12-15

days after transplanting (DAT), 30-35 DAT and 45-50 DAT (Department of Science and Technology, 2016). This is due to the limited availability of the carrageenan biostimulant.

Farmers applied 1.7 liters per hectare of herbicide, 1.4 liters per hectare of insecticide, 2 packs of rodenticide, 0.4 liters per hectare of fungicide, and 1.4 sachet of molluscicide. It is recommended that farmers use pesticides sparingly, change varieties every two to four cropping seasons, perform community planting, take care of beneficial insects, and know the pest species (Philippine Rice Research Institute, 2010c).

The use of the carrageenan biostimulant is a more environment-friendly alternative to the exclusive use of chemical inputs. The research project in which this study was connected to promoted the reduction of farmers' heavy use of fertilizers with the introduction of biostimulants. The effect is that the farmers, with the introduction of the biostimulant, decreased fertilizer use. This is because the carrageenan biostimulant enhances the nutrient usage efficiency of the rice crop; therefore, there is no need to apply as much fertilizer.

However, the farmers in the study area still continue to use other chemical pesticides despite the introduction of the biostimulant. This is perhaps because the research project did not force nor promote the use of chemical pesticides. The farmers still have a choice if they decrease or retain pesticide application to the rice crop.

In the study sites, farmers usually needed 115 labor man-days per hectare from seed management to harvesting. When the carrageenan biostimulant was applied to the farm, the labor input became 122 labor man-days per hectare. The labor requirement in the study areas is higher than the national average of the 60 man-day labor requirement (Bordey et al., 2017).

Table 2. Production Inputs of Farms before and after Carrageenan Application

<b>Production Inputs</b>	<b>Before Carrageenan Application</b>	<b>After Carrageenan Application</b>	<b>Difference (units per hectare)</b>
Seeds (kg/ha)	126	126	-
Fertilizer (Php)			
N (kg/ha)	141.8	100.7	-41.1
P (kg/ha)	42.3	29.3	-13.0
K (kg/ha)	25	18.1	-6.8
Carrageenan (L/ha)		6.7	6.7
Herbicide (L/ha)	1.7	1.7	-
Insecticide (L/ha)	1.4	1.4	-
Rodenticide (packs/ha)	2.7	2.7	-
Fungicide (L/ha)	0.5	0.5	-
Molluscicide (sachet/ha)	1.4	1.4	-
Labor (man-days per ha)	115	122	7
. Land Preparation	49.4	49.4	-
. Crop Establishment	10.4	10.4	-
. Crop Care and Maintenance	56	63	7
. Harvesting	0.5	0.5	-

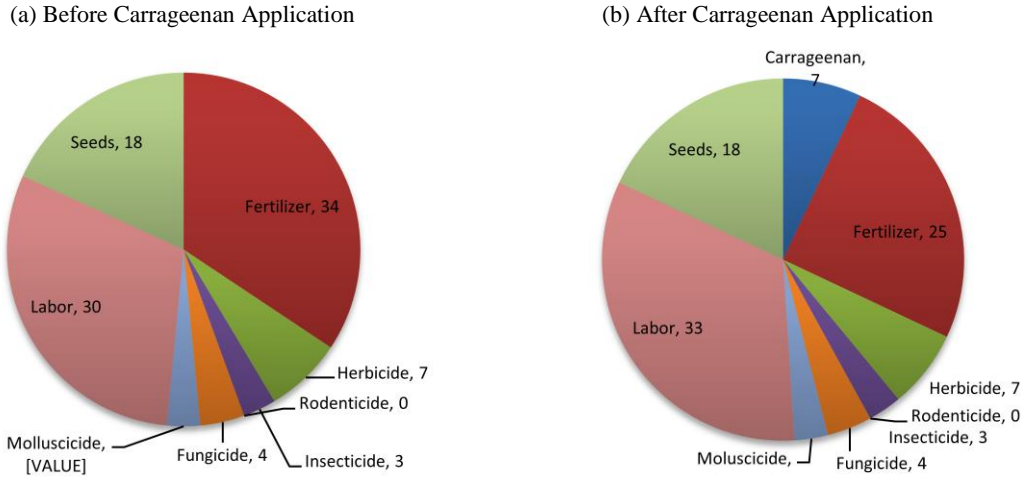
Note: \*a man-day is equivalent to an eight-hour work day.

### 3. Production Cost

The average cost of production estimated before and after the use of the irradiated carrageenan in rice production in the study areas were Php 27,997 and Php 27,095, respectively. Table 2 presents the production cost details for both. Fig. 2 shows the average distribution of production cost elements in the sampled farms before and after carrageenan biostimulant application in the farms. Without the biostimulant, fertilizer and labor costs accounted for 34% and 30% of the total variable costs, respectively. Farmers used 141 kg of N (Nitrogen), 42 kg of P (Phosphorus), and

25 kg of K (Potassium), translating to around Php 10,000. Farmers spent about 115 man-days for rice farming, costing around Php 8,800. On the other hand, when farmers used the carrageenan biostimulant, the share of fertilizers of total production cost decreased to 25%, while labor increased to 33%. When the carrageenan biostimulant was applied to the farm, farmers used 100 kg of N, 29 kg of P, and 18 kg of K, translating to around Php 7,000. Farmers spent 122 man-days for rice farming, costing around Php 9,300. With Php 200 per liter of carrageenan, the share of the carrageenan biostimulant of total production cost is 7%.

Fig. 2. Average Distribution of Cost of Production, before and after the Application of the Carrageenan Biostimulant



4. Gross Margin Analysis

The results of the gross margin analysis showed practice (before carrageenan biostimulant application) and after carrageenan biotimulant application in Table 3. The average gross margin for both were positive, which means that rice production is a profitable

business. The calculated gross margins were Php 38,500 and Php 53,000 before and after carrageenan biostimulant application, respectively. This indicated that if a farmer used the carrageenan biostimulant, he would earn a higher gross margin of Php 17,000 due to the increase in yield of 900 kg/ha.

Table 3. Results of Gross Margin Analysis per Hectare

Production Inputs	Before Carrageenan	After Carrageenan	Difference Php/ha
	Application Php/ha	Application Php/ha	
Seeds	4,813	4,813	
Carrageenan	-	1,356	1,356
Fertilizer	9,648	6,951	
Herbicide	1,903	1,903	-
Insecticide	725	725	-
Rodenticide	99	99	-
Fungicide	1,100	1,100	-
Molluscicide	870	870	-
Labor	8,840	9,278	
Total Variable Cost (Php/ha)	27,997	27,537	-903
Yield (kg/ha)	3,490	4,366	876
Revenue (Php/ha)	66,532	82,396	15,864
Ave Paddy Price (Php)	19	19	
Gross Margin (Php)	38,535	55,302	16,767

## 5. Profitability Ratios

The estimated yield, revenue, total variable costs, gross margin, and calculated profitability ratios for farms before and after the use of the radiation modified carrageenan are summarized in Table 4. The calculated gross ratio (GR) for farms without the carrageenan biostimulant was 0.73, which meant that the total variable costs was about 73% of gross income. Meanwhile, the calculated GR for farms with the carrageenan biostimulant was 0.49. This means that the total variable costs for such farms were 49% of gross income. A ratio of less than 1 is desirable, and a lower value indicates higher returns per peso. The GR was lower when the carrageenan biostimulant was used on the farms, indicating that the use of the technology improved profitability.

The calculated benefit-cost ratios (BCR) were 2.37 and 3.04 when the farms did not use and used the irradiated carrageenan, respectively. Such values indicated that the expected benefits exceeded the expected costs. These results affirmed that rice farming is still economically feasible. The total costs would need to rise by 137% and 204%, respectively, for both farms before the BCR would be 1, which is the breakeven point. If the reciprocal of the BCR was calculated and subtracted from 1 (Gross Ratio), the values revealed that the benefits could fall by 58% and 67% before the BCR would be reduced to breakeven point for farms before and after the irradiated carrageenan, respectively. The BCR and GR are higher when the carrageenan biostimulant was applied on the farms, indicating additional profitability.

Table 4. Benefits, Variable Costs, and Gross Margins before and after the Application of the Carrageenan Biostimulant

Farm	Average Yield (Kg/ha)	Average Price (Php/kg)	Revenue (Php)	Total Variable Cost (Php)	Gross Margin (Php)	Gross Ratio	Benefit Cost Ratio
Before Application	3,490	19	66,531	27,996	38,534	0.58	2.37
After Application	4,366	18	82,395	27,093	55,302	0.67	3.04

Previous studies only focused on quantifying the growth promoting and yield increasing effects of carrageenan in rice ( Abad et al., 2014; Khan et al., 2009). This study was first to quantify the associated costs and revenues at the farm level with the application of the carrageenan biostimulant in rice production in the study areas. This study showed that the application of the carrageenan biostimulant in rice further improves a farmer's gross margin. As a consequence of its application, there was a change in the distribution of production cost elements, i.e. labor costs accounted for the bulk of the costs, next were fertilizers, and then seeds. This study was first to demonstrate that the application of fertilizer was reduced with the application of the carrageenan biostimulant, but consequently increased labor costs at

the farm level. Thus, production cost decreased minimally with the application of the carrageenan biostimulant. As indicated by an increase in yield, the results affirmed the yield effect of the carrageenan biostimulant ( Abad et al., 2014; Khan et al., 2009). Such a yield increase translated to an increase in gross margin by Php 16,000 per ha. Therefore, this study was first to demonstrate that the application of the carrageenan biostimulant improves the profitability of the small-scale rice farmers in the selected study areas.

## V. Summary and Conclusion

Concerns on the negative effects of too much reliance on chemical inputs on human health and the

environment have led to the increasing interest of researchers in biostimulants in crop production. Previous research had documented the beneficial effects of using irradiated carrageenan as a biostimulant in rice production. However, very little in the literature had determined the profitability of the carrageenan biostimulant at the farm level. The major findings of this study included that there is still an opportunity for improving profitability among small scale rice farmers with the use of the carrageenan biostimulant. When farmers used the carrageenan biostimulant, the average yield per hectare increased from 3.5 MT/ha to 4.4 MT/ha. In the sampled farms with a usual practice of not using carrageenan, fertilizers and labor costs contributed to 34% and 30% of the production costs, respectively. If the said biostimulant was applied to the farms, the contribution of fertilizers to the total production cost decreased to 25%, while labor increased to 33%. Using the biostimulant, the farmers generated higher gross margins, GR, and BCR. A gross margin of Php 55,300 per hectare for farms was generated in farms that used irradiated carrageenan, as compared to a gross margin of Php 38,500 per hectare when no irradiated carrageenan was applied. The GR was higher at 0.67 if the biostimulant is used, compared to a GR of 0.58 if the farm did not use it. The computed BCR was also higher at 3.04 when the carrageenan biostimulant was applied in the farms as compared to a BCR of 2.37 when there was no carrageenan biostimulant application. Such results indicated that the expected benefits exceeded the expected costs when the carrageenan biostimulant is used. The findings specified that though both practices were profitable and economically feasible, using the carrageenan biostimulant would generate greater yield and profit for the farmers.

At the moment, more field verification testing is being conducted and coordinated by DOST-PCAARRD, NCPC-CAFS, UPLB, and the Department of Agriculture Regional Field Offices in different regions and provinces in the Philippines. DOST-PCAARRD and the PNRI are also in the process of negotiations with the possible private sector-led distributors of the carrageenan biostimulant. The farmers are indeed eager to access the biostimulant. Currently however, farmers can only obtain the carrageenan biostimulant through the research projects of the institutions.

Therefore, based on the findings, it is recommended that rice farmers use more environmentally and human friendly agricultural technologies such as irradiated carrageenan in rice crop production. Rice farmers are also encouraged to develop their own best practices with the use of irradiated carrageenan in their respective farm areas, which may include the reduction of other chemical inputs besides fertilizers. Rice researchers and scientists should also continue trials of irradiated carrageenan in other rice farming provinces and test its applicability. Since this particular biostimulant is not yet available on the market, the concerned government institutions should ensure the future availability of irradiated carrageenan in the areas where demand has already been created, especially in Bulacan, Nueva Ecija, and soon, Isabela. The concerned institutions should also partner with the industry for the mass production and promotion of irradiated carrageenan, and further ensure its availability and affordability. Lastly, the research institutions should then develop more biostimulants to increase the variety of products available on the market.

The author has not declared any conflict of interest.

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## The Current State of E-logistics in Mexico

Erendira Yareth Vargas Lopez<sup>a</sup> and Shinkyuo Lee<sup>b</sup>

<sup>a</sup>*School of International Trade, University of Colima, Mexico*

<sup>b</sup>*Department of International Commerce, Pai Chai University, South Korea*

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### ABSTRACT

**Purpose** – With the exponential growth of electronic commerce, new logistic strategies have emerged to enable companies to adapt to these drastic changes. Successful e-logistics must provide flexibility to parties involved in the supply chain. In Latin America, and particularly in Mexico, e-logistics face a series of challenges that compromise its optimal performance. As a result, the purpose of this paper is to present an overview of the current state of e-logistics, as well as update the literature in Mexico.

**Design/Methodology/Approach** – This qualitative research employs secondary data from the World Bank (Logistics Performance Index) and Statista, as well as extant literature on e-logistics and e-commerce focusing on the Latin American country, Mexico.

**Findings** – The key findings are three-fold. First, it appears Mexican online shoppers consider free shipping when buying online. Order delays seem to be the main problem they face when buying online. Second, retailers and logistics companies appear not to apply integrated information systems. Third, for retailers and logistic companies to become globally competitive, they need to take advantage of the increased connectivity to develop applications that will reduce problems related to delivery.

**Research Implications** – This study is expected to assist future empirical research with regards to internet connectivity and logistics as well as those in academia as a reference source. Finally, it will enable retailers and logistics companies to re-visit their models to fit current trends.

**Keywords:** e-commerce, e-logistics, logistics, retailers

**JEL Classifications:** L81, L87, L90, M19

### I. Introduction

In this technological era, companies require more accurate and faster information technology in order to enter the market and gain competitive advantage over

their competitors. E-commerce has brought new challenges, as well as opportunities, to logistics management (Bayles, 2002). However, for small and medium enterprises, the challenges of e-commerce are greater because they have neither the experience nor the sufficient resources to achieve good performance. Palacios and Kraemer (2003) mentioned that the penetration of electronic transactions in domestic and local markets varies according to the conditions established in each country. These conditions include

<sup>a</sup>First author,  
E-mail address: [yarethv@hotmail.com](mailto:yarethv@hotmail.com)

<sup>b</sup>Corresponding author,  
E-mail address: [sklee@pcu.ac.kr](mailto:sklee@pcu.ac.kr)

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many factors and characteristics that determine a country's predisposition to the growth of both digital networks and the volume of business conducted via the web. According to the World Trade Organization (1998), the term 'electronic commerce' has been defined as the production, distribution, marketing, sale, or delivery of goods by electronics means.

The popularity of online shopping has grown dramatically in recent years around the world and as e-commerce grows, there is also a growing need to find new ways and models that meet the expectations of demand and achieve innovations in the business. Despite the economic downturn, Latin America is one of the fastest-growing regions for e-commerce behind Asia-Pacific, and it is a market that retailers have to pay attention to (Cooper, 2016).

In the case of Latin America, the biggest e-commerce markets countries are Brazil, followed by Mexico and Argentina. As a result, it is appropriate to upgrade the current status of e-logistics in Mexico. E-Logistics is a relatively new concept that has been studied in many countries. However, in Mexico, little research can be found. This could be attributed to the use of the internet as a means of buying products online in recent times. Gunasekaran, Ngai and Cheng (2007) defined E-Logistics as a logistics community network consisting of third-party logistics service providers, including warehousing and transportation networks with suitable information technologies, with the objective of providing one-stop value-added services to customers. Previous research points out the difference between e-commerce and traditional commerce. Kadhubek (2015) noted that the lack of direct contact with the product, verbal and non-verbal contact with the seller, and the necessity to deliver goods to a large number of individual recipients are some of the characteristics that differentiate e-commerce from traditional commerce. The level of e-logistics offered by these stores should be as high as possible in order to balance the negative effects of e-stores, creating logistics value to satisfy client needs. Similarly, Kim, Oh and Woo (2016) compared traditional and e-logistics (See Table 7).

Much research that focuses on e-commerce in Latin American countries. For example, Palacios and Kraemer (2003) have focused on globalization and e-commerce; Riveros and Silva (2007) have studied e-commerce and logistics, highlighting the security of transactions through the use of e-mail in the context of Latin America. Moreover, Ruiz-Molina (2008) studied the components of the logistics service quality of a retail company and assessed the technological intensity, confirming that it positively influences customer satisfaction. In addition, Palacios (2003) studied the development of e-commerce in Mexico, arguing that private businesses were the main drivers of the growth of e-commerce relative to other sectors, like government and consumers. However, studies related to e-logistics in Latin American countries in general and Mexico, in particular, are limited. Also, there are some changes with regard to the number of internet users and smartphones. For instance, internet penetration in 2007 was around 21 percent. This skyrocketed to about 64 percent coverage in 2017. Similarly, the number of smartphone users increased from 2.6 percent in 2008 to 82.7 percent in 2016. Internet being the core element in e-logistics, it is appropriate to fill in the e-logistics literature in Mexico. Therefore, the purpose of this paper is to present an overview of the current state of e-logistics, as well as update the literature in Mexico.

The result indicates that Mexican online shoppers consider free shipping and delivery time when purchasing online. However order delays seem to be one of the major problems faced when buying online. In addition, retailers and logistics companies are currently not able to apply integrated information systems to the supply chain. Finally, for retailers and logistics companies to become internationally relevant, there is the need to take advantage of the increased connectivity in Mexico to develop applications that will lessen problems related to delivery.

The remainder of this review is organized as follows: Chapter II presents the behavior of e-commerce in Latin America. Chapter III delves on the concept of e-logistics. Chapter IV presents the state of e-logistics and Chapter V shows the conclusion.

## II. E-commerce in Latin America and Mexico

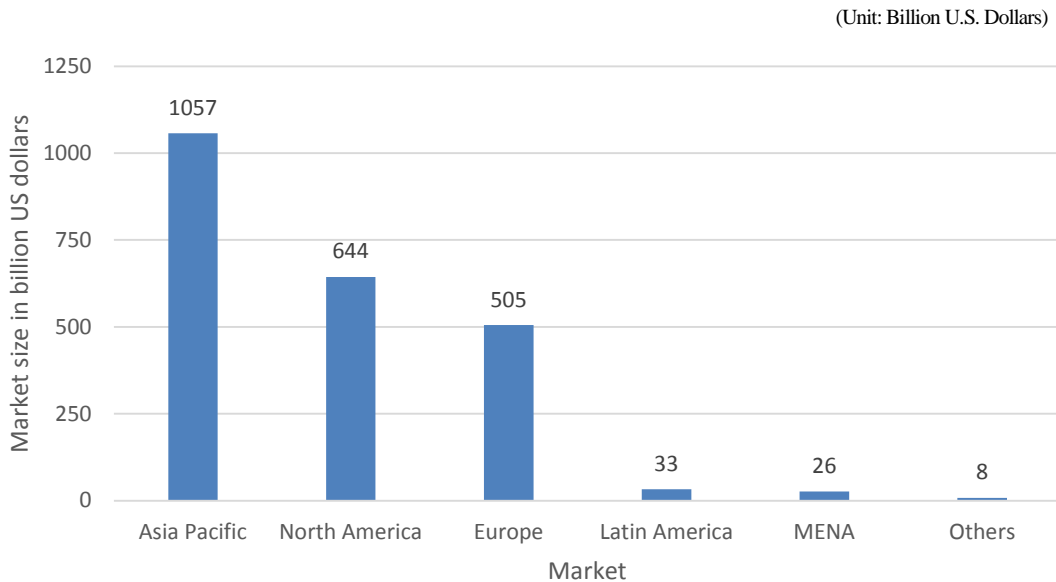
### 1. E-commerce in Latin America

In 2015 in Latin America, 42% of distribution of all e-commerce spending was generated by Brazilian online shoppers, followed by Mexican (17%), Argentinian (12%), Chilean (9%), Colombian (6%), and others (14%) (Statista, 2018e). In a worldwide

comparison, B2C e-commerce spending in 2015 amounted to U.S. \$1,057 billion in Asia Pacific. The next-ranked amounts were North America with U.S. \$644 billion, Europe at U.S. \$505 billion, and Latin America at U.S.\$33 billion, as shown in Fig. 1.

Even though the above information shows a large gap in the online shopping model among Asian and Latino consumers, e-commerce in Latin America is growing faster than in the rest of the world.

Fig. 1. Global E-Commerce Spending in 2015, by Region



Source: Statista (2018a).

In 2015, e-commerce of goods and services turnover in Latin America grew by 28 percent. Considering global growth of almost 20% in the same year, this is significant growth (Ecommerce Foundation, 2016). Retail e-commerce sales in Latin America during 2015 reached U.S. \$40.98 billion, and it is projected to grow to U.S. \$79.7 billion by 2019 (Statista, 2018e). This rapid increase in retail sales reflects the acceptance of e-commerce in the market by consumers. On the other hand, the average online transactions in this region are 9.2%, while Asia Pacific

was the highest ranked region with 38.2% in the same year. This means that retailers have a broad market to take advantage of but it also means greater competition.

With regards to internet penetration by region, Latin America accounted for 56% of population with internet access, which seems to indicate that it is one of the main barriers of electronic commerce in this region, as shown in Table 1. This problem is reflected not only in the performance of e-commerce, but also in that of logistics.

Table 1. Internet Access per Region

Region	Internet Access	Online Population
Regions Total	45%	2,520.4mn
North America	78%	297.9mn
Europe	75%	515.8mn
Latin America	56%	220.8mn
Asia Pacific	39%	1,223.2mn
MENA	38%	147.9mn
Others	21%	114.8mn

Source: Extracted from Ecommerce Foundation (2016).

The World Trade Organization (2013) stated that mobile phones play an important role in the expansion of e-commerce in developing countries. In 2017, the mobile subscriber penetration rate in Latin America represented about 67 percent of SIMs owned (Statista, 2018b).

## 2. E-commerce in Mexico

The Mexican e-commerce market is quite significant for the Latin American region; since 2016,

it has represented 17% of all e-commerce expenditure in the region. Further, according to the Internet.mx Association (2018), digital purchases seem to have had an upward trend since 2009, as shown in Table 2. Specifically, during 2016, an increase of more than 28% compared to the previous year was observed. This suggests that in the coming years, companies should be better prepared in terms of digital processes in order to respond to market needs.

Table 2. E-commerce Evolution in Mexico

	2009	2010	2011	2012	2013	2014	2015	2016
Thousands of Millions Pesos (MXN)	24.50	36.50	54.50	85.70	121.60	162.10	257.09	329.85
USD Billions	-	-	-	-	-	*12.2	*16.22	*17.63

Note: Average Exchange Rate 2016: MXN 18.71 = 1 USD.

Source: Extracted from Internet.mx Association (2018).

The digital purchase behavior of Mexicans shows that internationally, online shoppers buy from the U.S., Asia and Latin America. Specifically, in 2017, the majority of Mexican shoppers (75%) made an online purchase from U.S.-based retailers (such as eBay, Amazon, and among others), followed by Asia with 49%. This means that international logistics plays an important role for Mexican online buyers. This trend is similar to what was reported by Kim and Chung (2016), which found 85% of Korean international

shipping was done in the U.S. Some of the main reasons for international purchases among shoppers are price (61%), unique products (53%), and brands and unavailability of product in Mexico (52%). The reputation of an online store and the quality of products and brands are some of the reasons given by Mexican online shoppers for buying from the U.S. With regards to buying from Asia, price, variety and new products were most relevant (Internet.mx Association, 2018).

Table 3 below shows the influence of devices and their uses for online purchases in percentages. It can be said that the use of smart phones increased significantly in 2017 for online purchases. In research conducted by Kearney (2016), derived from a new

telecom regulatory reform in 2013, the AT&T Company was allowed to enter the Mexican market and favor fairer competition. This implies more competitive prices and options for consumers in terms of internet access and mobile services.

Table 3. Device Usage among Mexican Online Shopper

	Device Ownership		Device Used for Online Purchases	
	2016 (%)	2017 (%)	2016 (%)	2017 (%)
Computer	91	92	85	85
Smartphone	90	92	62	70
Tablet	53	57	31	32

Source: Extracted from Internet.mx Association (2018).

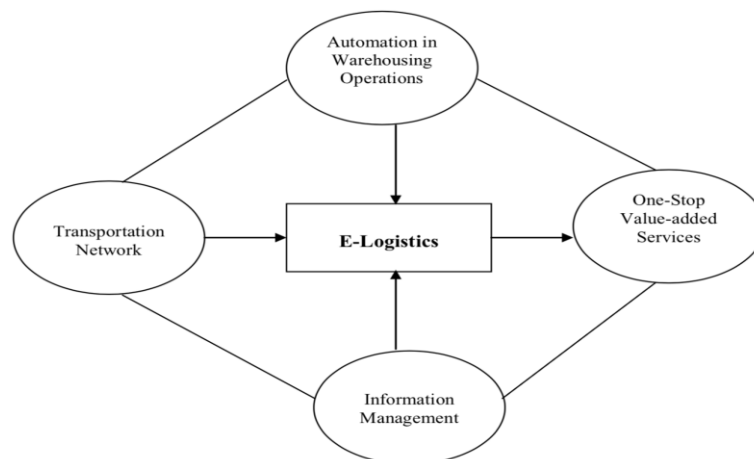
### III. The Concept of E-logistics

Nowadays, globalization and the development of information technologies have changed business processes directing and techniques. Therefore, e-commerce opens possibilities to new markets as well as new operating processes. At the same time, it requires all logistics functions to fit in the same model to achieve user satisfaction. This is how e-commerce has contributed to the expansion of e-logistics and promoted the development of new logistics processes. Ruiz (2015) stated that since logistics has been totally overwhelmed by the digital sales model, an improvement in strategies that involve distribution,

delivery and the return of products will increase the confidence of clients. Dębkowska (2017) examined e-logistics and non-e logistics applied companies in the transportation-forwarding-logistics (TFL) sector and concluded that e-logistics have a positive effect on their financial conditions.

Gunasekaran, Ngai and Cheng (2007) mentioned four important components in e-logistics: one-stop value-added services, management of electronic information, a transportation network, and automation in warehousing operations (Fig. 2). Mexican retailers that intend to operate efficiently and competitively should build core competences around these components.

Fig. 2. Conceptual Framework for E-logistics



Source: Gunasekaran, Ngai and Cheng (2007).



Table 4 elaborates some factors that have impacted logistics in the past and at present. Perhaps these same factors will have a different impact in the future

because the conditions in which they develop are also changing.

Table 4. Factors Influencing E-logistics

Factor	Impact in the Past	Impact Now
Economic Globalization	Searching for sources of supply and sales only in the immediate vicinity	Sources of supply and sales-not dependent of the location
Individualization of Preferences	Standardization of products, lower availability of products; thus, a client bought what was in stock	Research on client preferences and opinions, individual approach towards a client, professional customer service and consultancy
Development of Information Technology	Manual entering barcodes when selling, a lengthy time for information flow, extended time of ordering goods	Information systems integrating many different fields of activity, rapid information flow, quick ordering of goods
Integration of Clients	Treating clients as a whole, not enough attention to each client	Orientation toward a client
Development of Global Networks	Lack of deeper relationship with suppliers and clients, attention of companies in networks was, above all, focused on themselves	Cooperation with suppliers, information flow between companies and suppliers and between companies and clients, transfer to customer feedback to suppliers, distance management of stores with no necessity to leave the office
E-business Development	Lack of Internet access	Possessing own website, communication with clients, suppliers and inside the company using the Internet, ordering online, working on the Internet panel that enables clients shopping with home delivery

Source: Kadlubek (2015).

Table 5 illustrates a comparison between conventional logistics and e-logistics. The main characteristics found in e-logistics are related to information and the use of integrated systems based on electronic

connectivity. In this respect, while conventional logistics uses individual systems in each part of the logistics process, in e-logistics integrated tracking and ordering systems can be seen.

Table 5. Comparison between Conventional Logistics and E-logistics Concepts

Division	Conventional Logistics	E-Logistics
Product	Stylized product	Variety of product
Place	Restricted area	Unlimited wide area
Logistics Framework	Individual framework	Systematic integrated logistics framework
Management Scope	Individual company/supply chain	e-Market place
Information	Step-by-step physical tracking and individualized system	Integration and order tracking system and integrated information system
Core Competence	Cost and efficiency	Service and differentiation
Information Type	Company-based information	Electronic connectivity (internet-based)

Source: Kim, Oh and Woo (2016).

## IV. State of E-logistics in Mexico

### 1. Logistics

According to the World Bank (2018), based on the Logistics Performance Index (LPI), which is ranked 1 (worst) to 5 (best), out of 160 countries, Mexico was situated in the 54th position with a score of 3.11 in 2016. The LPI encompasses six key dimensions: efficiency of clearance process (2.88), infrastructure related to trade and transport (2.89), the ease of arranging shipments at competitive prices (3.00), quality of logistics services (3.14), tracking and tracing consignment (3.40), and timeliness of shipping (3.38). Compared to the Latin American region, Mexico is above average; Brazil is ranked first. The LPI shows the most critical factor is customs. This means that customs clearance in air traffic lasts 5.32 days, affecting the competitiveness of the logistics chain (Casas, 2017).

Keamey (2016), found that delivery time for an online purchase was between 10 to 15 days, which means that they were below the global leaders. These delays impoverish the service and discourage electronic commerce by subsequently affecting other aspects, such as consumer confidence.

E-Logistics requires strategic alliances between partners in order to provide different logistics services (Gunasekaran, Ngai, & Cheng, 2007). A study conducted by Arroyo, Gaytan and De Boer (2006) concluded that the percentage of Mexican firms that

outsourced logistics functions was lower than one, except in customs and freight brokering. Moreover, Duran-Escalada and Duhamel (2014) stated that companies cannot enjoy cost economies due to inadequate specialization of logistics services provided by logistics intermediates.

In Mexico, two modalities for delivery are handled. In the first modality, companies make their own logistics according to their needs. In the second modality, the company uses integrated logistics (3PL, Third Party Logistics Provider) to make the delivery (Rivero, 2017). This is because companies usually do not have the capacity to organize or maintain a distribution center. Also, this modality is a characteristic of retail stores. While the purchase can be tracked in the former, there is a break in the latter.

Moreover, Lourenço (2005) pointed out that transportation and delivery management are the only physical contact between the customer, logistics and e-commerce company. This suggests that online stores should pay more attention not only to their sales but also to the customer relation management (CRM).

For a Mexican online buyer, the most important aspects are related to free shipping, followed by delivery time and product tracking, as shown in Table 6. It seems that e-logistics is surpassed by demand of e-commerce, and is still in the process of transition from a traditional logistics to one in which it tries to match the needs of the market. This is a challenge for logistics managers that must be analyzed in depth.

Table 6. Evaluated Aspects Related to Delivery

Aspects	Rate (%)
Free Shipping	34
Short Delivery Times	21
Track and Trace the Product	18
Clearly Established Date and Time	18
Pick-up in Store	5
Payment Option for Express Delivery	4

Source: Cocktail Analysis (2017).

Unfortunately, the problems of urbanization in the country and the difficulty of accessing some areas hinder the performance of logistics as shown Table 7. Martinez-Olmos (2017), mentioned that urban mobility was one of the main factors affecting final delivery. Unlike developed countries such as the U.S. and emerging countries like Korea where physical

infrastructure is not a major problem in the supply chain, this appears to be problem in most developing countries, such as Mexico. Moreover, the same study states that among the reasons that generate non-compliance in deliveries are work schedules since it makes it difficult to deliver the product because there is no one to receive it.

Table 7. Most Frequent Problems When Buying Online

Most Frequent Problems	Rate (%)
Order Delays	64
Product Did Not Meet Expectations	17
Product Delivered Defective	11
Purchase Never Delivered	6
Product Delivered Does Not Correspond to Purchase.	6

Source: Cocktail Analysis (2017).

A new means of transport, optimizing delivery routes and contemplating margins in delivery times

would allow maintaining the level of service committed (Martinez-Olmos, 2017).

Table 8. Mexico: Internet Penetration 2000-2017

	Penetration (%)	Year	Penetration (%)	Year	Penetration (%)
2000	5.08	2006	19.52	2012	39.75
2001	7.04	2007	20.81	2013	43.46
2002	11.9	2008	21.71	2014	44.39
2003	12.9	2009	26.34	2015	57.43
2004	14.1	2010	31.05	2016	59.54
2005	17.21	2011	37.18	2017	63.90

Source: Authors configuration based on Statista (2018c).

## 2. Internet Infrastructure

Dębkowska (2017) stated that in practice, e-logistics includes the virtual planning of the supply chain as well as the coordination of the logistic processes: that is to say, joining efforts to maximize automation and streamline them with the use of computer networks.

In 2017, Mexico had 71.3 million internet users, representing 63.9 percent of the population of six years or more. The total increase in users with respect to 2016 was 4.4 percent (Statista, 2018c).

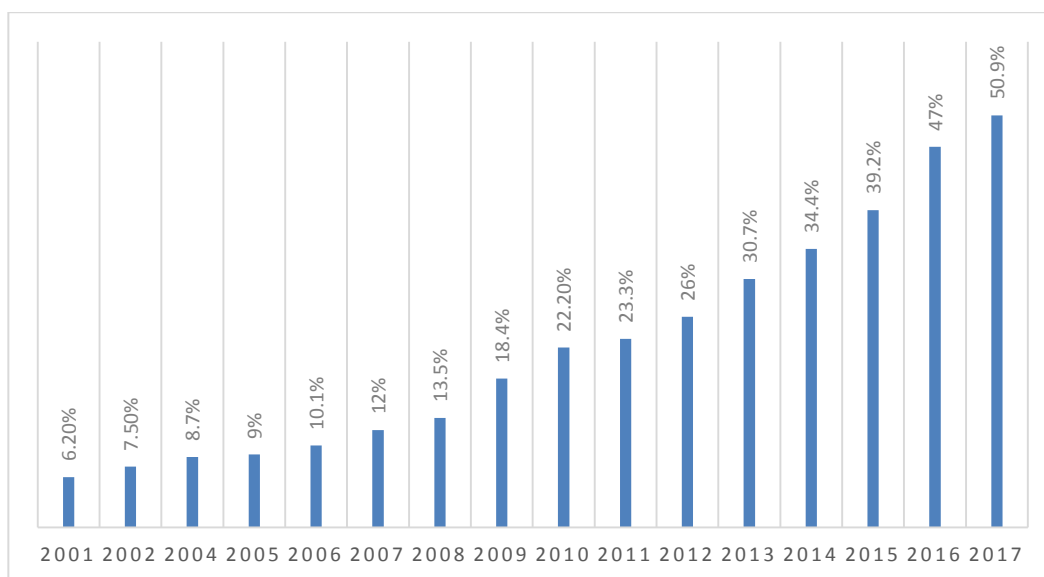
Despite the efforts of the Mexican government to facilitate access to the internet, the percentage of population without access to this service remains high.

In 2017, internet penetration reached 63.9% of the Mexican population, as shown in Table 8. There is still a great amount of population without connectivity; this problem becomes relevant to Mexican e-commerce and insertion in the digital economy (OECD, 2018). Further, during the same year, almost 51% of all Mexican households had internet access, up from 6.2 percent in 2001 as shown in Fig. 3. In addition, it can also be said that the use of internet is an urban

phenomenon since 86% of users of this service are concentrated in these areas. This makes the adoption of online shopping habits more difficult in less urbanized areas, and consequently, there is an issue of poor

tracking of delivery. This also means that both e-commerce and logistics companies are affected by the lack of internet coverage in the country.

Fig. 3. Share of Household with Internet Access in Mexico from 2001 to 2017



Source: Statista (2018d).

Table 9. Difficulties Purchasing on Mobile Device

%	Device	
31%	Internet connection too slow	INTERNET CONECTION NET: 46%
27%	Internet connection not reliable	
26%	Retailers do not have mobile app	NOT MOBILE PRESENCE NET: 35%
19%	Retailers do not have mobile site	
25%	Limited bandwidth on mobile device	
22%	Purchases not safe / secure	DIFFICULTY WITH PURCHASES NET: 45%
21%	Purchases take too long	
17%	Purchases on device confusing	
19%	Data plans too expensive	COST OF MOBILE NET: 24%
9%	Newest mobile devices too expensive	
11%	No access to payment options	

Source: Internet.mx Association (2018).

Now, difficulties around internet connection through mobile devices seem to be another barrier affecting online purchases in Mexico. In Table 9, 11.46% of problems when purchasing through mobile device are related to internet connection, while 35% of difficulties are related to the lack of applications for smartphones in making purchases. Another barrier faced (22%) when buying on mobile devices is security (safety). This result appears to be in line with empirical results documented for online shoppers in developing countries. Ahmed and Aguilar (2013) compared online shopping behaviors of 100 Mexican and 100 Canadian student online shoppers. Compared to the Canadians, Mexicans are found to be more positive about online shopping from existing stores, and are more mistrustful of new online shops. Similarly, Adnan (2014) found psychological factors (trust and security) to be the most important in determining online purchasing for Pakistani consumers.

### 3. Information System

In Mexico, it is necessary to invest in the infrastructure required to support the flows of a warehouse and have more competitive operations, generating a smaller amount of waste and mainly optimizing costs (Martinez-Olmos, 2017). However, Rios (2009) concluded that the high costs of the systems that manage all operations via e-commerce, the high cost of a new technological platform, and hiring specialized people to manage websites are among the main barriers faced by SME-sized e-commerce exporting companies.

Rivero (2017) mentioned failures from expired product photographs, unreliable inventory availability, and website failures are still frequent when purchasing online. This seems to indicate that the technological platform is not capable of integrating information with accuracy.

### 4. Return Policies

Žurek (2015) stated that this is the most difficult and expensive process because it is still a new market and companies do not have a proper procedure for processing returns. Given the premise that e-commerce is based on the fact that it is virtual, it is natural to have return policies allowing customers to have the guarantee that they will be satisfied in all aspects (Martinez-Olmos, 2017).

Online shoppers expect to return products in the same way they buy them. However, from a logistics point of view, this implies additional transportation, storage and all procedures related to the registration of the return product. This makes it difficult for retailers to establish clear return policies. On the other hand, this forces the consumer to keep or sell the product. This is because returning the product involves an extra expense for the consumer, which sometimes cannot be affordable. Put simply, it is a complicated process. Lourenço (2005) stated this process involves additional transport and activities in storage, such as status check, re-entry in storage, repair, and so on. However, Mexican retailers and logistics companies are putting measures in place to improve the processes involved in returning a product. Nowadays, the most relevant aspects in terms of product return for Mexican consumers are procedures without additional charges, followed by reimbursement and speed.

Policies should be as clear as possible for indicating permitted products, refunds, return times and the means to make the return. Reverse logistics should be made as simple as possible, allowing the customer to have confidence in having their products again, as soon as possible (Martinez-Olmos, 2017).

## V. Conclusions

E-logistics has been relatively new topic in Mexico and the literature found is quite limited. Mexican e-commerce is growing at an accelerated pace, and so is e-logistics. The use of technology to improve logistics processes has a positive effect on e-commerce. With

regard to Mexican e-commerce, international logistics has become more relevant in recent years as more than half of Mexican online buyers make purchases from international retailers located mainly in the U.S. and Asia. The results of this study are as follow.

First, Mexicans consider free shipping and short delivery time the most important factors when buying online. Both retailers and the logistics sector are forced to adjust their procedures to achieve profitability. However, urbanization appears to be a barrier that hinders the performance of logistics. This is confirmed by the fact that order delays are the main problem related to logistics faced by online buyers. Similarly, return policies are another problem that online buyers encounter. Considering that online shoppers expect to return products in the same way they make the purchase, it seems that return policies are still a challenge for e-commerce, and they must be able to make them easily, quickly and without additional costs.

In addition, the information systems do not correspond with the stock, distribution and web page, which affects delivery time negatively. E-logistics requires investment in information systems because this lack of infrastructure also reduces the benefits of e-commerce, and sometimes generates uncertainty and distrust in the buyer. Currently, it seems that there is lack of integrated systems as far as e-logistics in

Mexico is concerned. As a result, e-logistic companies, in order to become competitive, need to develop tracking and tracing systems where the parties involved (suppliers, retailer and customer) can converge. In fact, access to real-time information by not only buyers but also other parties, in most cases, can be difficult. These findings are similar to Kim (1996), where the lack of integrative logistics concepts were mentioned as one of the problems in Korean logistics.

From this study, it is evident that more Mexicans have internet connectivity and smart phones than ever before. It seems Mexican retailers are missing benefits that the internet offers in enhancing e-commerce as well as facilitating online purchasing. There is a need for both logistics companies and online retailers to take advantage of increased connectivity to satisfy customers. Improvement in each area of the information and communication systems platforms will also bring positive results for not only for e-logistics but also for e-commerce. Since Mexican e-logistics are following the same trend as Korea, it would be proper to analyze similar models from Korea applied in the e-logistics industry. Finally, this work is expected to be used as basic reference material for future researchers that would like to empirically investigate the impact of internet connectivity and logistics.

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## The Spaghetti Bowl Phenomenon in Free Trade Agreements (FTAs) among APEC Economies<sup>\*</sup>

Anne Meryl M. Chua<sup>a</sup>, Yolanda T. Garcia<sup>b</sup> and Emmanuel Genesis T. Andal<sup>c</sup>

<sup>abc</sup>Department of Economics, College of Economics and Management, University of the Philippines Los Banos

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### ABSTRACT

**Purpose** – This study attempts to empirically determine if the spaghetti bowl phenomenon (hereinafter referred to as the SBP) exists among the 21-member APEC trade bloc. The SBP phenomenon claims that the crisscrossing of multiple free trade agreements (FTAs) of a country with its partner economies can lead to trade diversion, which creates a disadvantageous effect on the trade flows of the countries involved. The underlying cause of this SBP phenomenon is the proliferation of FTAs, which can result in more trade conflicts than benefits. Hence, this study seeks to establish whether the current FTAs in the APEC trade bloc actually cause trade diversion or trade creation.

**Design/Methodology/Approach** – Tinbergen's gravity model of trade was used in this study to investigate if the SBP phenomenon occurs in the APEC trade bloc. The model contains the respective GDPs of the partner countries and their distances, but was augmented to capture the SBP effect through the inclusion of an index represented by a binary variable for the existence of FTAs interacting with the growth in the total number of concluded FTAs per country.

**Findings** – Results of the study showed a positive and statistically significant coefficient for the SBP index in the gravity model. This suggests that the negative effect of the spaghetti bowl phenomenon is not yet present in the APEC trade bloc. Instead, the current number of FTAs still brings beneficial effects to trade flows among the APEC economies.

**Research Implications** – This result provided evidence that the currently concluded trade agreements in the APEC trade bloc resulted in trade creation rather than trade diversion, which was generally espoused by the spaghetti bowl phenomenon in western countries. Since only 29% of the total panel of economies included in the analysis showed the presence of a common FTA between trading partners, this proved to be too low to bring about the detrimental effect of the spaghetti bowl phenomenon among APEC economies.

**Keywords:** augmented gravity model, free trade agreements (FTAs), spaghetti bowl phenomenon (SBP), trade diversion, APEC trade bloc

**JEL Classifications:** C23, F13, F68

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<sup>a</sup>First author, E-mail address: [merylmchua@yahoo.com.ph](mailto:merylmchua@yahoo.com.ph)

<sup>b</sup>Corresponding author, E-mail address: [garcia.yt@gmail.com](mailto:garcia.yt@gmail.com)

<sup>c</sup>Co-author, E-mail address: [etandal@up.edu.ph](mailto:etandal@up.edu.ph)

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## I. Introduction

Free trade agreements (FTAs) have flourished around the world since the 1990s. According to the World Trade Organization (2015), there were already 406 enforced FTAs and 206 more were waiting to be approved as of April 2015. With the influx of these trade agreements, it is important to understand whether the proliferation of these FTAs are still beneficial, or already disadvantageous to the total trade flows among participating countries in a given trade block.

In general, countries seek FTAs for beneficial effects on the domestic economy as a whole. Whalley (1998) gave four underlying reasons why countries increase their involvement with FTAs. First, the gains from trade are probably the most obvious and rational objective for any country to participate in trade negotiations. Removing trade barriers through these agreements would benefit all participating countries. Second, it strengthens domestic policy reform by tying countries into trade agreements, and thus making it hard to reverse future domestic protectionist reforms. Third, countries that are bound by a customs union increase their multilateral bargaining power compared to individual countries. Fourth, trade agreements guarantee access to the world market. Therefore, it is often beneficial for smaller economies to seek trade agreements with larger economies. Access to the market of larger economies provides strategic trade linkages on the part of the smaller economies. During the 1950s, European nations viewed FTAs not only as a mere agreement on the trade of goods and services but also as an agreement to prevent European wars. Their integration through FTAs brought about deeper economic integration that became the priority of their involvement with FTAs.

Although many economists believe that trade agreements provide positive impacts for any economy, a strand of literature has also concentrated on the

diversion effects of trade agreements. In an article by Powell and Low (2011), the negative impacts of regionalism were enumerated. According to the authors, FTAs create market confusion for trading partners through the existence of multiple preferential rates that were applied or used. Also, various border rules may increase transaction costs that will become a burden for smaller economies. FTAs can also create regulatory failure; instead of focusing the agreement on tariffs and quotas, it can contain other social regulations pertaining to labor, environment, and health issues which can actually hinder trade. Similarly, FTAs can divert trade. Trading tends to occur only among member economies of the trade bloc, leaving non-member economies limited access to the world market. Thus, FTAs can cause the deterioration of overall global welfare. For example, with trade protection afforded to member economies by the agreement, better quality goods from non-member countries cannot reach the international market. Thus, inefficiencies in infant industries are encouraged, which can hinder the growth of the domestic economy of the member country.

More importantly, FTAs can also give rise to the occurrence of the “spaghetti bowl phenomenon”. This term was coined by Bhagwati in 1995 in referring to the crisscrossing of rules of origin between trading countries, which exists due to the proliferation of trade agreements. The spaghetti bowl phenomenon occurs when countries create their own unique trading agreements whenever they trade with other countries. Specifically, the agreement may consist of preferential treatments and special exceptions or regulations that may not generally apply to other trading partners. This phenomenon was likened to numerous strands of spaghetti noodles tangled up in a bowl, hence the term “spaghetti bowl phenomenon”.

In general, the problem with the spaghetti bowl phenomenon lies in the rules of origin that are used to determine the source or location of a product to

guarantee that only the member countries of FTAs gain from the benefits of trade agreements (Gretton and Gali, 2005). Sometimes a product needs to undergo several stages of processing in different countries; hence, it becomes difficult to conclude in which country a product originates. In addition, the varying terms of agreement of trading countries embodied in their laws and regulations affect the rules of origin, which exacerbate the problem.

Recently, the issue of the spaghetti bowl phenomenon became a popular topic in the area of trade, especially in that the media tends to sensationalize the adverse results. For example, in the Philippines, the Department of Trade and Industry (DTI) has made pronouncements regarding the need to “deal with the spaghetti bowl phenomenon on the rules of origin” (Miraflor, 2015). The DTI further added that “by harmonizing and simplifying rules of origin and making its application simple and non-restrictive across different FTAs, trading conditions will be simplified which will contribute greatly to APEC and WTO.”

At present, the number of scholarly works that focused on the empirical analysis of the spaghetti bowl phenomenon remains low. Nevertheless, there were several important works on the phenomenon that came out since the mid-2000s. To date, there are few studies that have empirically shown that the spaghetti bowl phenomenon occurs (Kimura et al., 2006 and Sorgho, 2014). These authors empirically proved the existence of the phenomenon via the use of the trade gravity model. The results of their studies were in line with the view of Bhagwati (1995). Kimura et al. (2006) used cross-section trade data in 2003 for 132 countries, while Sorgho’s work (2014) used panel data of 119 countries covering trade data from 1995 to 2012.

However, these studies were generally applied to western economies. Specifically, the trade gravity

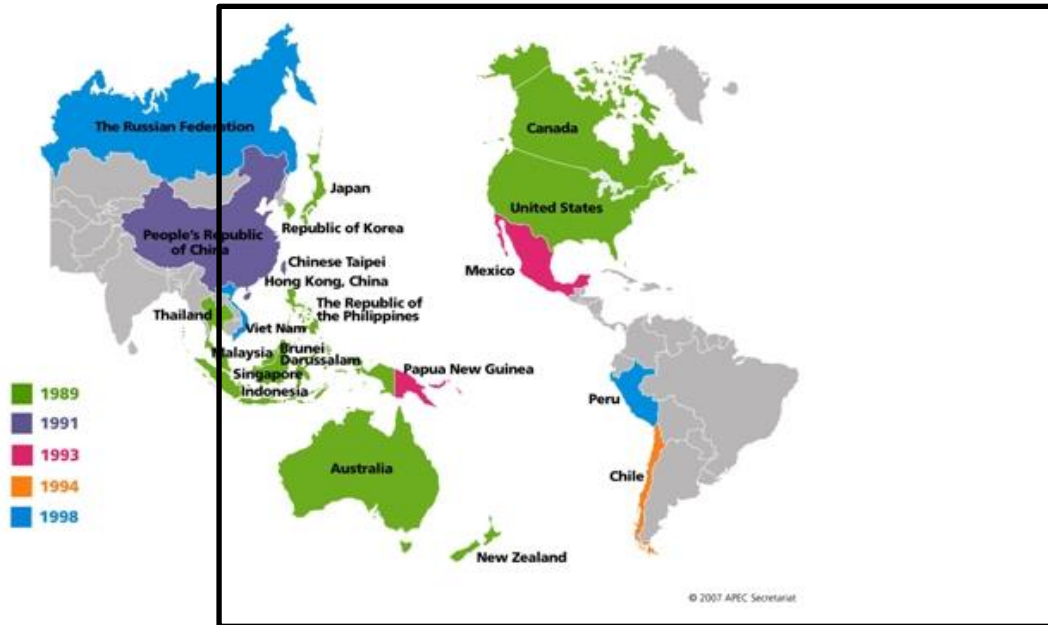
model used in these studies allows the evaluation of the effect of multiple FTAs, specifically in whether it results in trade creation or trade diversion. One example is the case of Gauto (2012), who used the gravity model to analyze the effects of a trade agreement called Mercosur between five South American countries. The author concluded that the average regional imports in this trade bloc increased by 266 percent since 1995. This growth of imports was attributed to the Mercosur agreement, which revealed gains from trade.

In this study, the occurrence of the spaghetti bowl phenomenon was investigated among the 21-member economies of the Asia-Pacific Economic Cooperation (APEC). APEC economies include Australia, Brunei Darussalam, Canada, Indonesia, Japan, South Korea, Malaysia, New Zealand, Philippines, Singapore, Thailand, United States, Chinese Taipei (Taiwan), Hong Kong, China, Mexico, Papua New Guinea, Chile, Peru, Russia, and Vietnam (Fig. 1). APEC is an economic forum wherein these economies strive to encourage free trade and economic cooperation throughout the Asia-Pacific region (APEC website, 2015). It was established in 1989 in response to the development of trade blocs (such as the EU and ASEAN) around the world.

In general, this study aims to empirically investigate if the negative effect of the spaghetti bowl phenomenon exist in APEC economies as demonstrated by similar trade blocs in the US and EU. Specifically, it aims to determine if APEC countries entering into multiple FTAs indeed result in trade diversion as claimed by the phenomenon.

The remainder of the paper is organized as follows: Section 2 presents the theoretical framework and the analytical model used in the study; Section 3 discusses the results of the analysis, and the last section presents the concluding remarks.

Fig. 1. Map of APEC Member Economies



Source: Treasury (2007).

## II. Analytical Framework

The gravity model of trade is one of the most common empirical methods used in analyzing international trade flows. In 2015, Anukoonwattaka showed that the gravity model can be specified to determine the impacts of WTO membership, FTAs, currency unions, migration flows, FDI between countries, and even disasters. The traditional form of the model shows that the bilateral trade flows have a positive relationship with the countries' gross domestic products (GDP), but have a negative relationship with the distance between the two countries. Trade costs are often incorporated into the model by including demographic variables to capture the ease or difficulty in transporting products from one country to another, e.g., geographical adjacency, common language, colonial links, common currency, population, and island condition (whether or not a country is an island country or landlocked). Each of these factors had been

found to be important determinants of bilateral trade in many past studies.

With the emergence of FTAs, it is expected that countries can enter into trade agreements with other countries and get the best value for their money. For example, a country can buy goods from abroad that would have been impractical if the country had chosen to produce the goods locally. On the other hand, another country that has specialized in producing a good can sell this on the world market and gain from this trade. However, the notion of the positive correlation of the proliferation of trade agreements in increasing trade activity of countries may be countered by the ability of the same notion to hinder trade. In fact, the rise of trade agreements can result in trade diversion. This is the main argument of the spaghetti bowl phenomenon. The crisscrossing rules of origin between trading countries and their multilateral trade agreements can ultimately complicate trade flows, and thus cause trade diversion (Bhagwati et al., 1998). Note that forging multiple FTAs with different partner

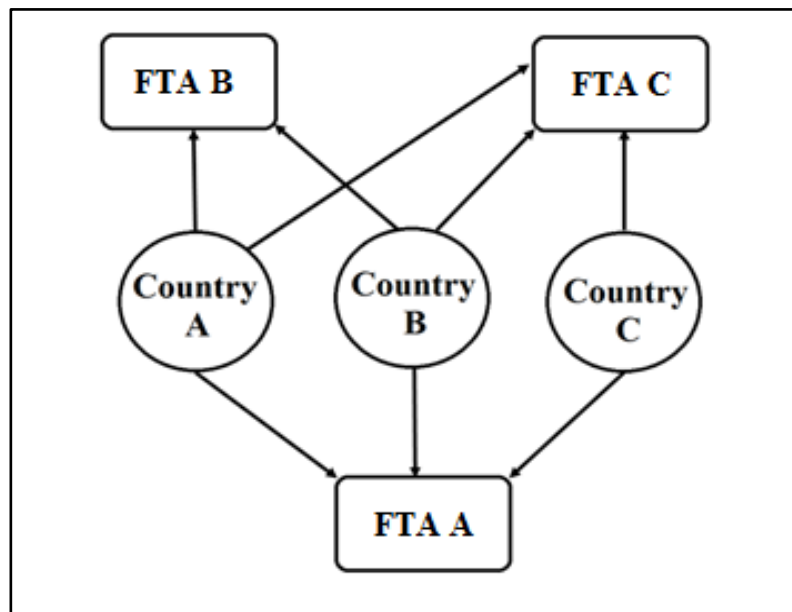
countries entails having many of rules of origins to follow. Consequently, this can create trade confusion in such a way that exporter countries are faced with higher transaction costs when exporting products to an FTA partner country (Kimura et al., 2006).

A simple way to understand the dilemma of countries on which trade agreement they need to follow whenever they trade is illustrated in Fig. 2. Basically, the figure shows that there could be confusion between trading countries when different trade agreements are enforced. For example, the figure shows that two countries, A and B, can belong to three trade agreements. The confusion lies on which agreement, A, B, or C, should be followed should these two countries trade. This overlapping trade regime complexity was stated in the work of Kim in 2014.

Applying this scenario to the 21-member APEC bloc would result to an illustration of how “tangled”

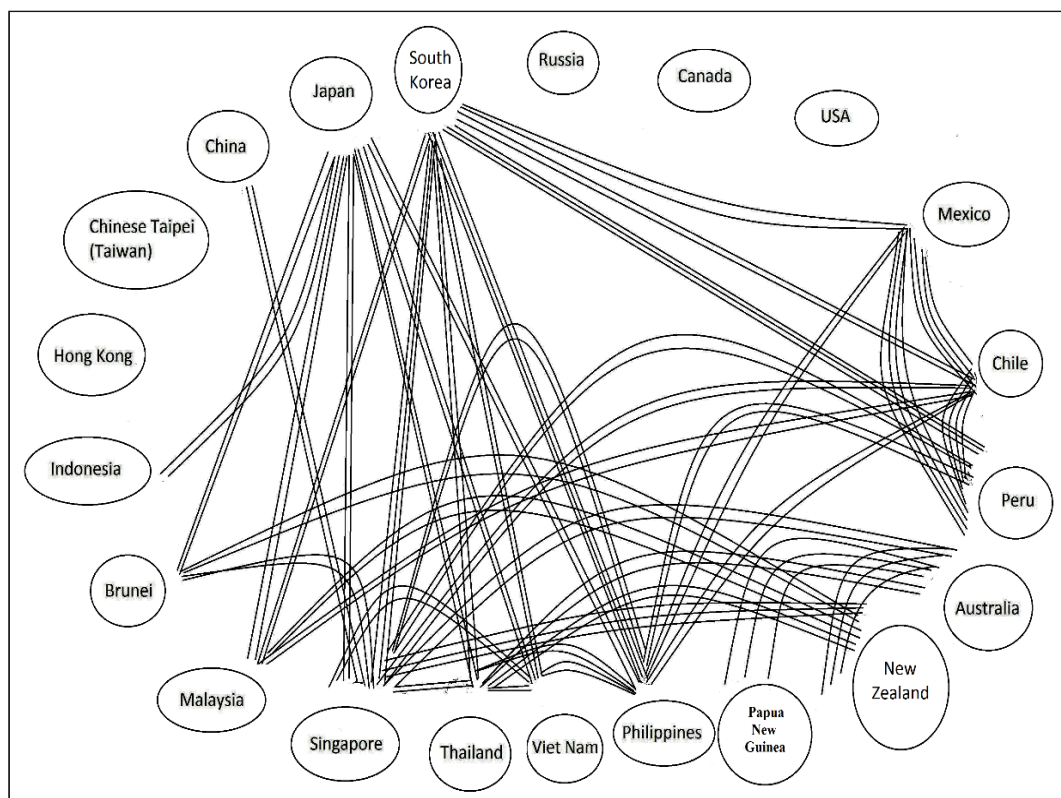
the rules of origin can be. Fig. 3 demonstrates the actual map of agreements among APEC economies that have two or more common trade agreements between paired economies. It demonstrates the dilemma of which trade agreement will have to be followed by any paired APEC economies whenever they trade, given the numerous FTAs that they have. Each line connecting any two countries represents the trade agreement between them, which can be viewed as strands of spaghetti noodles (Śledziwska, 2015). Specifically, every noodle is associated with a unique set of regulations, tariff rates, and rules of origin that must be complied with when these countries trade. The rise in the number of trade agreements concluded by a country implies that the varying regulations enforced by each trade agreement increases. Thus, trade agreements can become so complicated it may lead to the occurrence of the so-called spaghetti bowl phenomenon.

Fig. 2. Overlapping Trade Regime Complexity



Source: (Kim, 2014).

Fig. 3. Actual Map of Common FTAs among APEC Economies as of 2012



Among the APEC member economies, the Latin American countries, namely Mexico, Chile, and Peru, have the highest number of common trade agreements listed. If Mexico and Peru were to trade, the predicament of which trade agreement they would observe arises. The figure shows four connecting lines between Mexico and Peru, and consequently, these four lines represent the trade agreements that are common between these two countries. Thus, Mexico and Peru may face confusion in the trade agreements that they apply to traded goods. For example, they may choose the tariff rates indicated by the Protocol on Trade Negotiations, Global System on Trade Preferences, Latin American Integration Association, or the bilateral trade agreement called the Peru-Mexico trade agreement.

### III. Research Methodology

The use of the gravity model in analyzing trade between and among countries has been around for more 50 years. The model was proposed by Jan Tinbergen in 1962, which used the same principle embodied in Newton's Law of Gravitation (Anderson, 2011). Since then, the model is often used in the study of trade flows among open economies, especially in analyzing the impact of WTO membership, FTAs, currency unions, migration flows, and FDI between countries. The basic specification of the trade gravity model is as follows:

$$TF_{ij} = A \frac{(GDP_i)(GDP_j)}{Distance_{ij}} \quad (1)$$

where  $TF_{ij}$  is the trade flow between country  $i$  and country  $j$ ;  $A$  is a proportionality constant;  $GDP_i$  and

GDP<sub>j</sub> are the Gross Domestic Products of the two trading partners, country *i* and country *j*, respectively, while Distance<sub>ij</sub> is the distance between the two countries. Taking the logarithm of both sides of equation 1 leads to the standard linearized form of the trade gravity model:

$$\ln TF_{ij} = \ln A + \ln GDP_i + \ln GDP_j - \ln Distance_{ij} \quad (2)$$

This traditional form of the model shows that the growth in trade flows ( $\ln TF_{ij}$ ) has a positive relationship with the sum of the growths of the trade partner's respective GDPs ( $\ln GDP_i$  and  $\ln GDP_j$ ), and a negative relationship with the growth in the distance ( $\ln Distance_{ij}$ ) between the two countries.

According to Shepherd (2013), the entirety of all production of an economy is equivalent to its GDP. In the context of the gravity model in physics, the GDP of a country represents the "mass" of a country (Anderson, 2011). The decision of a country to trade with another country depends mainly on economic size, represented by their respective GDPs. Starck (2012) gave a good explanation for this assumption by arguing that the capability of country *i* to export to country *j* is determined by country *i*'s GDP. At the same time, country *j*'s decision to import from country *i* extends only up to country *j*'s purchasing power, which is also determined by its GDP. Hence, the economic sizes of the two trading economies can be viewed as both demand and supply forces that can affect their trade flows.

In the model, the countries' gross domestic products represent their income level; hence, growth in GDP implies an increase in the expenditure capability of a country (Starck, 2000). Understandably, a higher expenditure capability of a country will allow its population to demand more quantities of a good in both the domestic and import markets, which can affect the level of trade between the two countries. Moreover, growth in GDP may also increase the level of exports of a given country due to its higher productivity associated with higher growth in GDP (Helpman & Krugman, 1985).

Therefore, it is expected that large scale economies export more to smaller countries since more goods or services can be produced in the former. At the same time, large economies are able to import more from other countries because they have higher purchasing power. On the other hand, smaller economies benefit from trading with the larger countries since they tend to have access to goods that are not produced in their own country. According to Anderson (2014), any small country will naturally trade more with larger countries; hence, they tend to be more open to trade.

On the other hand, the distance between countries also plays an important role in determining trade flows. Starck (2012) defined this as the geographical distance between the trading partners, or the distance between capital cities in nautical or land miles. Trade between two countries decreases as geographical distance increases. This is due to the fact that distance is associated with transaction cost; farther countries will entail more transport costs to move their goods. Other factors like forgone value of time during shipment and communication costs also tend to be higher for trading countries that are far apart, and thus can hinder trade between them. Since these factors are difficult to measure, the variable distance is often used as a proxy for transaction costs.

In this study, trade flows<sub>ij</sub> were represented by exports between the exporter country *i* and importer country *j* due to its popularity in most spaghetti bowl phenomenon studies. Exports of country *i* are consequently the imports of country *j* when both countries are trading. Also, export data are well monitored since government policies on tariff and import quotas require them to be properly accounted for. Another vital justification for the choice of export value as representative of trade flow between countries is the potential of exports in increasing the national income of a country. Thus, high GDP values of countries can be correlated with high trade flows in terms of exports between countries.

The existence of the spaghetti bowl phenomenon can be established econometrically by augmenting the trade gravity model to include the FTA variable in the



model (Anukoonwattaka, 2015). In this study, a dummy variable is included in equation 2 to capture the potential trade effects of FTAs among trading APEC economies.

$$\ln TF_{ijt} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln Distance_{ijt} + \beta_4 FTA_{ijt} + \varepsilon_{ijt} \quad (3)$$

The following are the definitions of the key variables in the model:

- $\ln TF_{ijt}$  - growth in total value of exports of APEC member country i to country j at time t, in US\$
- $\ln GDP_{it}$  - growth in nominal GDP of APEC member country i at time t, in US\$
- $\ln GDP_{jt}$  - growth in nominal GDP of APEC member country j at time t in US\$
- $FTA_{ijt}$  - binary variable which is equal to 1 if an APEC member country i has an FTA with country j at time t, and zero otherwise
- $\beta$ 's - parameters of the model
- $\varepsilon_{ijt}$  - random error term of the model

As Bhagwati et al. (1998) observed, the proliferation of trade agreements can cause trade diversion and lead to what is called the spaghetti bowl phenomenon. Hence, to detect the occurrence of such phenomenon, a SBP index to capture the interaction between the  $FTA_{ijt}$  binary variable and growth in the number of FTAs concluded by each country was added to the equation. Hence, the final model of the study is specified as follows:

$$\ln TF_{ijt} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln Distance_{ijt} + \beta_4 FTA_{ijt} + \beta_5 SBP_{ijt} + \varepsilon_{ijt} \quad (4)$$

where:  $SBP_{ijt} = FTA_{ijt} \times \ln NUM_{ijt}^{FTA}$

The variable  $NUM_{ijt}^{FTA}$  is computed as  $NUM_{it}^{FTA} + NUM_{jt}^{FTA}$ , or the sum of the number of FTAs of exporter country i and importer country j,

respectively, at time t. The  $SBP_{ijt}$  index is the spaghetti bowl phenomenon variable computed as the product of the dummy variable  $FTA_{ijt}$  and the growth in the number of FTAs ( $\ln NUM_{ijt}^{FTA}$ ) of the trading countries at time t. This interaction term between  $FTA_{ijt}$  and  $NUM_{ijt}^{FTA}$  shows whether bilateral trade is affected by a country entering additional trade agreements at a given time period with other countries. This variable is expected to generate a negative coefficient in the regression run if it results in an adverse effect on the trade flow between partner countries. Specifically, this negative effect supports the spaghetti bowl phenomenon and can be observed when the numbers of FTAs concluded by trading partners are unusually high.

This study covered all APEC member economies focusing on their bilateral trade flow data from 1982 to 2012 in 5-year intervals. Using continuous years for this analysis may not show enough trade variability; hence, some time lag had to be incorporated into the data set to capture some variations in trade flows associated with the FTAs of trading countries. Note that the 5-year interval was arbitrarily chosen to allow some medium term negotiations in the trade agreements between partner countries to materialize.

The number of observations used in this analysis was 2,940 trade flows of 21 countries for seven periods between the years 1982 to 2012. Bilateral export data were collected from the United Nations Commodity Trade Statistics Database of the UN COMTRADE website. The data on the GDP of the 21 economies were obtained from the World Development Indicator of the World Bank website. Furthermore, the World Trade Organization (WTO) website was accessed to determine whether two countries were involved in some trade agreements, which provided information on the number of FTAs a certain country participates in. The information on distance between two countries was gathered from a French website, Centre d'Étude Prospectives et d'Informations Internationales, or CEPII.

Since trade gravity models often use panel data to capture the unobserved cross country differences in

trade flows that may result from some preferential agreements like FTAs over time, the ordinary least squares (OLS) method is no longer ideal for this type of analysis. Note that when heterogeneity is not controlled, the regression results may be biased since the unobserved preferential treatments among trading countries can affect the impact of the SBP index on the trade flows. To address this unobserved heterogeneity in the trade agreements across countries and across time, the generalized least squares (GLS) was used where the trade gravity model was specified either as a fixed effects or random effects model. The panel data version of equation 4 is specified as follows:

$$\ln TF_{ij} = \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln Distance_{ij} + \beta_4 FTA_{ij} + \beta_5 SBP_{ij} + \phi_{ij} + \varepsilon_{ij} \quad (5)$$

where  $\phi_{ij}$  is the unobserved preferential treatment effects among trading APEC member countries, which is either incorporated in the intercept if the latent variable varies across trading partners (fixed effect model) or to the error term if it varies across time (random effects model). To decide which version of the gravity model would be more relevant to this analysis, the Durbin-Wu-Hausman test was implemented to establish if the fixed effects or the random effects model is more suitable for the data set at hand. The Durbin-Wu-Hausman test statistic is specified below and is  $\chi^2$  distributed with degrees of

freedom equal to the number of  $\beta$  parameters in the gravity model.

$$\chi^2 = \sum \frac{(\beta_{FE} - \beta_{RE})^2}{VAR(\beta_{FE}) - VAR(\beta_{RE})} \sim \chi^2_{\beta}$$

where:  $\beta_{FE}$  and  $\beta_{RE}$  are parameter estimates of the fixed effects and random effects model, respectively.

$VAR(\beta_{FE})$  and  $VAR(\beta_{RE})$  are variances of the  $\beta$ -parameters of the fixed effects and random effects model, respectively.

#### IV. Results and Discussion

Expectedly, undocumented trade flows are often encountered in trade data. In this study, almost five percent of the observations had missing export data. These were commonly found in the countries of Brunei, Vietnam, and Taiwan, especially during the earlier years of 1982 and 1987. To address this problem, the value 1 was added to all the export data to avoid an undefined value for  $\ln(\text{export})$  when  $\text{export} = 0$  (De Benedictis and Taglioni, 2011). Although this procedure would result in some bias in the estimators of the model, the risk was taken due to the importance of this variable in the model. Table 1 presents the means of the key variables in the gravity model where the dependent variable was renamed  $\text{Export}+1$  to signify the solution to zero export values.

Table 1. Means of Export, GDP, and Distance of APEC Trading Partners from Panel Data Covering 1982 to 2012

Variable	Observation	Mean	Std. Dev.
Export+1 (B USD)	2,940	5,954.7	23597.89
Mean GDP (B USD)	2,940	931.3	2309.855
Mean distance between trading partners (km)	2,940	8,337.1	5556.861

Sources: UN Comtrade (n.d.) and CEPII (n.d.).

The average export of each member economy of APEC for the observed years was 5,954.7 Billion USD. On the other hand, the mean GDP was 931.3 Billion USD, which represents the economic size or the

country's ability to export and import goods among each other. The respective GDPs per country are presented in Table 2, where the US, Japan, and China registered the largest economies in terms of income

within the APEC trade bloc. This means that these countries were the main contributors of traded goods and had the highest purchasing power that could affect the growth of exports from other member economies. Lastly, the average distance between trading economies within APEC was 8,337.1 kms.

Another problem that was encountered in the analysis was the non-existence of trade agreements for some countries for some period under study. For example, Hong Kong and Taiwan did not have any

FTAs until 2002; hence, their observations were zero for the last 20 years. Because of this, the sample size for the gravity model with the SBP index was reduced from 2,940 to only 270 observations, i.e., only those economies with registered trade agreements were included in the regression run. Since the formula of the SBP index is the product of  $FTA_{ijt}$  and  $\ln(NUMFTA_{ijt})$ , whenever the trading economies had no FTA, the SBP index is equal to zero and thus was dropped automatically from the regression run.

Table 2. Average GDP of APEC Economies from 1982-2012

(Unit: Billion US Dollars)

Country	Average Nominal GDP	Country	Average Nominal GDP
Australia	426.7	New Zealand	61.7
Brunei	5.5	Peru	52.6
Canada	687.0	Philippines	73.4
Chile	70.5	Papua New Guinea	4.1
China	1,191.2	Russia	605.2
Hong Kong	124.2	Singapore	74.7
Indonesia	197.9	Thailand	122.6
Japan	3,316.3	Taiwan	228.7
Korea	448.8	USA	7,876.7
Mexico	466.6	Vietnam	33.9
Malaysia	86.4	Grand Mean GDP	931.3

Source: UN Comtrade (n.d.).

Table 3 presents the complete list of specific trade agreements of each country, and Table 4 shows the comprehensive tally of the number of trade agreements concluded by APEC economies for the selected years. Over the last three decades, the average number of FTAs in APEC countries increased from around 4 to 11 agreements per member. It grew at a rate of 14% to 27% every five years, or 3% to 5% annually. The highest number of FTAs in 2012 was registered for Chile (24), Singapore (19), and Peru (14).

Based on Table 4, almost 71% of the total observations resulted in a zero SBP index. The SBP index is the product of the dummy for the existence of FTAs and the logarithm of the total number of FTAs

between two APEC economies; hence, the zero SBP suggests that either the partner countries have no FTA, or had only one agreement. Results showed that the bulk of zero SBPs came from the absence of bilateral FTAs among APEC member countries. It therefore follows that only 29% of the member countries had existing common FTAs among each other. Of this amount, about 14% had an SBP index ranging from 1% to 2%. The rest of the countries (15%) had an SBP index of less than 1%.

Results of the Durbin-Wu-Hausman test yielded a p-value of 0.0002, which was statistically significant at  $\alpha=1\%$ . Thus, the fixed effects version of the trade gravity model was chosen, which implies that the

preferential trade agreements of APEC member countries do vary across countries, but is consistent over time. This observation is in line with Sorgho's

results in 2014. It therefore follows that the foregoing gravity model analysis pertains to the parameters of the fixed effects regression (Table 5).

Table 3. Number of Notified FTAs of APEC Member Countries under the WTO from 1982 to 2012.

Country	Number of FTAs						
	1982	1987	1992	1997	2002	2007	2012
Australia	2	3	3	3	4	6	8
Brunei Darussalam	0	0	1	1	1	4	8
Canada	0	0	0	3	4	4	8
Chile	2	2	3	4	7	15	24
China	1	1	1	1	2	7	11
Hong Kong	0	0	0	0	0	1	3
Indonesia	0	0	2	2	2	3	8
Japan	0	0	0	0	1	5	13
Korea, Republic of	2	2	2	2	4	7	12
Mexico	2	2	3	5	9	11	13
Malaysia	0	0	2	2	2	4	12
New Zealand	1	2	2	2	3	5	9
Peru	2	2	2	2	4	4	14
Philippines	1	1	3	3	3	4	9
Papua New Guinea	2	2	2	3	3	4	5
Russia	0	0	0	7	7	9	10
Singapore	0	0	2	2	4	13	19
Thailand	0	0	2	3	3	7	11
Chinese Taipei	0	0	0	0	0	2	4
USA	0	1	1	2	3	9	14
Vietnam	0	0	2	2	2	3	8
Mean FTAs	4	4	5	6	7	8	11
Growth in number of FTAs every 5 years (%)	-	13.38	15.83	16.75	19.34	25.60	27.43
Growth in annual number of FTAs (%)	-	2.68	3.17	3.35	3.87	5.12	5.49

Source: WTO (2015).

Results showed that the signs of the GDP and distance growth coefficients were statistically

significant with the correct signs. The coefficient of the GDP variable for the exporting country signifies that a

one percent growth in its GDP will increase export volume by 0.2%. On the other hand, a one percent growth in the GDP of an importing economy will increase its export volume by 0.85%. This suggests that the effect of GDP growth on export volume was larger for economies that have a larger demand potential for imported goods. Moreover, export volume tended to decrease by 1.1% whenever the

distance between two trading economies increased by one percent. Hence, in its simplest form, the trade gravity model emphasizes that bigger country pairs tend to trade more while distant country pairs tend to trade less. Moreover, the negative effect of distance on the gravity model can be linked to the higher costs of transport, processing, and time required in trading, which limit the growth of exports.

Table 4. SBP Index of Trading Partners in APEC with Common FTAs, 1982-2012.

SBP (%)	Freq.	Percent	SBP (%)	Freq.	Percent
0*	1,888	70.71	3.04	18	0.67
1.1	52	1.95	3.09	26	0.97
1.39	118	4.42	3.14	10	0.37
1.61	96	3.60	3.18	10	0.37
1.79	48	1.80	3.22	10	0.37
1.95	56	2.10	3.26	10	0.37
2.08	24	0.90	3.3	14	0.52
2.2	14	0.52	3.33	8	0.30
2.3	18	0.67	3.4	4	0.15
2.4	36	1.35	3.43	4	0.15
2.48	12	0.45	3.47	14	0.52
2.56	14	0.52	3.5	8	0.30
2.64	14	0.52	3.56	4	0.15
2.71	10	0.37	3.58	4	0.15
2.77	20	0.75	3.61	4	0.15
2.83	24	0.90	3.64	4	0.15
2.89	14	0.52	3.76	2	0.07
2.94	26	0.97			
3	32	1.20	Total	2,670	100

Note: \* SBP equal to 0 represents observations that have no common FTA.

With respect to the issue of the spaghetti bowl phenomenon, the relevant variables in the regression model were the FTA dummy and the SBP index. Both variables showed significant coefficients despite their

likely multicollinearity. Results showed that the presence of FTAs between trading partners proved to be beneficial to their export growth as evidenced by its positive significant coefficient.

Table 5. Fixed Effects Parameter Estimates of the Trade Gravity Model, 1982-2012

Independent Variables	Coef.	Std. Err.	t-ratio	P >  t
lnGDP of Exporter i	.227432**	.05537	4.11	0.000
lnGDP of Importer j	.846639**	.01527	55.45	0.000
lnDistance	-1.15012**	.03731	-30.83	0.000
SBP index	.1987107**	.03055	6.51	0.000
FTA dummy	.6636085**	.09066	7.32	0.000
_cons	9.633689**	.39339	24.49	0.000
Within R2	0.6716			
Between R2	0.4591			
Overall R2	0.5662			

Note: \*\* significant at 1%.

Similarly, the SPB index showed a positive significant coefficient. This is contrary to the general results established in the US and EU where the crisscrossing of rules origin due to the proliferation of FTAs generally affect trade volume negatively. Specifically, for APEC economies, the interaction term between the FTA dummy and the growth in total number of notified FTAs of the trading economies indicates a positive effect, which defies the spaghetti bowl phenomenon. This implies that the concluded trade agreements of the APEC economies are still beneficial to the APEC economies' overall exports. At the present position, an additional one percent increase in trade agreements of the APEC economies will increase their export volume by 0.2%.

The absence of the SBP phenomenon in APEC economies rests on the thinness of FTAs in this particular trade bloc; only 27% of the total panel of 2,940 observations indicated the occurrence of a common trade agreement among APEC member economies. Therefore, the existing common trade agreements of the APEC economies are presently too low to generate a trade diverting SBP. Instead, it resulted in a trade creation effect which is beneficial to the APEC economies.

## V. SUMMARY AND CONCLUSIONS

The proliferation of FTAs across many countries in the world as the root of the occurrence of the spaghetti bowl phenomenon was first pointed out by Bhagwati in 1995. This issue is important since the SBP can negatively affect the overall volume of exports and imports from trading countries. Whether the spaghetti bowl phenomenon exists or not among APEC economies was analyzed in this study via Tinbergen's trade gravity model. The study concluded that the spaghetti bowl phenomenon does not yet exist in the APEC trade bloc, since only a small number of the member economies have common trade agreements. This indicates that the forging of new FTAs within APEC is still welcome and can promote positive effects on trade volumes.

Results of this study have paved the way for an alternative view on the current situation regarding bilateral free trade agreements among APEC economies. Instead of the usual trade diversion effect expected from the spaghetti bowl phenomenon, a reverse case of trade creation was established. This therefore presents a new perspective when entering into new trade agreements within APEC. Since the

number of FTAs is expected to grow among APEC economies in the future, this study therefore recommends a follow-up investigation of the existence of the spaghetti bowl phenomenon when FTAs become more rampant in this particular trade bloc.

When that time comes, it will be interesting to also know the optimal number of FTAs for APEC economies in order to avoid the detrimental effect of the spaghetti bowl phenomenon.

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