ISSN (Print) : 2773-9414
ISSN (Online) : 2774-0005

วารสาร
เศรษฐศาสตร์
มหาวิทยาลัยแม่โจ้

JOURNAL OF ECONOMICS
MAEJO UNIVERSITY

ปีที่ 4 ฉบับที่ 1 เดือนมกราคม - เดือนมิถุนายน 2567
VOL. 4 NO. 1 JANUARY - JUNE 2024

วารสารเศรษฐศาสตร์ มหาวิทยาลัยแม่โจ้
Journal of Economics Maejo University

วัตถุประสงค์ของวารสาร

วารสารมีวัตถุประสงค์เพื่อส่งเสริมและเผยแพร่ผลงานวิชาการและงานวิจัยที่มีคุณค่าต่อการพัฒนาองค์ความรู้ทางเศรษฐศาสตร์และสาขาที่เกี่ยวข้อง รวมถึงเป็นสื่อกลางในการแลกเปลี่ยนองค์ความรู้ ทฤษฎี และข้อคิดเห็นเชิงวิชาการในหลากหลายมิติ อาทิเช่น เศรษฐศาสตร์การพัฒนา เศรษฐศาสตร์การเมือง เศรษฐศาสตร์เกษตรและสิ่งแวดล้อม การเงิน พฤติกรรมองค์กร ระบบสหกรณ์ ระหว่างประเทศ การท่องเที่ยว การพัฒนาสังคมและชุมชน ตลอดจนด้านการบริหารและการจัดการ

วารสารมุ่งเน้นการส่งเสริมและเผยแพร่องค์ความรู้ทางเศรษฐศาสตร์สู่แวดวงวิชาการและสังคม เพื่อให้เกิดการพัฒนาและประยุกต์ใช้ความรู้ทางเศรษฐศาสตร์อย่างเหมาะสม โดยมีเป้าหมายในการสร้างผลกระทบเชิงบวกต่อชุมชน สังคม และภาคนโยบายในวงกว้าง

ประเภทของผลงานวิชาการที่จะรับ

1. บทความวิชาการ (Academic Article)
2. บทความวิจัย (Research Article)

ขอบเขตของวารสารเศรษฐศาสตร์ มหาวิทยาลัยแม่โจ้

วารสารเศรษฐศาสตร์ มหาวิทยาลัยแม่โจ้ เผยแพร่บทความทั้งภาษาไทยและภาษาอังกฤษ โดยบทความที่จะได้รับการตีพิมพ์ต้องมีเนื้อหาที่เกี่ยวข้องกับเศรษฐศาสตร์ในหลายมิติและการพัฒนาสังคมและชุมชนและการจัดการ (การบริหารและการจัดการ) ต้องนำเสนอให้เห็นถึงการสร้างสรรค์องค์ความรู้ทางวิชาการที่มีประโยชน์และน่าสนใจ รวมถึงการนำเสนอผลการวิจัยที่เป็นปัจจุบัน เป็นประโยชน์ต่อแวดวงวิชาการและวิชาชีพ และบทความจะผ่านการพิจารณากลั่นกรองโดยผู้ทรงคุณวุฒิที่มีความรู้ความสามารถในสาขาที่บทความนั้นเกี่ยวข้องและสัมพันธ์กัน โดยขอบเขตเนื้อหาทางวิชาการของบทความที่จะเผยแพร่ในวารสารเศรษฐศาสตร์ มหาวิทยาลัยแม่โจ้ จะต้องมีเนื้อหาครอบคลุมในด้าน ดังต่อไปนี้

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- ด้านการพัฒนาสังคมและชุมชน
- ด้านการจัดการ (การบริหารและการจัดการ)

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พิมพ์ที่

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โทรศัพท์: 053-875-265

E-mail: maejournal.sd@gmail.com

บทความ ข้อความที่ปรากฏในวารสารฉบับนี้เป็นความคิดเห็นของผู้เขียนโดยเฉพาะ
บรรณาธิการและกองบรรณาธิการไม่จำเป็นต้องเห็นพ้องด้วย และไม่ถือเป็นความรับผิดชอบ
ลิขสิทธิ์เป็นของผู้เขียนและวารสารเศรษฐศาสตร์ มหาวิทยาลัยแม่โจ้
การตีพิมพ์ต้องได้รับอนุญาตจากผู้เขียนโดยตรงและเป็นลายลักษณ์อักษร

บทบรรณาธิการ

วารสารเศรษฐศาสตร์ มหาวิทยาลัยแม่โจ้ ปีที่ 4 ฉบับที่ 1 ประจำเดือนมกราคม - มิถุนายน 2567 นำเสนอผลงานวิจัยคุณภาพจำนวน 5 บทความ ซึ่งสะท้อนประเด็นทางเศรษฐศาสตร์ในหลากหลายมิติ ทั้งเศรษฐศาสตร์การพัฒนา เศรษฐศาสตร์การเมือง เศรษฐศาสตร์เกษตรและสิ่งแวดล้อม การเงิน พฤติกรรมองค์กร ระบบสหกรณ์ เศรษฐศาสตร์ระหว่างประเทศ การท่องเที่ยว และการพัฒนาสังคมและชุมชน ตลอดจนการบริหารและการจัดการ

กองบรรณาธิการขอแสดงความขอบคุณเป็นพิเศษต่อผู้ทรงคุณวุฒิทั้งภายในและภายนอกมหาวิทยาลัยที่ได้ร่วมพิจารณาและให้ข้อเสนอแนะอันทรงคุณค่าในการพัฒนาคุณภาพบทความ ตลอดจนขอขอบคุณผู้นิพนธ์บทความที่ไว้วางใจส่งผลงานเพื่อตีพิมพ์ในวารสารของเรา

กองบรรณาธิการมุ่งมั่นรักษามาตรฐานทางวิชาการและการเผยแพร่องานวิจัยและบทความวิชาการ เพื่อส่งเสริมองค์ความรู้และพัฒนาวงการเศรษฐศาสตร์ให้ก้าวหน้ายิ่งขึ้น หวังเป็นอย่างยิ่งว่าบทความที่ได้รับการคัดสรรในฉบับนี้จะเป็นประโยชน์แก่ผู้อ่าน และขอขอบคุณทุกฝ่ายที่มีส่วนร่วมในการสนับสนุนให้วารสารฉบับนี้สมบูรณ์และเผยแพร่ได้อย่างมีคุณภาพ

ผู้ช่วยศาสตราจารย์ ดร.กฤตวิทย์ อัจฉริยะพานิชกุล
บรรณาธิการ

ทัศนะและข้อคิดเห็นของบทความในวารสารฉบับนี้เป็นของผู้นิพนธ์แต่ละท่าน
ไม่ถือเป็นทัศนะและความรับผิดชอบของกองบรรณาธิการ

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Journal of Economics Maejo University

Factors Affecting Thai Fresh, Chilled, Frozen, and Dried Fruits Export to China

Chanakan Prathippanathama[1] and Siwarat Kusona[2]
Faculty of Economics, International Economics, Maejo University,
Chiang Mai, Thailand[1, 2]
Corresponding Author, E-mail: l.lilly110200@gmail.com

Received 3 January 2025; **Revised** 24 January 2025; **Accepted** 28 January 2025

Abstract

This study investigates the economics factors which affecting Thai fruits export to China by study with economics factors are GDP of Thailand, GDP of China, transportation cost of Thailand, exchange rate baht per yuan, and population of China by the information times series data during the period 1989-2018 equal 30 years. The paper extends the standard gravity model to the factors that affect Thai fruits export to China. The result can be summarized as three main finding: GDP of Thailand, exchange rate baht per yuan, and population of China are significant positive effect on value of Thai fruits export and 2 main found that GDP of China, transportation cost are significant negative effect on value of Thai fruits export. We explain these results and suggest policy.

Keywords: Thai Fruit Exports; China Market; Trade Factors

1. Introduction

Export is the main sector that very important to driving economic of Thailand and export is one of the important mechanisms driving the country's economy to have a high growth rate. It is considered another area of business that is important to entrepreneurs and the country. Because it is a business that can bring a lot of foreign currency into Thailand in each year and these income is part of the money that can be used to develop and solve the economic problems that occur is important for the expansion of investment and creating demand for labor, helping to import foreign currencies, creating effective use of resources, helping to advance technology, and help reduce the dependence on foreign products. More

over export with agricultural product is the most products that Thailand can export with very high value equal 43,735.46 in 2018 it is the value that higher more than other product and it is the value that higher than other countries which Thai export (Bank of Thailand, 2019). The Thai government and other department that concerned have the objective to stimulate Thai fruit exports, therefore, there are policies or activities to encourage Thai exporters to enter the international fruit export market by government has a policy that is a long-term agricultural and cooperative strategy in the future from year 2017-2036 (Prime minister delivery unit, 2017) by the National Economic and Social Development Plan No.15 (2032-2036), the project has 13 main policies as follows: 1) Agri-Map policy 2) Large agricultural policy 3) Center establishment policy Nationwide Agricultural Development 882 Centers Nationwide 4) Organic Agriculture Policy 5) Quality Policy for Agricultural Product Standards Farm Inspection 6) Agricultural Bank Policy 7) New Agricultural Policy 8) Delivery System Policy Irrigation area and water distribution, amount of water storage, 9) Area development policy for 10) Agricultural policy reform The strength of the cooperatives 11) Farmers market policy 12) Smart Farmer policy 13) Smart officer policy that all 13 policy have relate to Thai agricultural export (Ministry of Agriculture and Cooperatives, 2016).

More over the Department of Export promotion has a policy for the development and support Thai fresh, chilled, frozen, and dried fruits export to be able to entry in the world market by having a policy to preserve the old and new markets and implementing policies including organizing various activities to push Thai fruit exports (Department of Export Promotion, 2018). By that policy is large-scale agricultural extension system policy have the principles is increase the efficiency of production such as reduce production cost and the production has quality as the standard that market need and then Thai government have new policy is government policy pushes Thailand to be the fruit metropolis of the world. Supporting the product processing industry for community enterprises and SMEs by support marketing and consumption have to promote the quality of product and have to connect the business partners with other countries in online and offline channels supporting the distribution of production outside the production sources, development the transportation sector for consumers receive the product faster, and development the potential of productivity for upgrade and improve productivity potential especially in the cultivation that need to use techniques and technology to help increase the quality and quantity of production accordance with the market demand and funding sources for entrepreneurs to push Thailand to become a fruit metropolis in the world (Sentangsedtee, 2018). So all the policy can be help the export ability of Thailand can export to China.

Thai fruit is an economic crop that can make high income for Thailand especially the Chinese people who love the deliciousness and believe in the good quality of Thai fruits causing Thailand can be export to China most at the high value and the top 3 of fruits that Thailand can exports is durian, longan, and mangosteen (Thaiemarket, 2017). So, we can see

in the Table 1 Thailand can export the fresh, chilled, frozen, and dried fruits to China at high value in many year. If we talk about fruits the first market that our think about is China is the country that highest export value of Thai fresh, chilled, frozen, and dried fruits export in Table 1 when compare with other countries.

	Value : Million baht					
	2013	2014	2015	2016	2017	2018
China	13,553.54	12,592.08	16,086.01	18,129.99	22,396.91	32,395.74
Vietnam	5,058.49	9,246.81	10,309.95	17,670.08	34,867.58	31,789.59
Hong kong	5,204.99	8,781.56	7,437.72	6,960.37	6,129.45	7,639.99
Indonesia	1,503.47	2,345.39	1,920.36	2,084.55	2,948.63	2,124.87
USA	1,424.88	1,720.37	1,703.02	2,185.49	2,154.17	2,571.91

Table 1 The fresh, chilled, frozen, and dried fruits export market
Source: Thailand Trading Report, 2019

In Table 1 the value of Thai fresh, chilled, frozen, and dried fruits export to China is increasing value every year but in 2014 the value of Thai export is decreasing from 2013 and can see in the Table 1 have the competition between China and Vietnam some year Thai can export to Vietnam more than China at a great value in year 2018 equal 32,395.74 million baht (Thailand Trading Report, 2019).

More over Thai fruit is one of the important products that benefit from the Free Trade Agreement between ASEAN and China (ACFTA) which has caused China to cancel the import duty of every Thai vegetable and fruit since 2003 is an important tool to help create advantages and expand trade opportunities for farmers and Thai fruit exporters since this agreement came into force. Thai fruit exports to China grew by 1,312 percent (Economynews, 2019) in 2018, Thai fruit exports to China totaled 1,927.31 million US dollars, while in the first 5 months (January-May) of 2019 Thai fruits went the Chinese market is still expanding continuously with an export value of 1,199.69 million US dollars. Thai fruits export has expanded by 31% of export over the same period of the year 2018 (Economy news, 2019). Not only that the growth rate of Thai fresh, chilled, frozen, and dried fruit exports has increased in some year at a very high value even though some year decrease from the Figure 1

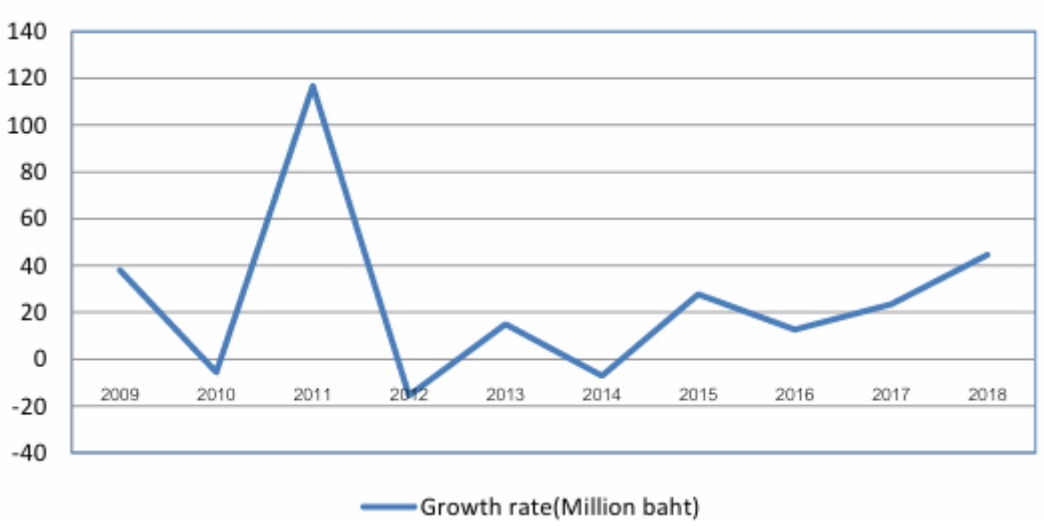

Figure 1 Growth rate of Thai fresh, chilled, frozen, and dried fruits export to China
Source: Thailand Trading Report, 2019

Although in some years the growth rate will be negative but can be observed that in the last 3 years. Thailand has the ability to export to China at a high growth rate every year in last 3 years between 2016-2018.

From past research Anucha Phuriphanpinyo (2017) studied the factors affecting the export of agricultural product as the researcher he studied the impact of agricultural product exports by overall of agricultural products its means have not subdivide the product type. He has suggestions for the future research by studying product for provide detailed information.

To studying by the subdivide the product type in agricultural product by means of choosing to study specific product types in agricultural for example Rice, Rubber, Cassava, Cane, fruits, Corn, and etc. To be used as a guideline to study, Researcher are interested to studying about fruits type with the export of fresh, chilled, frozen, and dried fruits of Thailand to China. Use economics factors that affecting the export sector. Then have the objective is to study about the factors affecting Thai fresh, chilled, frozen, and dried fruits export to China. Why Thai can still export to China with high value where study product classification by the product that interesting is fruits. The detail as fresh, chilled, frozen, and dried fruits and study with China by times series data in1989-2018 equal 30 years.

2. Research Objectives

This study investigates the economics factors which affecting Thai fruits export to China by study with economics factors are GDP of Thailand, GDP of China

3. Research Methodology

As previously stated the aim of this study is to studying the factors that affecting Thai fresh, chilled, frozen, and dried fruits export to China by use times series data with yearly in year 1989-2018 around 30 years.

3.1 Data

In this table shows the variable information that use to study for finding the factors affecting Thai fruits export to China.

Variable proxy	Indicator name	Unit	Data source
Ex_{tc}	Value of Thai fresh, chilled, frozen, and dried fruit exports to China	Million Baht	Bank of Thailand
GDP_t	GDP of Thailand	Billion US Dollar	World bank
GDP_c	GDP of China	Trilion US Dollar	World bank
TC_t	Transportation cost	Baht per liter	Macrotrends
EXR_{tc}	Exchange rate baht per yuan	Baht per Yuan	Bank of Thailand
P_c	Population of China	Billion person	World bank

Table 2 Information used

3.2 Theoretical Model

World bank Gravity model is the model that start by Tinbergen (1962) he applied from Newton's Law "Universal Law of Gravity" applied to measure the trade by the point of Newton's Law is assume that have two materials there are whose mass equal (M_1) and (M_2) ,material have spaced equal (d) ,and the attraction energy between the two materials is (F_g) (Thatchawan Kanitphong, 2013) as follows:

$$\mathrm{F_g} = \mathrm{G}\ \frac{\mathrm{M_1 M_2}}{\mathrm{d_2}}$$

(1) From equation (1) the attraction energy (F_g) increasing with the increase in the mass of both materials (M_1) and (M_2) but inverse variation to the distance between the materials (d) meaning that both materials have a higher mass and nearby the attraction energy between materials (F_g) will increase (Partner students, 2013).

Tinbergen applied Newton's law of attraction to research on the international trade between Countries Somprasong Phromuj (2013) can make equation (1) be a new equation:

$$F_{ij} = \beta\ \frac{Y_i Y_j}{D_{ij}}$$

(2) The major in point of this model is the model that used the variable from economy to study the international trade with two countries or more than by other variable is Xij (Thatchawan Kanitphong, 2013). Equation can be transformed in to:

$$F_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} D_{ij}^{\beta_3} X_{ij}^{\beta_4}$$

(3) Where, F_{ij} is the export value from country i to country j; β_0 is the constant; Yi is the usually the nominal gross domestic product (GDP) in country i; Yj is the market size of trading country j; Dij is the geographic distance between country i and country j; Xij is denotes any other additional factors that can either aid or impede trade between country i and country j.

3.3 Empirical Model

So, The gravity model is model that specific to study with factors affecting Thai fresh, chilled, frozen, and dried fruits export to China because this model is suitable to study and popular to apply for International trade and this model can use many variables explain effect to export sector. So, Gravity model is appropriate for study.

$$Ex_{tc} = \beta_0 \left(GDP_t^{\beta 1}\right)\left(GDP_c^{\beta 2}\right)\left(TC_t^{\beta 3}\right)\left(EX_{tc}^{\beta 4}\right)\left(P_c^{\beta 5}\right)$$

(1) Where, Ex_{tc} is Thai fresh ,chilled ,frozen ,and dried fruits export value of Thailand to China; β_0 is a constant; (GDP_t is Gross Domestic Product of Thailand;GDP_c is Gross Domestic Product of China; TC_t is Transportation cost of Thailand; EX_{tc} is exchange rate of Thai baht per Yuan; P_c is population of China.

Then, modify to Semilog (lnx) in equation (5).

$$Ex_{tc} = \beta_0\, \beta_1 ln(GDP_t) + \beta_2 ln(GDP_c) + \beta_3 ln(TC_t) + \beta_4 ln(EX_{tc}) + \beta_5 ln(P_c) + \varepsilon_{tc}$$

(2) After, the equation can be transformed in to log from the equation (6) is below:

$$(Ex_{tc}) = \beta_0 + \beta_1 (GDP_t) + \beta_2 ln(GDP_c) + \beta_3 (TC_t) + \beta_4 (EX_{tc}) + \beta_5 (P_c) + \varepsilon_{tc}$$

(3) In this equation have ε_{tc} is error term and have to be take log just β_2 ln(GDP_c) because Gross Domestic Product of China have the skewness by in some year GDP of Chin growth very high but some year increase not much means in 30 years GDP of China have swing growth not flow causing the data skewness. So should have to modify by take log will can reduce the skewness of data cause to make the data close to the normal distribution means reduce the complexity (Bussiness analyticsnnida, 2019).

From the equation (6) will help to fine the answer to the objective which factors affecting the export of Thai fresh, chilled, frozen, and dried fruit to China and which factors can make Thailand can export at the high value.

The proxy	Variable	Hypothesis
GDP_t	GDP of Thailand	+
GDP_C	GDP of China	+
TC_t	Transportation cost	-
EXR_{tc}	Exchange rate	+
P_c	Population of China	+

Table 3 Hypothesis statements

This table is a table showing the assumptions of each factor variable. In which direction it should be expected, in theory it should be as follows

GDP of Thailand or Gross domestic product in Thailand will be positive relationship with value of export which have the same direction. Zheng, et al. (2017) said “The market size in country that is exporter such as GDP, is generally considered a main determinant of international trade flows and is included in standard gravity model specifications, because the development level of a national economy is a common proxy for trade demand or supply”.

GDP of China or Gross domestic product in China will be positive relationship with value of export which will have the same direction found that the factors affecting the demand for Thai fruit exports to China statistically significant is the price of Thai fruit exports to China, embroidered with the consumer price index of China and the value of Gross domestic product per capita in China adjusted by China's consumer price index and GDP of China can tell about the economic situation of trade partner country (NattachadaDetpong, 2018). But there is a conflict with research of Prasert Chaitip, Chukiat Chaiboonsri, and Apiraphol Dewitt (2015) that said the mostly of export has a negative relationship with variables Gross domestic product of trade partner country in long-run and short-run equilibrium.

Transportation cost will be negative relationship. Zheng, et al. (2017) said Distance is basic factors required in the gravity model specification according to conventional international trade theory and can shows the cost of export. Distance or transportation cost as a proxy for trading cost, tends to be a negative factor for exports.

Exchange rate will be positive relationship. It is found that the currency of the exporting country or importer affects the price of the product. If at any time the Thai baht depreciates, the price of the goods calculated in the currency of the exporter will increase the demand for delivery. If the Thai baht depreciates, the product price is calculated in the currency of the exporter. Significant exports have increased demand for exports will be higher (Nattachada Detpong, 2018). Many studies have discussed the impact of the bilateral exchange rate on bilateral trade (Oskooee, 1986). Those studies were usually based on the pass-through

effect of the exchange rate (Goldberg and Knetter, 1997). The exchange rate of trade partners is expected to have a positive effect on exports.

Population of China will be positive relationship. The mostly of export has a positive relationship with variables population in long-run and short-run equilibrium, means canned pineapple in syrup is possibly substitution goods for those countries. If the population of the partner country increases the exporting countries will be able to export more as the population of country increases which will be related to demand in economics (Prasert Chaitip, ChukiatChaiboonsri, and Apiraphol Dewitt, 2015).

4. Result and discussion

The finding in table 4 show the factors are affecting Thai fresh, chilled, frozen, and dried fruits export to China by researcher have studied all 5 variable for find the factor that effect value of export which factors affect export. The results are as follows.

	Coefficient	Std. Error
C	-207330.0000***	57072.2800
GDP_t	128.8162***	16.6434
ln (GDP_C)	-15759.2100***	4532.4140
TC_t	-67.9019***	23.2960
EXR_{tc}	3281.7870***	641.4335
P_c	143018.8000***	42703.2900
R^2	0.9530	
Adj.R^2	0.9432	
DW	2.0282	
F:	97.3401	

Note: 1) C is Value of Thai fresh, chilled, frozen, and dried fruit exports to China 2) GDP_t is Gross Domestic Product of Thailand 3) ln (GDP_C) is Gross Domestic Product of China 4) TC_t is Transportation cost of Thailand 5) EXR_{tc}) is exchange rate Thai baht per yuan 6) P_c is population of China 7) *,**,*** stands for significance at the 1% level ,5% level ,and 10% level respectively.

Table 4 Regression Results for export value of Thailand

The findings in table 4 show that First, the result of Gross Domestic Product of Thailand ,exchange rate Thai baht per yuan ,and population of China is positive relationship with value of Thai fresh ,chilled ,frozen ,and dried fruit exports to China. Gross Domestic Product of China and transportation cost of Thailand is negative relationship value of Thai fresh, chilled, frozen, and dried fruit exports to China.

Gross Domestic Product of Thailand and value of Thai fresh ,chilled ,frozen ,and dried fruit exports to China is the same direction as the amount of value of export is an Thai fresh ,chilled ,frozen ,and dried fruit exports to China with a statistical significance of 1 percent when the GDP of Thailand increasing 1 billion US dollar will increase the amount of value of Thai fresh ,chilled ,frozen ,and dried fruit exports to China 128.8162 million Baht means if GDP of Thailand has high value or increasing it will make Thai can export more because GDP of Thailand can explain the economic situation for analysis about export sector and GDP of Thailand can tell the ability of Thai that is exporter to other countries which is consistent with Zheng, et al. (2017) that study about the determinants of Chinese nonferrous metals imports and export which empirical result of the export the GDP in country is same direction as significant with exports value.

Exchange rate of baht per yuan and value of Thai exports is the same direction as the amount of value of export is an Thai fresh, chilled, frozen, and dried fruit exports to China with a statistical significance of 1 percent when the exchange rate of baht per yuan increasing 1 baht per yuan will increase the amount of value of Thai fresh, chilled, frozen, and dried fruit exports to China 3281.7870 million Baht. Exchange rate of Thai baht per yuan as this research finding that same direct with value of Thai export consistent with Oskooee (1986) and Goldberg and Knetter (1997) from in the hypothesis have the same effect that is expected to be positive.

When the Thai baht depreciates effecting in the country having an advantage in price competition or effecting in increased export revenue converted into Thai Baht and follow with Nattachada Detpong (2018) if at any time the Thai baht depreciates, the price of the goods calculated in the currency of the exporter will increase the demand for delivery. If the Thai baht depreciates, the product price is calculated in the currency of the exporter. Significant exports have increased demand for exports will be higher. Another one the result same as direction is an positive the reason is exchange rate of Thai baht is depreciate it will export if compare with baht per yuan (Jakravint Piamworakaroon, 2017).

Population of China and value of Thai exports is the same direction as the amount of value of Thai fresh, chilled, frozen, and dried fruit exports to China with a statistical significance of 1 percent when the population of increasing 1 billion person. It will increase the amount of value of Thai export is an Thai fresh, chilled, frozen, and dried fruit exports to China 143018.8000 million Baht. Population of China is the same direct with value of Thai export which is consistent with Gamkan luangwirutkol (2010) that she study about factors affecting exports of fresh, chilled, frozen shrimp of Thailand to the United States, Japan and South Korea have to talk about the population variable in the same direction as significant with exports value if population increase cause to Thai can export more with increasing value.

Gross Domestic Product of China and value of Thai exports is not same direction as the amount of value of Thai fresh, chilled, frozen, and dried fruit exports to China with a statistical significance of 1 percent when GDP of China increasing 1 percent will decrease the

value of Thai fresh, chilled, frozen, and dried fruit exports to China 15759.2100 percent which the result is not according to the theory of gravity model and inconsistent with Nattachada Detpong (2018) and Zheng, et al. (2017) that they result are positive effect to export value and Gross Domestic Product of China is the variable that same direct with export value means when the GDP of trading country have high value of GDP it will make exporter country can export more (Zheng, et al., 2017). In the result of this variable is consistent with Prasert Chaitip, Chukiat Chaiboonsri, and Apiraphol Dewitt (2015) the result is negative effect to export value wherewith GDP of China is the proxy of market size that imported country. The market size of the partner country is negative may be caused by economic problems in that country or the economic slowdown which is the reason (Prasert Chaitip, Chukiat Chaiboonsri, and Apiraphol Dewitt, 2015).

In this case show the results not according to the theory of gravity model in the hypothesis. Market size of China has the large economy then if GDP of China has the negative way its means the country's overall economy and domestic cash flow are slowing (Finnomena, 2018). More over last 8-9 years ago (2010 2019) China GDP has the growth rate decrease (World development indicators, 2019). So, that is the reason which affect Thailand can export less of fruits when GDP increase or decrease will directly affect all of country whether it is about investment sector, export and import sector which the result show by that reason (Finnomena, 2018).

Transportation cost of Thailand and value of Thai fresh, chilled, frozen, and dried fruit exports to China is the not same direction in hypothesis with a statistical significance of 1 percent when transportation cost of Thailand increasing 1 million per liter will decrease the value of Thai fresh, chilled, frozen, and dried fruit exports to China 67.9019 million Baht. Transportation cost of Thailand is consistent with Zheng, et al. (2017) that study about the determinants of Chinese nonferrous metals imports. Usually, the direction of this variable is will follow with the theory of gravity model (Thatchawan Kanitphong, 2013). When the transportation cost decrease will effect to export more its means reduce the cost of export cause to country can be get benefit from the lower transportation costs.

The last is constant or C in table 4 it’s means value of Thai fresh, chilled, frozen, and dried fruit exports to China is equal-207330.0000 million baht by does not depend on other factors (GDP of Thailand, GDP of China, transportation cost of Thailand, exchange rate of Thai baht per yuan, and population of China) means Thailand can export to China decrease 207330.0000 million baht. If not studying the above mentioned factors the value of Thai export maybe not have. Therefore should be study with other factors. Then able to point out the importance of all factors why all factors should be study together and traced to why all factors is significance at 1%. R squared is equal 0.9530 means can explain 95.3% and another 4.7% is can’t explain, Adjusted R squared is 94.32%, Durbin Watson equal 2.0282 is appropriate, and F statistic is the highest at 97.340.

5. Conclusion

This research is study about the five factors of economy that are affecting Thai fresh, chilled, frozen, and dried fruits export to China by study with five factors in economics sectors to analysis for finding the factors that affect Thailand can still export to China with high value. Five factors they are GDP of Thailand, GDP of China, transportation cost of Thailand, exchange rate of Thai baht per yuan, and population of China by use times series data with yearly in year 1989-2018 around 30 years.

Variable	Hypothesis	Result	Conclusion
GPD of Thailand	+	+	accept
GDP of China	+	-	reject
Transportation cost of Thailand	_	-	accept
Exchange rate baht per yuan	+	+	accept
Population of China	+	+	accept

Table 5 The conclusion of result

The result illustrated that has the accept are 4 variables and reject 1 variable from the study of 5 variables as the GDP of Thailand, transportation cost of Thailand, exchange rate of Thai baht per yuan, and population of China are accept hypothesis. But GDP of China is reject hypothesis.

From the results of regression analysis can be used to recommendation to government for supporting export sector by findings the result of each variable there are GDP of Thailand, GDP of China, Transportation cost, exchange rate Thai baht per yuan, and population of China which is the variable that is important to economy. By from the result shows the value of population can increase export value therefore the government can planning for export strategy by use analysis from the result. It's means the countries that have high population maybe can export more than the countries that have less population and also talk about the demand of country. If countries high population the demand also high. So government will try to plan how Thailand fruits export will be entry to the target group (high population) including the other negotiation for support export. So can develop the ability of export by strategic planning for stimulate Thai fruits export entry to the world market and support export sector of Thailand to compete in the world due to export is the one important sector that can measure for define strategies that help driving the economy not only in Thailand but this is worldwide our attach importance to exports, so that is the policy recommendation from this result how to bring Thai export.

For future research, researcher recommends studying by focus on specific factors of fruits for example production information, fruits price inside and outside country, climate

change and should more factors that different. Finally, those interested would benefit from future research by take an interest more about export sectors because export is the main sectors that very important for Thai economic.

6. References

Bank of Thailand. (2015). *Exchange rate (1996-2001).* Retrieved from https://www.bot.or.th/App/BTWS_STAT/statistics/ReportPage.

Business Analytics and Data Science @ NIDA. (2019). *Logarithm information*. Retrieved from https://businessanalyticsnida.wordpress.com/2019/02/04

Coahchanun, R. (2017). *National trade strategy survival for the Thai economy. National Assembly Library of Thailand*. Retrieved from https://library2.parliament.go.th/ebook/content-issue

Department of Foreign Trade. (n.d.). *Thai-Chinese Free Trade Area impact on Thai product exports.* Retrieved from http://www.dft.go.th/th-th/ShareDocument1

Detpong, N., & Chaiprasit, K. (2018). Relationship between internal and external factors influencing durian export to the People's Republic of China. *Journal of Social Human and Humanity*, 8, 333-339.

Friesenbichler, K. (2018). Inflation and broadband revisited: Evidence from an OECD panel. A replication study of Yi and Choi (Journal of Policy Modeling, 2005). *International Journal*, 2(1), 2018.

Jerez, D. H. V., & Chasco, C. (2019). Long-run determinants of economic growth in South America. *Journal of Applied Economics*, 19(1), 169-192.

Kamkarn, L. (2010). *Factors affecting the export of Thailand's fresh frozen shrimp to the United States of America, Japan, and South Korea*, (Master's Project, M.Econ. in Managerial Economics). Graduate School, Srinakharinwirot University.

Lina, S., Shia, K., & Yeb, H. (2018). Exchange rate volatility and trade: The role of credit constraints. *Review of Economic Dynamics*, 30, 203-222.

Lucey, B., Wang, X., Wang, Y., & Xu, Y. (2019). *Can financial marketization mitigate the negative effect of exchange rate fluctuations on exports? Evidence from Chinese regions. Finance Research Letters.* Retrieved from https://www.sciencedirect.com/science/article

Lugovskyy, V., & Skiba, A. (2016). Positive and negative effects of distance on export prices. *Journal of Economic Behavior & Organization*, 127, 155-181.

Lutz, M. B. (2019). Trade sophistication in developing countries: Does export destination matter? *Journal of Policy Modeling,* 41(1), 39-51.

Macrotrends. (2020). *Crude oil prices-70-year historical chart*. Retrieved from https://www.macrotrends.net/1369/crude-oil-price-history-chart

Mesa, M. C. P., Barranco, M. C. G., Muñoz, L. P., & Gómez, E. G. (2019). Transport as a limiting factor for the growth of Spanish agri-food exports. *Research in Transportation Economics*, 78, 100756.

Ministry of Commerce. (2019). *International trade statistics*. Retrieved from http://www.ops3.moc.go.th/thtrade/slapopup.html

Nantapo, C. W. T., Muchen, V., Nkukwana, T. T., Hugo, A., Descalzo, A., Grigioni, G., & Hoffman, L. C. (2015). Socio-economic dynamics and innovative technologies affecting health-related lipid content in diets: Implications on global food and nutrition security. *Food Research Internationa*l, 76(4), 896-905.

Narayan, S., & Bhattacharya, P. (2019). Relative export competitiveness of agricultural commodities and its determinants: Some evidence from India. *World Development*, 117(C), 28.

Peterson, E. W. F., & Valluru, S. R. K. (2000). Agricultural comparative advantage and government policy interventions. *Journal of Agricultural Economics Reading*, 4.

Phuriphanpinyo, A. (2017). The impact of agricultural product export on income and employment in the Thai economy. *Sukhothai Thammathirat Open University*, 1-77.

Piamworakaroon, J. (2017). Impact of exchange rate volatility on international trade of Thailand with major trading partners. Chulalongkorn University.

Puey Ungpakorn Institute for Economics Research. (2018). *SMEs policy promoting.* Retrieved from https://www.pier.or.th/

Sachdev, H. J., & Bello, D. C. (2014). The effect of transaction cost antecedents on control mechanisms: Exporters' psychic distance and economic knowledge as moderators. *International Business Review*, 23(2), 440-454.

Stanišić, N. (2018). *European Journal of Applied Economics*. Retrieved from http://journal.singidunum.ac.rs/

The World Bank. (2019). *Export value index (2000 = 100).* Retrieved from https://data.worldbank.org/indicator/TX.VAL.MRCH.XD.WD.

The World Bank. (2019). *GDP (current US$) – China.* Retrieved from https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=CN

The World Bank. (2019). *Import value index (2000 = 100) – China*. Retrieved from https://data.worldbank.org/indicator/TM.VAL.MRCH.XD.WD? locations=CN

Trade Services. (2019). *List of export-importers.* Retrieved December 31, 2019, from http://www2.ops3.moc.go.th

Xu, J., Mao, Q.,& Tong, J. (2016). The impact of exchange rate movements on multi-product firms' export performance: Evidence from China. *China Economic Review*, 39, 46-62.

Zheng, Y., Shao, Y., & Wang, S. (2017). The determinants of Chinese nonferrous metals imports and exports. *Resources Policy*, 53, 238-246.

Does the arrival of electric vehicles affect price of goods and service in Europe?

Jiraya Somna[1] and Siwarat Kusona[2]
Faculty of Economics, International Economics, Maejo University,
Chiang Mai, Thailand[1, 2]
Corresponding Author, E-mail: mju6312107306@gmaejo.mju.ac.th

Received 22 March 2024; **Revised** 30 March 2024; **Accepted** 30 April 2024

Abstract

This study wants to answer, "Does the arrival of electric vehicles affect price of goods and service in Europe?" Using multiple linear regression estimates on panel data by 12 country are Norway, United Kingdom, France, Germany, Netherland, Sweden, Italy, Austria, Switzerland, Denmark, Spain, and Belgium since 2010 to 2022, Using demand theory. The result show that Consumer price index, Electric price and exchange rate are significant make the arrival of electric vehicles are affect to price of goods and services in Europe that increase at price level. Policy recommendations to the government to make incentive for electric vehicle users are reduce tax for electric vehicle using and support electric vehicle on transportation part such as free charging at public stations and road toll exemptions.

Keywords: Price level; Electric vehicle; Price of goods and services

1. Introduction

Price of goods and service depend on two sections are internal factor including: production cost, financial resources, positioning strategy, pricing strategy and external factors including: economics, market demand, competition, target customers' finances, seasons (My, 2023). The price of oil is one of the factors that affect product prices for both manufacturing products and agricultural products because of transportation costs (Kilian, 2013).

In Europe have import oil from Russia but since 2022 the Russia and Ukraine war new lead Europe reduce import oil from Russia about 82 % (Jones, 2023) and the Europe changed to import oil from The United States instead of Russia, causing The United States are

Europe's number one exporter of oil (Bounfour & Luthi, 2023). However, since the import of oil from US, the price of oil started to rise significantly, with oil price increase from 9 to 12 US dollars per barrel, three to four times higher than before the war (Eurostat, 2023). Causing the consumer price index increase from 120.61% from 127.78% in 2022 (Ycharts, 2023) Because the United States has been affected by the war in Russia and Ukraine, the average price of a gallon of gas has risen by 5 cents overnight to $4.065, and the price has increased more than 42 cents within a week As a result, the price of oil in the Europe continues to increase, and the price of products also increases (White, 2022).

Electric vehicles are part of transportation to solve the problem of the consumer price index increasing after the Europe imported oil from the United States, which will affect most of transportation sector in 2021.In figure 1 show Europe recorded an increase of EV in transportation sector compare with 2020 such as Finland increased 136%, Croatia increased 127%, and Italy increased 122%, while Czechia increased 12% and Spain increased 15% (Eurostat, 2023b) in addition the Europe has a policy for electric vehicles to reduce greenhouse gas emissions from 40% of total Europe to zero (Parliament, 2023). In the case of from Finland has incentives and legislation to make people more interested in using electric vehicles by the government a tax deduction of €170 per month from the taxable value (income tax) of BEVs in 2021–2025. The employer can pay for charging electricity at the workplace or a public charging point to the company car driver with limited car benefits or the employee driving their own car. It is tax-free for the driver. The benefit depends on whether the employer wants to pay for it and the vehicle tax, which is paid at the time of purchase (Commision, 2021). (Johansson-Stenman, 2003)

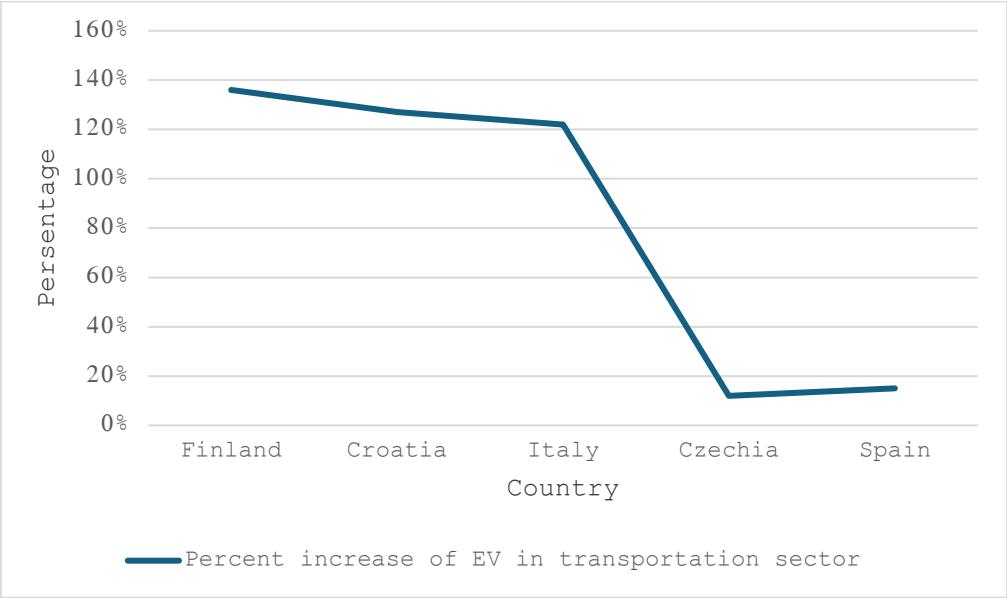

Figure 1 Europe recorded an increase of EV in transportation sector compare with 2020
Source: Eurostat, 2023

Electric vehicles have become important in transportation due to rising oil prices. Europe is interested in electric vehicles as they affect the price of goods and help reduce greenhouse gas emissions. In figure 2 show top 12 country have grown of number of electric passenger car are Norway, United Kingdom, France, Germany, Netherland, Sweden, Italy. Austria, Switzerland, Denmark Spain and Belgium (Yanatma, 2023) in 2021 compare 2022. In 2003 Fredrik Carlsson and Olof Johansson-Stenman found case in Sweden price of oil and electric vehicles have results that are no different because electric vehicles have a high battery cost and a high maintenance cost but since 2022 found that electric vehicles can reduce greenhouse gas emissions for 2.0 gigatons CO2-eq(2000 million ton) and case in the world EV can help reduce transportation cost and help reduce produce price(Chen Tang, 2022; Hossein Ranjbar, 2022).It will be interesting to see in if Europe benefit from electric vehicle.

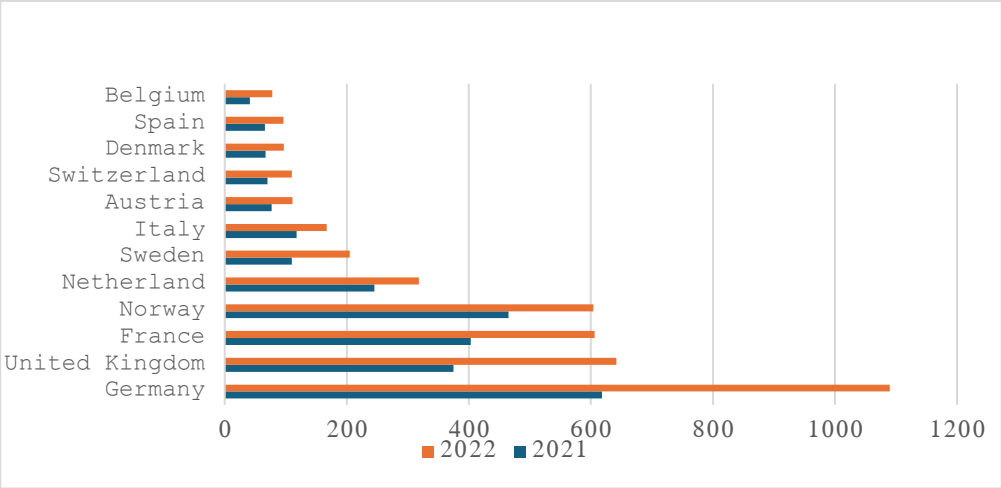

Figure 2 Grown of number of electric passenger cars in Europe 2021 to 2022
Source: Euro News, 2023

In this study we want to find electric vehicle can affect to price of goods and service in Europe because Europe has objective in 2030 Europe can reduce greenhouse gas emissions make Europe take electric vehicle to part of transportation instead gasoline car but gasoline car is one of factor to affect price of goods and services. For this reason, Europe take electric vehicle to part of transportation instead gasoline car this study we want to know when Europe take electric vehicles to part of transportation that will make effect to price of goods and services in Europe measure by price level index for study price of goods and services in Europe has effect.

2. Research Objectives

2.1 To examine the impact of the arrival of electric vehicles on the prices and costs of goods and services in Europe.

2.2 To analyze the factors influencing price changes in goods and services associated with the introduction of electric vehicles in the European market.

3. Research Methodology

3.1 Data

This study we focus on factor affect to produce price, use panel data of 12 country there are Norway, United Kingdom, France, Germany, Netherland, Sweden, Italy. Austria, Switzerland, Denmark Spain and Belgium collect data by annual year in 13 period since 2010 to 2022.Variable we estimate price level (percentage) as independent variable from Eurostat. And we have 5 dependent variable to estimate specific affect to price level there are consumer price index (percent) and electric price (per kilowatt) from Eurostat, Gasoline price (per litter) from International Energy Agency (IEA), GDP per capita (per dollar) from World bank national and Exchange rate (per dollar) from Organization for Economic Cooperation and Development (OECD).

Variable	Meaning	Units	Sources
PRICE	The average of current price across the entire of goods and services produced in an economy	Percentage	Eurostat
CPI	Overall change in the prices of goods and services that people typically buy over time.	Percentage	Eurostat
GASOLINE	Cost of Gasoline per litter	Current U.S. dollar	International Energy Agency
ELECTRIC	Cost of electric price per kilowatt	Current U.S. dollar	Eurostat
GDPPC	Economic metric that breaks down a country's economic output per person by GDP of nation dividing population of country.	Current U.S. dollar	World bank national
ER	Which one currency will be exchanged for another currency	Current U.S. dollar	Economic Cooperation and Development

Table 1 the variable and definition

3.2 Methodology

3.2.1 Theoretical Model

We study to relationship between cost of eletric vehicles and product price use demand theory by Garrett J. van Ryzin(2012) demand model consider customers to be decision makers because demand is the result of decisions made by many individuals such as the choice to purchase one company's product over another. Wait or buy now, buying more or less, etc (Ryzin, 2012). Following: $Qd_{it} = f(P_{it}, Y_{it}, Prg_{it}, T_{it})$

In demand function Qd is quantity of demand or consumer willing to pay for goods and service at i is country and t is time period can measure by price (P) is price of good and service or change in the price of the commodity at i is country and t is time period, income (Y), price relate goods and service (Prg) is price has relate to good and service such as if pricr of butter incraese will make demand of bread fall at i is country and t is time period and test (T). In this study we can change variable to suits for our research following as $equation\ 2$

$$PRICE_{it} = f(CPI_{it}, GDPPC_{it}, GASOLINE_{it}, ELECTRIC_{it}, ER_{it})$$

Where price level $(PRICE)$ is the average of current prices across the entire of goods and services produced in an economy.Price level can measure quantity of demand or consumer willing to pay for goods and service from Deonir De Toni and Andressa Tormen(2021) they found price level can effect to purchase intention such as high price VS low price has effect to purchase intention (Deonir De Toni et al., 2021). We can instead quatity of demand (Qd) to price level $(PRICE)$ from Garrett J. van Ryzin(2012) demand model measure by consider customers to be decision makers.

Consumer price index (CPI) is Overall change in the prices of goods and services that people typically buy over time. Consumer price index can measure price of goods and service or change in the price of the commodity and can tell inflaion rate in that time by consumer price index base year is 100 such as if consumer price index increase 110 it mean inflation in that time has 10 % at time meanning in that time price of goods and service increase more than previous year around 10 % (Oner, 2022). from report of National Statistical (2022) inflation on moment of Covid-19 pandemic has a lot of effect to price of goods and service increase make quantity of buy goods and service decrease by inflation has increase 8% (Jenkins, 2022). We can instead Price (P) to consumer price index (CPI) for measure change in price can effect to price level.

Gross domestic product per capita $(GDPPC)$ is Economic metric that breaks down a country's economic output per person by GDP of nation dividing population of country. We can instead Income(Y) to Gross domestic product per capita $(GDPPC)$ because Jeffrey H. Bergstrand(1991) found There are positive relationship between the price level and gross domestic product (GDP) per capita (Bergstrand, 1991). In 2020 Javier Cravino and Samuel Haltenhof (2020) can measure Gross domestic product per capita has positive effect to price

level by sectoral differences in intermediate input shares (Haltenhof, 2020). Gasoline price($GASOLINE$) is cost of Gasoline per litter and electric price($ELECTRIC$) is cost of electric price per kilowatt. We can instead price relate goods and service (Prg) to Gasoline price ($GASOLINE$) and Electric price ($ELECTRIC$) because Michael Gelman and Yuriy Gorodnichenko(2016) study about the response of consumer spending to changes in gasoline prices in America they found change in gasoline price has large effect to consumer spending (Michael Gelman et al., 2016) and Dora Gicheva and Justine Hastings(2007) found gasoline price increase make consumer change dinner outside to buy goods from groceries for reduce expenditure (Dora Gicheva, 2007). In 2013 Napoli found Europe take electric vehicle to part of transportation for reduce greenhouse Gas Emission. In part of transportation is price of oil is one of the factors that affect product prices for both manufacturing products and agricultural products (Kilian, 2013) in Europe has take electric vehicle to part of transportation will be electric price has effect to price of goods and service in Europe.

Exchange rate (ER) is which one currency will be exchanged for another currency. We can put exchange rate to demand model because in 1985 Rudiger Dornbusch found the appreciation of the U.S. dollar has a large effect to price changes of different groups of goods (Dornbusch, 1985).

In theory we can put all variables in the independent variable there are consumer price index, Gross domestic product per capita, Gasoline price, Electric price and Exchange rate that effect to price level. We use study does the arrival of electric vehicles affect price of goods and service to measure price of goods and service in Europe will make price of goods and service increase or decrease when Europe take electric vehicle to part of transportation instead gasoline vehicle. Price level can measure price of goods and service in economic such as if previous years has price level 103 % but in this year has price level 105 % its mean in this years has price of goods and service will increase around 2 % from previous years. That make we can use price level for measure price of goods and service in Europe from 2010 to 2022 since Europe has registered electric vehicle in Europe will make effect to price of goods and service in Europe when electric vehicles into transportation part will make price of goods and service will increase or decrease.

3.2.2 Econometric Model

(1) This study we use Mutiple Linear Regression medthod is Panal data to analyze for find what factor will affect to price level by follow research quasion is Does the arrival of electric vehicles affect product prices in Europe to find gap of electric price will have effect to price of product in Europe by similar grown of number of electric passenger cars 12 country are Norway, United Kingdom, France, Germany, Netherland, Sweden, Italy. Austria, Switzerland, Denmark and Spain.

(2) In this study we use one dependent variable and five independent variables there are price level($PRICE$), consumer price index(CPI), Gross domestic product

per capita $(GDPPC)$, electric price $(ELECTRIC)$, gasoline price $(GASOLINE)$, exchange rate(ER) referred to $Equation\ 3$

$$PRICE_{it} = \beta_0 + \beta_1 CPI_{it} + \beta_2 GDPPC_{it} + \beta_3 GASOLINE_{it} + \beta_4 ELECTRIC_{it} + \beta_5 ER_{it} + \mu_{it}$$

(3) Where i is country that we study there are 12 country are Norway, United Kingdom, France, Germany, Netherland, Sweden, Italy. Austria, Switzerland, Denmark and Spain, t is time period since 2010 to 2022, $PRICE_{it}$ is the average of current prices across the entire of goods and services produced in an economy in 12 country since 2010-2022, CPI_{it} is overall change in the prices of goods and services that people typically buy over time in 12 country since 2010 to 2022, $GDPPC_{it}$ is economic metric that breaks down a country's economic output per person by GDP of nation dividing population of country in 12 country since 2010 to 2022, $GASOLINE_{it}$ is price of gasoline per litter in 12 country since 2010 to 2022, $ELECTRIC_{it}$ is price of electric per killowatt in 12 country since 2010 to 2022 and ER_{it} is which one currency will be exchanged for another currency in 12 country since 2010 to 2022 and μ_{it} is error term in $equation\ 4$ we use $PRICE_{it-1}$ (1 year lag) for solve autocorrelation problems.

$$PRICE_{it-1} = \beta_0 + \beta_1 CPI_{it} + \beta_2 GDPPC_{it} + \beta_3 GASOLINE_{it} + \beta_4 ELECTRIC_{it} + \beta_5 ER_{it} + \mu_{it}$$

(4) This study we have five variable are consumer price index, Gross domestic product per capita, gasoline price, eletric price and exchange. First we expect null hypothesis H0 : β_1 = 0 that consumer price index not effect to price level $(PRICE_{it})$, alternative hypothesis H1 : β_1< 0 that comsumer price index has possitive effect to price level$(PRICE_{it})$ because consumer price index can measure inflation rate that can tell if consumer price index increase will make price index will increase. Second we expect null hypothesis H0 : β_2 = 0 that gross domestic product per capita not effect to price level$(PRICE_{it})$, alternative hypothesis H1 : β_2< 0 that gross domestic product per capita has possitive effect to price level $(PRICE_{it})$ because gross domestic product per capita can measure indirectly income per capita that can tell if gross domestic product per capita will increase make income increase that can effect to price index will increase. Third we expect null hypothesis H0 : β_3= 0 that gasoline price not effect to price level$(PRICE_{it})$, alternative hypothesis H1 : β_3 < 0 that gasoline price has positive effect to price level $(PRICE_{it})$ because gasoline is one of factor to effect to transportation cost that will make if gasoline price increase will make price index will increase. Forth we expect null hypothesis H0 : β_4= 0 that electric price not effect to price level$(PRICE_{it})$, alternative hypothesis H1 : β_4 < 0 that electric price has positive effect price level$(PRICE_{it})$ because in the world has take eletric vehicle to part of transportation instead gasoline car because gasoline price has increase a lot and electrice vehicle can reduce greenhouse Gas emission such as some country in Europe and China. Last varaible we expect hypothesis H0 : β_5 = 0 that exchance rate not effect to price level$(PRICE_{it})$, alternative hypothesis H1 : β_5 > 0 that exchange rate has negative effect or depreciated that tell if exchange rate has depreciated will make price index will decrease.

4. Research Findings Summary

We study does the arrival of electric vehicles affects price of goods and service in Europe? by factor affect to price level are consumer price index, Electric price, Gasoline price, GDP per capita and Exchange rate by regression analysis the result show as table 2

Variable	Coefficient	Std. Error	T stat	Prob.
C	-326.2725	2599.569	-0.1255	0.9003
CPI	-0.2958	0.1493	-1.9807	0.0496**
Electric price	27.0413	10.0013	2.7037	0.0077***
Gasoline price	-0.6755	1.9567	-0.3452	0.7305
GDP per capita	5.3535	0.0002	0.2010	0.8409
Exchange rate	-3.5142	1.1934	-2.9446	0.0038***
AR(1)	1.002	0.0114	87.6893	0.0000
R2	0.9725			
Adj.R2	0.9713			
DW	2.1452			

Note: The symbols ***, ** and * are significant at 1%, 5% and 10 % level respectively.

Table 2 Regression analysis result

This table show R2 =0.9725 mean consumer price index, Electric price, Gasoline price, GDP per capita and Exchange rate expian factor can price level to 97 % in this table have 3 variable are singnificant to price level there are consumer pruce index, Eletric price and Exchange rate. First is consumer price index (CPI) has negative effect to price level by 0.2958 and significant at 5% level mean if consumer price index increase 1 % will be price level decrease 0.2958 %.

Consumer price index can describe inflation and can predict use from macroeconomic statistics such as real value of investment to micro-level budgeting such as construction project price forecasts (Marco K. W. Yu, 2010). Consistant with Oyekunle Janet Olufunmike (2019) found that CPI have negative and opposite to economic theory in Sub sahara African Countries because in Sub-sahara African Countries has vary fluctuations in inflation and Jonathan D. Church(2016) found that CPI can has decrease indirectly effect to price of goods and service Products by consumers, businesses, governments, and foreigners but not include import because current CPI does not reflect the fact that consumers can adjust their spending to achieve comparatively low priced goods or services, leading to

excessive increases in the rate of consumer price increases.On the other hand Allen Head, Alok Kumar and Beverly Lapham(2010) found about inflation rate increase will make price will increas because inflation increases, prices become more responsive with higher inflation that make price increase (Allen Head, 2010; Oyekunle Janet Olufunmike et al., 2019).

Next variable is Electric price has positive effect to price level by 27.0413 and significant at 1% level mean if eletrice price increase 1% will be price level increase 27.0413 %.In this study we get result are possitive because in Europe electric vehicle still unstable compared to gasoline car, in Europe Norway is leading transition to electric vehicles, with a large percentage of new car sales being electric but in 2019 case in china found negative because China has falling battery prices make electric vehicles more economically attractive. This has led to increased adoption of electric cars and bicycles for affordable transportation and China has a large number of electric cars in service, including cars, buses and trucks (Larry E. Erickson, 2019). However, Li Fei and Wu Chaofei (2013) found electric price can affect positive or negative to price because It depends on the structure between production and consumption cost of economic sector structure. Exchange rate has negative effect to price level by 3.5142 and have significant at 1% level mean if exchange rate depreciated will be price level decrease 3.5142 %.Rudiger Dornbusch(1982) found exchange rate are relate price of monies and price of goods if exchange rate depreciated will be increase in domestic real income increase demand for real balances and has effect to fall in domestic prices but in opposite if exchange appreciation will be higher interest rate make pricce will increase (Dornbusch, 1982).

5. Discussion of Research Findings

This study investigates whether the adoption of electric vehicles (EVs) in Europe affects the price of goods and services, particularly in the context of the region's shift from gasoline-powered vehicles to electric vehicles (EVs) as part of its broader effort to reduce greenhouse gas emissions. The research tests five hypotheses to assess the impact of this transition on price levels across various sectors.

Hypothesis 1: Consumer Price Index (CPI) The first hypothesis posits that the Consumer Price Index (CPI) has a negative effect on price levels in Europe due to fluctuations in inflation rates. The results support this hypothesis, as the CPI has shown considerable volatility from 2010 to 2022, contributing to periodic price increases. These fluctuations reflect broader macroeconomic conditions, such as inflation, which directly affect the cost of goods and services in the region. Thus, the adoption of electric vehicles, coupled with inflationary trends, seems to have a compounding effect on the overall price level.

Hypothesis 2: Electric Vehicle Price Impact The second hypothesis examines the relationship between the price of electric vehicles and the broader price levels in the

economy. The results support this hypothesis, indicating that the introduction of electric vehicles does indeed have a positive effect on price levels. This outcome is due to the current instability and structural challenges in the European economic sector, particularly in industries that manufacture or rely on electric vehicles. The high initial costs of EVs, limited infrastructure, and fluctuating demand contribute to the increase in prices of goods and services associated with this transition. However, as the market for electric vehicles matures, this effect may stabilize.

Hypothesis 3: Gasoline Prices The third hypothesis investigates the impact of gasoline prices on price levels. The study rejects this hypothesis, as the findings indicate that gasoline prices do not significantly affect the overall price levels in the economy. This suggests that, despite rising fuel costs, the transition to electric vehicles does not lead to a direct increase in the cost of goods and services, possibly due to the fact that the gasoline price is only one of many factors influencing the cost structure in Europe.

Hypothesis 4: Gross Domestic Product (GDP) per Capita The fourth hypothesis explores the impact of GDP per capita on price levels. The study rejects this hypothesis as well, indicating that GDP per capita does not significantly influence the pricing of goods and services. This result implies that, while higher economic output can lead to higher demand for goods and services, it does not directly correlate with price levels in the context of the electric vehicle transition.

Hypothesis 5: Exchange Rate Finally, the fifth hypothesis addresses the effect of exchange rates on price levels. The study accepts this hypothesis, revealing that a depreciating exchange rate has a negative impact on price levels, leading to a decrease in the cost of goods and services. This effect can be attributed to the reduced cost of imported goods, which may result from a weaker currency and subsequently lower prices in local markets. As electric vehicles become more widespread, this dynamic could further influence the price structures of related goods and services in Europe.

6. Knowledge from Research

This research provides valuable insights into the economic impacts of the adoption of electric vehicles (EVs) in Europe, particularly in relation to the prices of goods and services. The study highlights how the transition from gasoline-powered vehicles to electric vehicles influences various macroeconomic factors such as inflation, sectoral costs, and the pricing structure of goods and services.

1. Impact of Inflation and Consumer Price Index (CPI): The study underscores the significant role of inflation in influencing price levels, with the findings showing that the Consumer Price Index (CPI) is strongly correlated with price volatility in the European market. Fluctuations in inflation rates have a direct effect on the cost of goods and services, especially

as the economy shifts towards a more sustainable future through the adoption of EVs. This suggests that the adoption of electric vehicles occurs within a broader economic context where inflationary pressures are also at play.

2. Electric Vehicle Pricing and Economic Sector Challenges: A key takeaway from the research is the positive relationship between the introduction of electric vehicles and the increase in price levels. This effect is partly attributed to the current instability and structural challenges within the electric vehicle market, such as the high costs of EVs, limited charging infrastructure, and fluctuating demand. As the EV market matures, however, this impact on prices may stabilize. The findings suggest that while electric vehicles are a promising solution for reducing emissions, their initial economic footprint can cause temporary price increases in related sectors.

3. Gasoline Prices and Their Limited Effect on Price Levels: Interestingly, the research found that gasoline prices do not significantly influence the overall price levels in Europe. This indicates that the transition from gasoline to electric vehicles does not necessarily result in a proportional increase in the cost of goods and services, as gasoline prices are just one element in a larger, more complex pricing structure. This insight suggests that while fuel prices are an important consideration, other factors, such as technological advances and government policies, play a more pivotal role in shaping price dynamics in the context of EV adoption.

4. GDP Per Capita and Its Non-Influence on Price Levels: The study also revealed that GDP per capita does not have a significant impact on price levels in the context of electric vehicle adoption. This suggests that, while higher economic output can drive demand for goods and services, it does not directly correlate with price changes during the shift to a green economy. This finding challenges the assumption that higher economic development automatically results in higher prices, particularly when new technologies such as electric vehicles are introduced.

5. Exchange Rate Effects on Price Stability: Finally, the research emphasizes the role of exchange rates in affecting price levels. A depreciating exchange rate is found to have a negative effect on prices, which could lead to a reduction in the cost of imported goods. This could indirectly reduce the cost of goods and services associated with electric vehicle production and infrastructure, offering a potential economic benefit as the market for electric vehicles grows. The interaction between exchange rates and electric vehicle adoption suggests that global economic factors will continue to play a significant role in shaping the prices of green technologies.

In conclusion, the research provides a comprehensive understanding of how the arrival of electric vehicles influences price levels in Europe. It demonstrates that while the transition to EVs presents initial economic challenges, such as increased prices due to technological and infrastructure factors, it also offers long-term opportunities for price

stabilization, especially with supportive government policies. By addressing these challenges, such as providing financial incentives and expanding EV infrastructure, policymakers can help facilitate a smoother transition to a green economy, with a focus on reducing greenhouse gas emissions without sacrificing economic stability.

7. Recommendation

This study examines the economic impact of electric vehicle (EV) adoption in Europe, specifically on the price of goods and services. Based on the findings, the following recommendations are proposed for policymakers, businesses, and future research:

7.1 Policy Recommendations:

1) Promote EV Adoption: Governments should reduce barriers to EV adoption by offering financial incentives like tax cuts and investing in public charging infrastructure. These measures will make EVs more accessible and encourage widespread use.

2) Mitigate Price Hikes: To counter the price increases caused by EV adoption, governments should consider offering subsidies for EV buyers, reducing VAT on EV-related products, and stabilizing the EV market through long-term strategies.

3) Support Green Business Initiatives: Governments should encourage innovation in the green technology sector by offering R&D incentives. This will help lower EV costs and reduce their impact on inflation.

1.2 Business Recommendations:

1) Invest in Cost Reduction: Businesses should prioritize R&D to reduce EV costs and improve efficiency, making EVs more affordable for consumers and reducing price volatility.

2) Expand Charging Infrastructure: Companies should collaborate with governments to expand the EV charging network, increasing consumer confidence and demand for EVs.

7.3 Further Research Recommendations:

1) Examine Long-Term Effects: Future research should explore the long-term price impacts of EV adoption as technology advances and consumer adoption increases.

2) Analyze Regional Variations: Research should consider regional differences in the impact of EVs on price levels across Europe to tailor policies more effectively.

8. References

Allen Head, A. (2010). Market Power, Price Adjustment, and Inflation. *International Economic Review*, 51, 73-98.

Bergstrand, J. H. (1991). Structural Determinants of Real Exchange Rates and National Price Levels: Some Empirical Evidence. *The American Economic Review*, 81(1), 325-334.

Bounfour, S. A., & Luthi, W. (2023). New oil map: Impact of Russia's war on Ukraine on supply and demand, Transport & Environment, 2023.

Butler, E. (2024). Europe's two biggest economies seem to be winning the battle against the inflationary beast, but is it still too early for rate cuts? Euro.Business.

Chaofei, L. F. a. W. (2013). Electricity and the Economy. *Global Journal of HUMAN SOCIAL SCIENCES Economics*, 13(1).

Dornbusch, R. (1982). Exchange Rate Economics: Where Do We Stand? International Economics Policies and their Theoretical Foundations, 557-599.

Dornbusch, R. (1987). Exchange Rates and Prices. *The American Economic Review*, 77, 93-106.

Haltenhof, J. C. a. S. (2020). Real Exchange Rates, Income per Capita, and Sectoral Input Shares. *The Review of Economics and Statistics,* 102(1), 180-194.

Johansson-Stenman, F. C. a. O. (2003). Costs and Benefits of Electric Vehicles: A 2010 Perspective. *Journal of Transport Economics and Policy,* 37, 1-28.

Michael Gelman et al. (2016). The Response of Consumer Spending to Changes in Gasoline Prices. *AMERICAN ECONOMIC JOURNAL: MACROECONOMICS*, 15, 129-160.

Oyekunle Janet Olufunmike et al. (2019). Estimation of CPI of Some Sub-sahara African Countries: Panel Data Approach. *American Journal of Theoretical and Applied* Statistics 8(6), 246-259.

Stanisław Iwan et al. (2019). Electric mobility in European urban freight and logistics – status and attempts of improvement. *Transportation Research Procedia*, 39, 112-113.

The study of relationship between gross domestic product (GDP) and foreign direct investment (FDI): Compare Thailand outflow FDI and Laos GDP

Paweena Phiwkliang[1] and Siwarat Kusona[2]
Faculty of Economics, International Economics, Maejo University,
Chiang Mai, Thailand[1, 2]
Corresponding Author, E-mail: paweenaphiwkliang@gmail.com

Received 9 February 2025; **Revised** 12 March 2025; **Accepted** 20 March 2025

Abstract

This study examines the relationship between foreign direct investment (FDI) outflows from Thailand and the gross domestic product (GDP) of Laos, focusing on the causal link between these two variables. Using a causality test, the study determines whether FDI outflows from Thailand influence Laos' GDP or vice versa. Additionally, the research evaluates the impact of Laos' investment promotion policies on FDI inflows from 2005 to 2017. The findings provide valuable insights into the effectiveness of these policies in attracting foreign investment and their implications for economic growth. The results can serve as a reference for policymakers seeking to enhance FDI promotion strategies, ultimately contributing to national economic development.

Keywords: Gross Domestic Product (GDP); Foreign Direct Investment (FDI); Outflow FDI

1. Introduction

Foreign direct investment (FDI) is an investment made by a firm or individual from one country that go to invest in another country. This is the one of important factor that made a driving in the economy, because the investment will increase economic activity, especially in developing countries. If there is foreign direct investment will cause more capital that flow in economy system, has transferring know-how and technology and make labor have more skill. Foreign direct investment can be divided into two major are outflow foreign direct investment (Outflow FDI) and inflow foreign direct investment (Inflow FDI) , which outflow

foreign direct investment is the firms bring capital to invest in other country for receives the market share, then bring the profit come to their country for make the benefit. As well as, inflow foreign direct investment is the country that has the foreign investor comes to invest in their country and make the benefit such as capital flow, employment and including drive the economy.

In 2016, the global foreign direct investment flow was value over 1.67 trillion USD, and trend to increase all the time. According to the FDI Intelligence report, global FDI in 2016 has already invested over 776.2 billion USD. The trend of foreign direct investment will increase in the country or regions that have the economic growth. On the other hand, if in a country where economic slowdown or uncertainty, foreign direct investment will decrease, which for investment outflow FDI Mainly to expand business and increase market share. Choosing the country to invest will mainly look at the economic overview and these factors determine the investors in Thailand decide to move the capital into foreign countries. Thailand is a country that has the foreign direct investment (Outflow FDI) more than 710,799.56 million baht in 2015. In 2009, 2010, 2011 and 2012, the proportion of foreign investment accounted for 1.6, 1.4, 1.2 and 3.5 percent of Thailand's GDP. This shows that outflow FDI and Thai economic numbers have a significant percentage of capital outflows compared to Thailand's GDP. And can create employment, technology development and economic growth for the country that is the recipient of capital (Inflow FDI). Found that Thailand has the highest investment in ASEAN member countries, when representing the percentage of investment that Thai investors invest abroad, divided by region.

From the issue of benefits that Thailand has issued to foreign investment (Outflow FDI) and can create economic value for the recipient country. Therefore saw the issue of the relationship that the FDI has on GDP or the relationship that GDP has on FDI, how directly or inversely. And saw that the Thailand is moving capital to invest in foreign countries, is there any factor that attracts Thai investors to invest in that country or not? And when comparing the foreign investment statistics of the ASEAN member countries, it is found that Laos has been funded (Inflow FDI) from Thailand is the third most of foreign direct investment (Inflow FDI), after China and Vietnam respectively.

No	Countries	Unit of investment	Value of Investment (US)
1	China	185	2,536,634,040
2	Vietnam	88	1,132,246,387
3	Thailand	95	1,038,885,515

Table 1 Number of investment in Laos
(Ministry of planning and investment promotion department invest in the future, Invest in Laos)

When sorting the gross domestic product (GDP) of each country in the ASEAN member countries. Found that Laos has the 9th GDP number of ASEAN member countries. So when using data with low GDP, it can show the relationship between the outflow FDI from Thailand and the Lao GDP of the country that receives the capital most clears.

During the 5-year period, the Lao government has a policy to promote foreign investment by setting a policy to reduce investment tax rates in order to attract more foreign investors to invest in their countries. Therefore increasing the number of Thai investors who invest in Laos as well. The number of Thai investors that invests in Laos, what is the connection or relationship with the Lao GDP, which will focus on comparing only Thai FDI outflows and Laos GDP.

2. Research Objectives

2.1 To explain changes that affect investment by foreign investment policy and promotion of Laos.

2.2 To study the relationship between the outflow FDI of Thai investors and GDP of Laos.

3. Research Methodology

Foreign direct investment is an investment from one country that have gone out to build a business unit or invest in another country (Paopijit, 2014). It's made the transfer know-how and technology, as well as made the labor in host country have more skill and increase competitiveness (Suwankesorn, 2013) (Jitt, 2011).

Many factor that use for component the decision to invest. One of them is the gross domestic product (GDP) in host country (Chanthapong and Thanabadeephat, 2012). And foreign direct investment also important to driving the economic. Due to the economic growth, investment, export and gross domestic product have the relationship in same direction (Duangpasta, 2014) (Abbas, Akbar, Nasir, Aman, Muhammad and Naseem, 2011)

Therefore the relationship between foreign direct investment (FDI) and gross domestic product (GDP), which one is cause which one is effect. Use the granger causality test to prove. By before that use the unit root for test the stability of the data then use the augmented dickey-fuller test (Tepiya, Lonkani and Tangsomchai, 2015).

This study will study only the investment statistics of Thai investors (Outflow FDI) that have invested in Laos with the Laos GDP, by statistical target groups used in education are the number of investment value added each year for Thai investors in Laos and the economic value (GDP) of Laos.

3.1 Data

Collection secondary data as time series from 2005 - 2017, by founding outflow foreign direct investment from Thailand to Laos in Bank of Thailand and gross domestic product (GDP) of Laos from World Bank.

3.2 Method

The method that use in this study are divided into 2 part

3.2.1 Descriptive

Study of changes that affect investment by foreign investment policy and promotion of Laos information on increasing investment policy in Laos each year. And compared with the statistics of increasing foreign direct investment (FDI) in Laos and then explain the relationship that the Lao government's investment policy has a direct or indirect effect with investment.

3.2.1 Unit root test

The study of the relationship between Thai investors' that go to invest in Laos (outflow FDI) and GDP of Laos. First, will test the stability of statistical data using the unit root test. By use the augmented dickey – fuller test.

3.2.3 Granger causality test

After test the unit root, then tested the causal relationship between the GDP of Laos and the FDI outflow of Thai investors. By using an Eviews program to assist in the analysis of the data. And then explain the relationship between the variables between Laos GDP and Thai FDI outflow. Using statistical data, ie the GDP value of Laos, dating back 13 years

(2005-2017) and the value of Thai investment (Out Flow) that has been invested in Laos for the past 13 years (2005-2017)

4. Research Findings Summary

4.1 Descriptive

Explain the policy of the Lao government that it is related to a certain period of time. That has an impact on attracting. And changing the investment statistics that increase within Laos? How? Using statistical data, ie, the GDP value of Laos, dating back 13 years (2005 - 2017) and the Thai investment value increase (Out Flow) that has been invested in Laos for the past 13 years (2005-2017).

By the data that is compared, use information on the change of the Lao government's investment policy (showing that the Lao government started promoting investment to have foreign direct investment) promoted by reducing the tax rate and the suspension of the concession for a temporary period. As the table below.

priority	1st , remote areas, remote areas, inconvenient infrastructure	2nd, areas with some utilities	3rd, the big city area where basic infrastructure is ready
Promoted business, level 1	Tax exemption for 10 years	Tax exemption for 8 years	Tax exemption for 4 years
Promoted business, level 2	Tax exemption for 8 years	Tax exemption for 6 years	Tax exemption for 2 years
Promoted business, level 3	Tax exemption for 6 years	Tax exemption for 4 years	Tax exemption for 1 years

Notes: (This law has been announced in 2009)

Table 2 Laos government policy

When combined with the 7th Economic-Social Development Plan of the Laos, the GDP growth rate between the years 2011-2015 will be as high as 8% per year in accordance with the investment targets in Laos. Raised at least 1.7 billion dollars per year. And when compared to the investment value table (capital increase) of Thai investors to compare changes since 2009.

Years	Value	Years	Value
2005	-55.41	2011	-101.13
2006	17.82	2012	247.26
2007	76.4	2013	203.85
2008	97.34	2014	283.37
2009	297	2015	450.76
2010	350.13	2016	433.46

Table 3 Investment value (Capital increase)

When compared based on the Laos government's investment promotion policy that started in 2009 and compared with the Thai investors' capital increase statistics, Thai investors have increased capital from the previous year, that was no investment policy of the Lao government more than 200 million US dollars or about 6,600 million baht. And the capital has continued to increase until the current year.

Clearly shows the Laos government's investment promotion policy affecting foreign direct investment and affecting the capital increase of Thai investors.

4.2 Unit root test

Table 4. Unit root test (Outflow FDI)

Null Hypothesis: D (X,2) has a unit root

Exogenous: Constant Lag

Length: 1 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.709395	0.0068
Test critical values:	1% level	-4.420595	
	5% level	-3.259808	
	10% level	-2.771129	

*MacKinnon (1996) one-sided p-values.

Note : X is outflow FDI from Thai investors

Null Hypothesis: D(Y,2) has a unit root

Exogenous: Constant Lag Length: 0 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.794506	0.0050
Test critical values:	1% level	-4.297073	
	5% level	-3.212696	
	10% level	-2.747676	

*MacKinnon (1996) one-sided p-values.

Note : Y is Laos GDP

From unit root test, X and Y has stability in second different. So it's not have the problem to test.

4.3 Granger causality test

Null Hypothesis:	Obs	F-Statistic	Prob.
X does not Granger Cause Y	11	0.19904	0.8247
Y does not Granger Cause X		6.02088	0.0368

The results of granger causality test are outflow FDI from Thailand (X) effect to Laos GDP (Y) but Laos GDP does not affect to FDI from Thai investors.

5. Discussion of Research Findings

The findings of this study shed light on the dynamic relationship between foreign direct investment (FDI) outflows from Thailand and the gross domestic product (GDP) of Laos. The causality test results indicate a significant link between these two variables, demonstrating that FDI outflows from Thailand play a crucial role in influencing Laos' economic growth. This suggests that Thai investments contribute positively to Laos' GDP, likely through capital inflows, job creation, technology transfer, and infrastructure development.

Furthermore, the study highlights the impact of Laos' investment promotion policies on attracting FDI. The evaluation of policies from 2005 to 2017 reveals that government initiatives, such as tax incentives, regulatory reforms, and infrastructure improvements, have been instrumental in increasing foreign investment. However, the effectiveness of these policies varies across different sectors, with certain industries experiencing more substantial benefits than others.

The findings also suggest that while FDI inflows have positively contributed to Laos' GDP, other macroeconomic factors such as political stability, regulatory transparency, and labor market conditions may influence the long-term sustainability of investment-driven

growth. Policymakers should, therefore, focus not only on attracting FDI but also on creating an enabling environment that ensures foreign investments translate into sustained economic development.

Overall, this study provides empirical evidence supporting the positive role of Thai FDI in Laos' economic expansion. The results underscore the importance of well-designed investment policies and cross-border economic collaboration in fostering regional economic growth. These insights can serve as a foundation for future policy adjustments aimed at enhancing FDI attraction strategies and optimizing their economic impact.

6. Knowledge from Research

This study provides valuable insights into the economic interdependence between Thailand and Laos by examining the causal relationship between Thailand's foreign direct investment (FDI) outflows and Laos' gross domestic product (GDP). The findings reveal whether Thailand's FDI outflows play a significant role in driving Laos' economic growth or if Laos' GDP growth itself attracts more FDI from Thailand.

Moreover, the study assesses the effectiveness of Laos' investment promotion policies from 2005 to 2017 in fostering foreign investment. The results highlight the extent to which these policies have influenced FDI inflows and contributed to economic expansion. The research underscores the importance of well-structured investment policies in enhancing cross-border economic collaboration, reinforcing regional economic integration, and promoting sustainable development.

By identifying key factors that drive FDI and economic growth, this study offers practical implications for policymakers. Strengthening investment incentives, improving regulatory frameworks, and fostering investor confidence can enhance Laos' ability to attract foreign capital. The findings serve as a reference for both Thai and Lao policymakers in formulating strategic economic policies that maximize the benefits of FDI, ultimately fostering long-term economic stability and growth in the region.

7. Recommendation

This study provides significant insights into the dynamic relationship between foreign direct investment (FDI) outflows from Thailand and the gross domestic product (GDP) of Laos, offering a deeper understanding of the role of cross-border investments in fostering economic growth. The findings underscore the potential of FDI in driving the economic development of Laos, particularly in the context of Thailand's outward investment.

The results highlight several key points:

1. Causal Relationship between FDI and GDP The study reveals the causal link between Thai FDI outflows and Laos' economic performance. Understanding this relationship can help both governments better leverage FDI for sustainable development.

2. Impact of Investment Promotion Policies Laos' investment promotion policies have played a crucial role in attracting FDI, but their effectiveness in fostering long-term economic growth depends on further refining these strategies and addressing potential barriers to foreign investment.

3. Policy Implications for FDI Attraction The research suggests that Laos should continue to enhance its investment promotion framework, focusing on policy stability, infrastructure development, and reducing bureaucratic hurdles to make the country more attractive to foreign investors.

Recommendations for Future Policy and Practice:

1. Strengthening Investment Promotion Policies Laos should continue to refine and adapt its investment promotion policies based on the findings of this study, with a focus on creating a more business-friendly environment for foreign investors. This could include offering tax incentives, improving legal frameworks, and enhancing transparency in the investment process.

2. Building Cross-Border Economic Partnerships Thailand and Laos can further strengthen their economic ties by establishing bilateral agreements that streamline investment processes and encourage more targeted, impactful FDI that aligns with the strategic needs of both nations.

3. Investing in Infrastructure and Human Capital For FDI to have a more significant impact on Laos' economic growth, investments in infrastructure (e.g., transportation, energy) and human capital development (e.g., education and skills training) are critical. This would enhance the overall investment climate and create more opportunities for sustainable growth.

4. Regular Evaluation and Policy Adjustment Policymakers in Laos should implement a system for regularly evaluating the impact of investment promotion policies, ensuring they remain adaptable to changing global economic trends and the evolving needs of the business sector.

8. References

Abbas, S., Akbar, S., Nasir, A., Aman, S., & Naseem, M. (2011). Impact of foreign direct investment on gross domestic product. *Global Journal of Management and Business Research*, 11(8), 35-40.

Borensztein, E., De Gregorio, J., & Lee, J. W. (1998). How does foreign direct investment affect economic growth?. *Journal of International Economics*, 45(1), 115-135.

Chanthapong, P., & Thanabadeephat, S. (2012). Factors influencing foreign direct investment in ASEAN countries. *Journal of Economics and International Business Research*, 4(2), 45-56.

Duangpasta, T. (2014). The impact of foreign direct investment on economic growth in developing countries. *International Journal of Economics and Finance*, 6(10), 120-127.

Jitt, P. (2011). Technology transfer and spillovers from foreign direct investment in Thailand. *Asian Journal of Technology Innovation,* 19(2), 99-117.

Okapanom, T., & Sricharoen, T. (2016). Factors affecting foreign direct investment in Thailand. Journal of Business. *Economics and Communications*, 11(2), 75-88.

Paopijit, C. (2014). Foreign direct investment and economic growth: A case study of Thailand. *Journal of International Business and Economics*, 2(1), 13-25.

Roy, S., & Mandal, K. K. (2012). Foreign direct investment and economic growth: An analysis for selected Asian countries. *Journal of Business Studies Quarterly*, 4(1), 15–24.

Suwankesorn, S. (2013). The role of foreign direct investment in enhancing technological capability in the Thai manufacturing sector. *Journal of Development Studies*, 49(8), 1178-1192.

Tepiya, P., Lonkani, R., & Tangsomchai, S. (2015). Causal relationship between foreign direct investment and economic growth in ASEAN-5 countries. *Asian Economic Journal,* 29(4), 333-350.

Factor influence to adoption of mobile commerce application

Tittaya Yotsar[1] and Siwarat Kuson[2]
International Economics, Faculty of Economics, Maejo University, Thailand[1, 2]
Corresponding Author: yokyoyo70@gmail.com

Received 3 January 2025; **Revised** 24 January 2025; **Accepted** 28 January 2025

Abstract

Currently, mobile phones play a significant role in daily life, particularly in the online trading business sector. Mobile commerce applications have gained widespread popularity as they facilitate communication and transactions through mobile devices. This study aims to identify the key factors influencing consumers' adoption of mobile commerce applications. Using data from 96 respondents, a modified version of the extended Unified Theory of Acceptance and Use of Technology (UTAUT) was employed. The findings indicate that performance expectancy, effort expectancy, social influence, facilitating conditions, trust, and price value significantly impact the adoption of mobile commerce applications. Additionally, the study reveals that the amount of expenses incurred influences application adoption, and consumer satisfaction with purchasing products via mobile commerce applications is reported to be at a very high level.

Keywords: Mobile commerce application; UTAUT; Adoption

1. Introduction

Communication has existed throughout history in every nation, group, and language. In its earliest stages, before the invention of communication devices, people relied entirely on bodily gestures and expressions to convey messages. Over time, communication evolved, enabling individuals to connect with others both nearby and across long distances. This progression has been driven by technological advancements that facilitate human interaction. Examples of such developments include the telegram, landline telephones, and mobile phones, each contributing to the continuous improvement of communication methods.

At present, technology, particularly the Internet, plays a crucial role in daily life. This has significantly contributed to the growth of the domestic economy, particularly in the business sector. Consumer behavior has shifted towards the use of dynamic and portable devices due to their affordability, compact size, and convenience, allowing users to carry them easily. Additionally, software development has made these devices more user-friendly. According to Hyperweb.ca (2013), the use of mobile internet devices doubled in 2012 and was projected to surpass computer-based internet usage within one to two years. In several countries, the percentage of mobile internet users was notably high, with Egypt at 70%, India at 59%, South Africa at 57%, Indonesia at 44%, Canada at 40%, and Thailand at 32%.

In Thailand, data from the 2016 Use of Information and Communication Technology in Households report indicated that in 2012, out of approximately 62.8 million people, around 31.7 million (50.5%) used smartphones. This number was expected to continue increasing in the following years.

The market in Thailand has evolved into a new form known as digital marketing, which refers to the trading of products through internet channels, commonly known as electronic commerce (E-commerce). This transformation reflects the country's growth into a digital economy. The increasing significance of online product purchases is evident, with the market value rising from 2.03 million baht in 2013 to 2014 and continuing to grow in 2015. According to Miss Sunisa Matchjit (2016), the value of the e-commerce market in Thailand is the highest in the ASEAN region for the B2C (Business-to-Customer) model. This highlights the growing importance of digital commercial transactions as a key factor in the modern economy.

Furthermore, advancements in mobile phone technology and wireless devices, including increased device variety, improved system performance, enhanced security, portability, and user-friendly interfaces, have contributed significantly to the expansion of e-commerce via mobile devices (Jakkrit Manwicha, 2016).

Mobile commerce (M-commerce) is defined by the Durlacher Research Institute (Lehner, 2001) as any transaction involving the exchange of monetary value conducted through a telecommunications network using mobile phones. M-commerce represents an extension of technology that has a direct impact on the growth of the e-commerce industry. There are various types of mobile commerce, each with specific contexts. This study focuses on mobile applications that facilitate the decision-making process for selling goods via mobile devices (M-commerce, 2018). The scope of mobile commerce includes different operational models. This encompasses transactions between businesses and individual consumers (Business-to-Customer or B2C) and transactions between businesses (Business-to-Business or B2B). However, recent trends indicate a rise in Consumer-to-Consumer (C2C) transactions, where individuals use smartphones as intermediaries, making this model increasingly popular (Suriyaphat Pumnamyen & Sitanon Jesadapiphat, 2016).

The smartphone market has experienced rapid growth, aligning with Chris Anderson's statement in Wired magazine (2010), "The Web is Dead," which suggests that people increasingly prefer accessing information through mobile applications rather than traditional websites. New Relic (2013) analyzed the mobile application market and provided key insights into user behavior. On average, an individual downloads approximately 41 applications. As of that time, the iOS and Android markets collectively hosted around 1.5 million applications. However, 60% of these applications were never downloaded. Additionally, most users check their mobile phones around 150 times per day. The proportion of consumers purchasing products via mobile phones has increased annually. In 2013, 39% of consumers made purchases through mobile devices, rising to 41% in 2014 and 43% in 2015 (Sittapong Lee Suwan, 2015). Mobile applications enhance consumer access to information, enabling faster searches and offering user-friendly systems that are easy to navigate. Consequently, the continuous development of new applications has become essential. Several factors contribute to the growing popularity and potential success of mobile applications over traditional e-commerce platforms. These include mobility (ease of carrying), reachability (quick access to information), ubiquity (widespread use of mobile phones), and convenience (compact size and user-friendly interfaces) (Noppadon Phongsatharak, 2008). This trend reflects the increasing acceptance of mobile applications in modern society. Furthermore, technological adoption influences consumers' continued engagement with social media, and they readily integrate innovative technologies into their daily lives (Tanyasiri Lappanich & Nittathananitakorn, 2016).

This research examines the extended Unified Theory of Acceptance and Use of Technology (UTAUT) as proposed by Sriyuknirund (2017), which provides a methodological framework for understanding the reasons individuals accept and adopt new information technology. The study aims to identify key principles and gain insights into consumer behavior regarding the adoption of mobile commerce applications (Singha et al., Sununthar et al., 2012). Consequently, UTAUT will be used as the theoretical foundation to evaluate the factors influencing consumers' adoption of mobile commerce applications. In exploring the determinants of technology adoption, numerous researchers have focused on behavioral intentions in choosing mobile commerce (M-commerce). This approach builds upon an understanding of consumer behavior and satisfaction in adopting M-commerce, as examined in studies by Yi-Shun Wang & Yi-Wen Liao (2007), Pruthikrai Mahatanankoon, H. Joseph Wen & Billy Lim (2005), and Silas Formunyuy Verkijika (2018). Based on the findings from previous research, this study will investigate the factors influencing the adoption of mobile commerce applications. Identifying these factors can be beneficial for M-commerce service providers in developing effective strategies to enhance consumer engagement, improve service understanding, and encourage repeat purchases, ultimately fostering long-term customer retention.

2. Research Objectives

This study aims to identify the key factors influencing consumers' adoption of mobile commerce applications.

3. Research Methodology

To better understand the factors influencing consumers' adoption of mobile commerce applications, this research employs a quantitative approach using a survey method. Questionnaires will be utilized as the primary data collection tool to gather insights from respondents.

3.1. Research Data

This study explores Generation Y (Manal Alduaij & Hanaa Al-Amari, 2016), focusing on undergraduate and graduate students in their first to fourth years at Maejo University, Chiang Mai. The research examines students who use mobile phones with internet access to make purchasing decisions through mobile commerce applications. This demographic is particularly relevant as students often possess technical knowledge in fields such as computer science, information systems, and telecommunications management. Additionally, they frequently utilize mobile phones for purchasing goods via mobile commerce applications, making them a key group for understanding adoption behavior in this context.

The sample size for this study is determined using simple random sampling, based on Taro Yamane's formula, with a confidence level of 95% and a margin of error not exceeding 5% (significance level of 0.05) (Noppadon Phongpananarat, 2008). This approach ensures a representative sample for analyzing the factors influencing consumers' adoption of mobile commerce applications.

$$n = \frac{N}{(1+Ne^2)}$$

where n is population size, N denotes the size of the population used in the study, and e indicates sampling error.

The validity and reliability of the questionnaire were assessed to ensure the accuracy and consistency of the measurement tool. To evaluate validity, the questionnaire was reviewed by university professors to confirm its relevance and appropriateness. Reliability was measured using Cronbach's Alpha, as implemented in the SPSS software program, following the approach of Swinda Thirawongchinda (2015). The results demonstrated a very strong reliability level, with a confidence level of 95% (significance level of 0.05). Additionally,

the questionnaire was pre-tested on a sample of 24 respondents to refine the survey instrument before full-scale data collection.

The study employs multiple regression analysis to examine the independent variables based on the Unified Theory of Acceptance and Use of Technology (UTAUT) model (Venkatesh et al., 2012). The independent variables include performance expectancy, effort expectancy, social influence, facilitating conditions, price value, and trust, while the dependent variable is the adoption of mobile commerce applications for purchasing goods. The relationship between these variables is analyzed using the following regression equation:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5$$

where X_1, X_2, X_3, X_4, X_5 are gender, education, revenue, popular to buy shoes, and amount of expenses, respectively.

4. Result and Discussion

4.1 Profile of the Respondents

The survey was conducted with a sample of 95 respondents, selected through random sampling due to time and budget constraints. The demographic profile of the respondents was analyzed based on gender, education level, and monthly income. The results indicated that the majority of respondents were female (71.88%), while male respondents accounted for 27.09%. In terms of education level, third-year students represented the largest group (43.75%), followed by second-year students (26%), first-year students (15.63%), and fourth-year students (10.42%). Regarding monthly income, a small proportion of respondents (4.2%) reported a low income, whereas the highest proportion (38.54%) had a relatively higher income. These findings provide essential demographic insights into the characteristics of respondents, which are relevant for understanding factors influencing mobile commerce adoption.

4.2 Factor Analysis

A linear regression analysis was conducted to identify the factors influencing the decision to use mobile commerce applications among first- to fourth-year students. The regression analysis examined which factors significantly impacted the decision to adopt mobile commerce applications. A total of 96 validated questionnaire responses were used for analysis, with a significance level of 0.05. The regression model was developed using the Enter method in the SPSS program, incorporating all relevant variables into the equation. The analysis was conducted in two parts by comparing the significance (Sig.) values of the coefficients with the

predetermined alpha (α) value of 0.05, allowing for the identification of significant predictors influencing mobile commerce adoption.

The study examines general information and consumer behavior in purchasing products through mobile commerce applications. Table 1 presents the results of the multiple regression analysis, identifying the key factors influencing the decision to adopt mobile commerce applications. This analysis evaluates the significance of various independent variables in predicting consumer adoption behavior, providing insights into the determinants that impact mobile commerce usage.

Variable	B	Std. Error	t	Prob.
Constant	0.244	0.451	0.542	0.589
Gender	0.476	0.284	1.677	0.097
Education	0.001	0.001	1.825	0.072
Revenue	0.037	0.132	0.28	0.780
Popular to buy shoes	0.680	0.258	2.632	0.010
Amount of expenses	0.383	0.107	3.591	0.001
R^2 = 0.295 F-Statistics =				

Table 1 Result of multiple regression analysis

Based on Table 1, the significance values indicate that the factors significantly influencing the adoption of mobile commerce applications at the 0.05 significance level are amount of expenses and popularity in purchasing shoes. These variables play a crucial role in consumers' decisions to adopt mobile commerce. The results of the regression analysis include the coefficient, which represents the strength and direction of the relationship between independent and dependent variables. A higher coefficient indicates a stronger influence of an independent variable on the dependent variable. Therefore, independent variables with higher Beta coefficients have a greater impact on mobile commerce adoption. These findings provide valuable insights for mobile commerce service providers, helping them better understand consumer behavior and develop effective strategies to enhance user engagement and adoption. From the efficiency to predictive value, R^2, is 0.295 meaning that all five independent variables can explain to decision adoption use mobile application of students the first to the fourth in university by 29.5 percent, the remaining percentage 70.5 caused by the influence of other variables. Moreover, statistics used to analysis teste with one-way analysis of variance (One-Way ANOVA). The result shows in Table 2 as follows:

Model	Sum of Squares	d.f.	Mean Square	F	Prob.
Regression	42.238	11	3.84	3.202	0.001
Residual	100.72	84	1.199		
Total	142.958	95			

Table 2 Result of One-Way ANOVA

The result, shown in Table 2, indicates that at least one independent variable significantly influences the decision to adopt mobile commerce applications among university students. Furthermore, the multiple regression analysis for factors affecting the adoption of mobile commerce applications confirms that the regression model is statistically significant, suggesting that the independent variables collectively impact mobile commerce adoption decisions. Additionally, the study evaluates consumer satisfaction levels regarding purchasing products through mobile commerce applications, measuring their overall experience and acceptance of mobile shopping platforms.

The independent variables in this study include performance expectancy, effort expectancy, social influence, facilitating conditions, trust, and price value, each representing a key factor influencing mobile commerce application adoption. Performance expectancy measures perceived usefulness, evaluating how the application enhances purchasing efficiency, while effort expectancy assesses ease of use, determining how simple and user-friendly the application is for consumers. Social influence examines the impact of interpersonal relationships and mass media, analyzing how peers and media affect consumer decisions. Facilitating conditions measure access to necessary resources, including technical support and knowledge essential for adoption. Trust focuses on security and privacy concerns, influencing consumer confidence in mobile commerce applications. Lastly, price value evaluates the cost associated with using mobile commerce applications, determining whether the perceived benefits justify the financial investment. Together, these factors provide a comprehensive framework for analyzing consumer behavior in mobile commerce adoption.

The results of the measurement of satisfaction to buy products via mobile phone applications is showed in Table 3. The average scores of many factors are between 3.50 and 4.49. These indicated that the consumers in Maejo university have satisfied in mobile commerce application adoption.

In this empirical study, we analyzed users' decisions regarding the adoption of mobile commerce applications. Our results indicate that amount of expenses and popularity in purchasing shoes significantly influence the adoption of mobile commerce applications.

These findings align with previous studies, including those conducted by Chutarat Kiatratham (2015) and Rizky Septiani, Putu Wuri Handayani, and Fatimah Azzahro (2017), which similarly identified these factors as key determinants in mobile commerce adoption.

Satisfaction Factors	Average Score
Buying products through applications helps to save travel time.	4.30
Applications are constantly updated.	4.04
There are many types of products to choose from in one application.	4.31
When buying products through applications, there will be convenience compared to buying products at the store.	4.08
The pictures or text in applications are easy to understand and comprehend.	3.70
Promotion affects the decision to buy your products.	4.09
Product presenter affects the decision to buy your product.	3.50
The word of mouth of those around you, such as friends, family, influencing the purchase of your products.	3.75
Some products need to be purchased through the application rather than buying through the store.	3.73
Satisfaction in payment via applications on mobile phones.	3.93
Trust in information displayed in applications.	3.55
Trust with service providers and products through applications.	3.55
Receiving the product at the time agreed with the seller.	3.72
Satisfaction at the price level of the product.	3.98
Satisfaction with the delivery service.	3.83

Table 3 Consumer satisfaction with mobile commerce applications

5. Conclusion

The adoption of mobile commerce (M-commerce) has become a growing research domain, attracting the interest of scholars worldwide (Chong, 2013; Liebana-Cabanillas, 2017; Zhang et al., 2012). This study identifies key factors influencing the adoption of mobile commerce applications, with amount of expenses emerging as a significant determinant. Additionally, consumer satisfaction with purchasing products via mobile commerce applications was found to be at a high level, with an average satisfaction score ranging from 3.50 to 4.49.

The UTAUT model was selected as the theoretical framework for this study due to its extensive application in examining technology adoption from a consumer perspective (Silas Formunyuy Verkijika, 2018). Future research should explore additional factors influencing M-commerce adoption, particularly those that resonate with consumer preferences.

Understanding these factors can help businesses retain existing customers, expand their consumer base, and refine application development strategies. Expanding the sample size and incorporating qualitative insights through open-ended questionnaire responses could provide further depth to the findings, allowing for a more comprehensive understanding of consumer adoption behavior.

6. References

Akbar, F. (n.d.). What affects students' acceptance and use of technology? Information Systems, Dietrich College, Carnegie Mellon University.

Alduaij, M., & Al-Amari, H. (2016). Factors moderating students' adoption decisions of mobile commerce. *Review of Public Administration and Management,* 4(1), 1-7.

Alkhunaizan, A. (2012). What drives mobile commerce? An empirical evaluation of the revised UTAUT model. *International Journal of Management and Marketing Academy*, 2(1), 82-99.

Alkhunaizan, W. (2012). What drives mobile commerce? An empirical evaluation of the revised UTAUT model. *Academic Journal of the University of the Thai Chamber of Commerce*, 35(4).

Eydgahi, A. (2016). Main factors influencing mobile commerce adoption. *Proceedings of the 2016 IAJC-ISAM International Conference*. Orlando: Florida.

Kiadrasamee, F. (2015). Factors affecting decision making behavior on purchasing through E-commerce of the people living in municipal area, Mahasarakham province. *Journal for Developing the Social and Community,* 6(2), 225–244.

Launglaor, W & Lealaphan, A. (2019). Smart phone buying behavior and factors affecting buying decision of Gen Y in metropolitan Bangkok. University of the Thai Chamber of Commerce. *Journal Humanities and Social Sciences,* 35(4), 147–164.

Septiani, R., Handayani, P. W., & Azzahro, F. (2017). Factors affecting behavioral intention in online transportation services: A case study of GO-JEK. *Procedia,* 124, 504-512.

Verkijika, S. F. (2018). Factors influencing the adoption of mobile commerce applications in Cameroon. *Telematics and Informatics,* 3(6), 1665-1674.

Zeeshan, M., Cheung, C., & Scheepers, H. (2009). Influencing factors for the adoption of M-commerce applications: A multiple case study. *Journal of Electronic Commerce Research.* Proceedings of the 11th International Conference on Enterprise Information Systems - Software Agents and Internet Computing, 53-60.

Factors that affect Green GDP in 5 world's greenest countries

Intharak Panpoon[1] and Siwarat Kusona[2]
Faculty of Economics, International Economics, Maejo University,
Chiang Mai, Thailand[1, 2]
Corresponding Author, E-mail: mju6312107321@gmaejo.mju.com

Received 19 January 2024; **Revised** 28 March 2024; **Accepted** 3 May 2024

Abstract

This study aims to identify the factors affecting green GDP in the world's greenest countries including Sweden, Denmark, United Kingdom, Finland and Switzerland over period 2000-2020. Estimate by panel data regression fixed effects model. The results show significant variables that are exchange rate, foreign direct investment, population and the labor force have positive effects on green GDP, while unemployment has negative effects. However, the exchange rate has a most positive effect. On the other hand, foreign direct investment has a less positive effect on green GDP than expected. So, in developed countries governments should have investment policies that focus on green investment for environmentally friendly and sustainable in the long term.

Keywords: Green GDP; World's greenest countries; Economic factors

1. Introduction

The world has started to change because of economic development, focusing on environmental resources and ecosystems along with the economic growth (Sonthi et al., 2019). This causes "sustainable development" being used for the first time in 1987 by the Brundtland and the discussion about Green GDP gained in the late 20th century, response to growing concerns about environmental sustainability (Mebratu, 1998). The difference between GDP and Green GDP is, Gross Domestic Product is total value of all goods and services produced within the borders of a nation, which solely focuses on economic activity without considering its environmental impact. But Green Gross Domestic Product is economic indicator that evaluates the economic output of a country while considering the environmental costs and

benefits associated with that output. It provides a more perspective on economic growth by reflecting on the sustainability of development among businesses, consumers, policymakers and mitigate environmental degradation (Stjepanović et al., 2017; Wang, 2011).

Internationally, organizations such as the United Nations and World Bank have stimulated the integration of environmental factors into economic indicators and policy frameworks. The System of Integrated Environmental-Economic Accounting it's one of the most accepted methods for calculating Green GDP (Kamesh, 2023). These contribute to understanding the relationship between economic development and environmental sustainability, but global Green GDP has not been measured. Some countries try to have integrate environmental considerations into their national accounting systems, including development of Green GDP. However, the adoption and implementation of these measures vary widely across countries and regions.

Table 1 shows the average differences in growth between the Green GDP and GDP for various groupings of countries. An average difference between the Green GDP and GDP for the world all 160 countries of 7.23% indicates that over the course of 50 years, GDP growth was, on average, over 7% higher than the Green GDP growth. Suggesting that the global economy was indeed implacable over the environmental issues and that ecological aspect of growth was largely ignored within a framework of international preoccupation with economic growth issues (Stjepanović, Tomić, & Škare, 2019)

Average difference in growth rates	Difference in %
Average (all countries)	7.23
EU countries	
- EU 27	2.52
- Euro Area	1.69
- EU 6 Founding countries	1.16
Countries by development	
- WB High-income countries	4.78
- WB Middle-income countries	7.66
- WB Low-income countr	10.54
COUNTRIES BY REGIONS	
- Europe	4.10
- Northern Europe	2.08
- Western Europe	1.07
- Southern Europe	5.49
- Eastern Europe	5.78

Source: Stjepanović, 2022

Table 1 Average of the Green GDP 1970-2019

For the 5 most environmentally friendly countries in the world: Sweden, Denmark, Finland, Switzerland and the United Kingdom, it is a good example for this study. From previous statistics, it can be found that if countries are classified according to their level of development, the growth gap between GDP and Green GDP will be higher with lower income levels. with high-income countries at 4.78%, middle-income countries at 7.66% and low income countries at 10%. All 5 countries are euro area countries with a proportion of 1.69%, with Sweden, Denmark and Finland in Northern Europe 2.08%, also Switzerland and United Kingdom in Western Europe 1.07%. We will see that developed countries invest more and promote sustainable economic behavior and lifestyles, even though those countries use resources from the environment by more than any other country and economic development can be achieved even though the environmental impact is greatly reduced (Stjepanovic, 2022).

At present, there is a lot of research on Green GDP. Which most of them only have research that calculates Green GDP and proves the formula for calculating Green GDP (Luo, Chen, & Wang, 2023; Sonthi et al., 2019; Stjepanovic, Tomic, & Skare, 2022; Stjepanović et al., 2017, 2019), as well as research to find factors affecting Green GDP. But most of them are variables related to the environment such as fossil fuels, renewable energy, CO2 emissions and various pollutants (Kalantaripor & Najafi Alamdarlo, 2021; Tomić & Stjepanović, 2022), And there are only a few research that have economic variables, such as the trade openness and FDI (Kamesh, 2023; Wang, 2011). But there is no research that uses economic variables such as economic variables such as inflation rate, exchange rates and interest rates are researched to see if they can have an impact on Green GDP. Also, there is research that suggests that Green GDP and economic variables are related, such as international trade affects Green GDP growth and carbon leakage. Low carbon trade is critical to stimulating Green GDP growth. Interest rates are positively linked to carbon prices. Meanwhile, exchange rates are negatively linked to carbon prices. (Yang, Wan, & Shen, 2023; Zhang et al., 2023). Bidirectional relationship between exchange rates and renewable energy. In the short term, a significant increase in the use of renewable energy causes the exchange rate to increase. Long-term results show that the use of renewable energy has a negative effect on the exchange rate, while inflation and currency exchange rates significantly affect the use of renewable energy. (Deka, Cavusoglu, & Dube, 2022). The use of renewable energy and financial innovations contribute to improving environmental quality, while economic growth and inflation worsen environmental quality deterioration in both the short and long term (Hao & Chen, 2023). Therefore, we decided to study this matter.

This research aims to study about the economic factors that affect Green GDP by selecting 5 of the most environmentally friendly countries in the world, to find that while the increase in green GDP has negative impact on GDP, what factors enable these countries to develop their economies while conserving the environment. It also serves as a guideline for other countries that are initiating the development of green economies. Moreover, with the

Sustainable Development Goals, which serves as a "blueprint for peace and prosperity" and helps guide to future studies for sustainable development that benefits to people wish to study this matter further.

2. Research Objectives

To investigate the economic, demographic, and investment factors affecting Green GDP in the five world's greenest countries.

3. Research Methodology

3.1 Data

This study focuses on the economic factors affecting Green GDP in world's greenest country using panel data of 5 country including Sweden, Denmark, United Kingdom, Finland and Switzerland from 2000 to 2020. For the data we have Green GDP US dollars calculate by actor, Exchange rate (2010 = 100), Inflation rate (annual %), FDI net (BoP, current US$), population (total), unemployment (% of total labor force), labor force (total). The sourced from World Development Indicators (WDI). Furthermore, Interest rate (percentage) sourced from OECD Statistics database.

3.2 Theoretical model

To study economic factors affecting Green GDP in world's greenest country this study uses production function. The approach follows the method from Zeng et al. (2023) that study Carbon-Reduction, Green Finance and High-Quality Economic Development and Tan and Sun (2024) they study about factor market distortion affect green innovation. where the Cobb Douglas production function following form:

$$Y_{it} = A_{it} K_{it}^{\alpha} L_{it}^{\beta}$$

(1) Where Y_{it} is the output (total production), A_{it} is a total factor productivity (TFP), a constant that captures the effects of technology and other factors not explicitly included as inputs, K_{it} denotes the capital input, L_{it} is the labor input, α and β denote the capital output and labor output of elasticity.

In economics, the production function explains an empirical relationship between specified output and inputs. A production function can be used to show the output of production for a firm, industry and nation (Apostolov, 2016). In this study the output is green gross domestic product of each country (Sweden, Demark, United Kingdom, Finland, Switzerland) and input is independent variable is exchange rate, interest rate, inflation rate, foreign direct investment, labor force, population and unemployment rate. Since this study does not include total factor productivity (TFP), following by Jiang et al. (2023); Oryani et al. (2021) we transform equation 1 into a linear form and rewritten as follows:

$$Y_{it} = f(K_{it}L_{it})$$

(2) Following by Chi et al. (2021); Kinyar and Bothongo (2024); Saidi and Hammami (2015) we added independent and dependent variables to the model. Replace Y and K with the output and the capital input variables following form:

$$GGDP_{it} = f(FDI_{it}L_{it})$$

(3) Replace L with the labor input variables following form:

$$GGDP_{it} = f(FDI_{it}LE_{it}POP_{it}UMP_{it})$$

(4) Add economic variables in the model following form:

$$GGDP_{it} = f(ER_{it}IR_{it}IF_{it}FDI_{it}LF_{it}POP_{it}UMP_{it})$$

(5) Where GGDP is green gross domestic product, ER_{it} is exchange rate, IR_{it} is interest rate, IF_{it} is inflation rate, FDI_{it} is foreign direct investment, LE_{it} is labor force, POP_{it} is population, UMP_{it} is unemployment rate

3.3 Econometric model

This study estimates the economic factors affecting Green GDP in world's greenest country using panel data of 5 country including Sweden, Denmark, United Kingdom, Finland and Switzerland from 2000 to 2020. Following by Chen et al. (2024) we use a panel data model to study the economic factors affecting Green GDP in world's greenest country. The equation of the panel data model is as follows:

$$Y_{it} = \alpha + \beta_0 + \beta_1 x_{1,it} + \beta_2 x_{2,it} + \beta_3 x_{3.it} + \ldots\ldots\ldots + \beta_n x_{n.it} + \varepsilon_{it}$$

(6) Where Y is dependent variable represents green gross domestic product, α is the entity-specific effect which accounts for unobserved heterogeneity across country, β_n is the coefficient vector that represents the effect of the independent variables on the dependent variable, X_n is the vector of independent variables, ε is the error term.

Taking the variables on both sides of Equation (6), we have:

$$GGDP_{it} = \alpha_i + \beta_0 + \beta_1 ER_{it} + \beta_2 IR_{it} + \beta_3 IF_{it} + \beta_4 FDI_{it} + \beta_5 LF_{it} + \beta_6 POP_{it} + \beta_7 UMP_{it} + \varepsilon_{it}$$

(7) Where i is countries (Sweden, Demark, United Kingdom, Finland, Switzerland), t is time period from 2000 to 2020, α is constant, GGDP as a dependent variable represents green gross domestic product, ER_{it} is exchange rate, IR_{it} is interest rate, IF_{it} is inflation rate, FDI_{it} is foreign direct investment, LF_{it} is labor force, POP_{it} is population, UMP_{it} is unemployment rate and ε is error term.

Unit root tests can be used to examine whether the trend data should be first differentiated or regressed on the timing function to keep the data stationary (McLeod et al., 2012). Moreover, economic and finance theory often suggests the existence of long-run equilibrium relationships between nonstationary time series variables. Therefore, we performed a Hausman test to decide whether to specify random or fixed effects (Baltagi, 2014). When using this alternative calculation of the Hausman test based on artificial regression, the null hypothesis is rejected, the random effects estimator is inconsistent and should not be used in regressors.

$$GGDP_{it} = \alpha_i + \beta_1 ER_{it} + \beta_2 IR_{it} + \beta_3 IF_{it} + \beta_4 FDI_{it} + \beta_5 LF_{it} + \beta_6 POP_{it} + \beta_7 UMP_{it} + \varepsilon_{it}$$

(8) Where i is countries (Sweden, Demark, United Kingdom, Finland, Switzerland), t is time period from 2000 to 2020, α is constant, GGDP as a dependent variable represents green gross domestic product, $ER_{it}$is exchange rate, IR_{it} is interest rate, IF_{it} is inflation rate, FDI_{it} is foreign direct investment, LF_{it} is labor force, POP_{it} is population, UMP_{it} is unemployment rate and ε is error term.

This study uses the panel data regression fixed-effect model to test the impact of variables that change over time. With fixed-effect model, it's assumed that something may impact or bias the variables, therefore needed to control such possibilities. This model removes the effects of time-invariant characteristics. So, the net effect of predictors on the outcome variable can be assessed (Wang, 2023).

4. Research Findings Summary

This paper study the factor affects green GDP in the most environmentally friendly country in the world (Sweden, Denmark, United Kingdom, Finland and Switzerland). The result estimated by using Cobb-Douglas production function and use panel data over the period 2000 to 2020 and estimated by panel data regression fixed effect model. The result show as table 2

Variable	Coefficient	Std. Error	T stat	Prob.
C	-2.48E+12	9.08E+10	-27.27069	0.0000
ER	9.51E+08	4.04E+08	2.353298	0.0221**
IF	-3.49E+09	3.04E+09	-1.145195	0.2569
IR	7.71E+08	9.88E+08	0.780656	0.4382
FDI	0.1393	0.048696	2.860580	0.0059**
LF	73174.76	36211.51	2.020760	0.0480**
UMP	-156130.7	12609.68	-12.38181	0.000***
POP	176590	3122.948	56.54605	0.000***
R^2	0.999733			
Adj.R^2	0.999606			
DW	2.045937			

Note: The symbols ***, ** and * are significant at 1%, 5% and 10 % level respectively.

Table 2 Regression analysis result

Table 2 shows the $EE2$ = 0.999 that mean the exchange rate, inflation rate, interest rates, inflation rate, FDI, population, unemployment and labor force can explain the change of green GDP up to 99 %. The result shown that have 5 variables are significant effect to green GDP, that are exchange rate, FDI, population, unemployment and labor force.

5. Discussion of Research Findings

First, exchange rate (ER) has positive effect to green GDP at 9.51E+08 and significant at 5% level, that mean if exchange rate increases 1%, it will make green GDP increase by 951,000,000 dollar. The results shown that an increase in the exchange rate has a positive effect on green GDP. For example, Sweden's exchange rate increase by 6% and make green GDP increase by 5.12% (Data, 2024).On the other hand, the weak exchange rates may boost exports, especially in smaller countries which are more dependent on trade but can grow through price advantages in green countries (Choi et al., 2019; Smaili & Gam, 2023). This is more particularly so because countries that have stable exchange rates can attract more green investments since investors like markets that have a low risk of volatility in the exchange rate that is associated with long-term, capital-intensive projects in green energy (Li et al., 2023).

Next is foreign direct investment (FDI) has positive effect to green GDP at 0.1393 and significant at 5% level, that mean if FDI increases 1%, it will make green GDP increase by 0.1393 dollar. Foreign direct investment (FDI) often acts as a driver for green growth through facilitation of clean technology transfer and energy efficiency. For example, identified that in developed such as Finland the FDI increased by 40% resulting green GDP increase by 3% (Data, 2024). FDI has tended to be important for green growth, mainly through transitions in energy that reduce energy consumption and subsequent emissions with higher effectiveness in countries with robust environmental policies. Further research on E-7 countries shows that FDI, besides the investments in renewable energy, reduces carbon emissions and, therefore, can contribute to greener economic growth. In Central and Eastern Europe, the environmental impact of FDI has been proved to have both a negative and positive effect depending on the quality of the regulatory environment and the mechanisms of technology transfer (Caetano et al., 2022; Christoforidis & Katrakilidis, 2021; Xu et al., 2023).

Labor force (LF) also has positive effect to green GDP at 73174.76 and significant at 5% level, that mean if labor force increases 1%, it will make green GDP increase by 73174.76 dollar. In case of Denmark, labor force increased by 1.4% that make green GDP increase by 4.73% (Data, 2024). Some studies confirm that labor force can increase Green GDP in the positive direction with greater intensity when they are carried out by skilled or educated workers. The productivity of green technologies for example has shown to increase with higher educations in the labor force, thus reduced environmental degradation, enhancing Green GDP and reducing regular one. It also determined that in some countries, namely China and the

BRICS nations, increase of stronger human capital specifically an educated populace could substantially help environmental performance and economic efficiency. Its success is largely because the labor force has adapted more quickly and effectively to new green technologies (Ahmed et al., 2022; Naseer et al., 2022; Qian & Wang, 2022).

Unemployment (UMP) has negative effect to green GDP at 156,130.7 and significant at 1% level, that mean if unemployment increases 1%, it will make green GDP decrease by 156,130.7 dollar. This result is like study of the OECD countries found that lower rates of unemployment are good for transitioning renewable energy, which presupposes higher unemployment rates would do the opposite, it can slow down the transition towards renewable energy and green economic growth (Guler et al., 2024). Such as, unemployment in United Kingdom increased by 33.47% it's reduced green GDP by 6.64% (Data, 2024). The study of G7 countries showed that countries with stable employment can attract more investment since green business initiatives need more labor (Ayad & Djedaiet, 2024).

The last one is population (POP) has positive effect to green GDP at 176,590 and significant at 1% level, that mean if population increases 1%, it will make green GDP increase by 176,590 dollars. The results like previous study show that the countries where population and energy policies are in the right place, it was found that the growth of population positively contributes directly to green economic growth, the rise in population increases demand for green products and services. Population growth can stimulate demand for renewable energy and sustainable infrastructure that increases green GDP (Abbas et al., 2024; Vo & Vo, 2021). For example, Switzerland's population increased by 0.74% can increased green GDP by 4.42% (Data, 2024).

6. Knowledge from Research

This study examines the factors influencing Green GDP in five of the world’s most sustainable countries—Sweden, Denmark, the United Kingdom, Finland, and Switzerland—using the Cobb-Douglas production function with panel data from 2000 to 2020. The analysis employs a fixed-effect panel regression model.The findings indicate that key determinants of Green GDP include the exchange rate, foreign direct investment (FDI), population, labor force, and unemployment rate. Among these, the exchange rate has the most significant impact, as a stronger currency reduces import costs, facilitating the advancement of green technologies. In highly developed economies such as Denmark, the productivity of green industries increases alongside a well-educated workforce.

Additionally, the expansion of the population and labor force has a positive effect on Green GDP by driving demand for environmentally friendly goods and services. However, while FDI contributes to green economic growth, its positive impact may be offset by

investments that are not environmentally sustainable, thereby slowing the overall progress of Green GDP.

Conversely, unemployment negatively affects Green GDP, as the transition to a green economy requires a substantial workforce. High unemployment rates may hinder the expansion of renewable energy sectors and eco-friendly businesses, limiting economic growth in sustainable industries.

Policy Implications

Based on these findings, governments should promote investment in green industries by reducing taxes for environmentally responsible investors and implementing employment policies that support the green economy, such as income certification and employee welfare programs. These measures can enhance domestic production and consumption of green goods and services while also fostering job creation in labor-intensive green industries. This study underscores that the growth of Green GDP is not solely driven by technological advancements but is also influenced by economic, human capital, and policy factors. A comprehensive approach that integrates investment incentives, labor market policies, and sustainable economic strategies is essential for fostering a more resilient and equitable green economy.

7. Recommendation

1. Practical Recommendations Based on the findings, the following practical recommendations can be made:

1 . 1 Investment Incentives for Green Industries – Governments should implement tax reductions or subsidies for businesses investing in sustainable industries to encourage green economic growth.

1.2 Employment Promotion Policies – Policies such as income certification and employee welfare programs should be strengthened to support the green economy, as green businesses are labor-intensive and require a stable workforce.

1.3 Exchange Rate Stability Measures – Policymakers should consider strategies to stabilize exchange rates, as currency fluctuations significantly impact the cost of importing green technologies and materials.

1 . 4 Encouraging Sustainable Foreign Investment – Regulations and incentives should be introduced to attract FDI that aligns with environmental sustainability goals while discouraging investments that harm the green economy.

1 . 5 Workforce Development and Green Education – Investments in education and workforce training should be prioritized to equip workers with the skills needed in green industries, particularly in countries aiming to enhance green technology innovation.

2. Policy Recommendations To enhance the effectiveness of green economic development, governments should:

2.1 Develop integrated green economic policies that align monetary, fiscal, and labor policies to support sustainable economic growth.

2.2 Establish environmental standards for foreign investments to ensure that FDI contributes positively to Green GDP.

2.3 Promote public-private partnerships (PPPs) to enhance collaboration between governments, businesses, and research institutions in developing green technologies.

2.4 Implement unemployment reduction strategies such as job creation programs in the renewable energy sector to support a smooth transition to a green economy.

3. Recommendations for Future Research While this study provides valuable insights into factors affecting Green GDP, further research is needed in the following areas:

3.1 Inclusion of Additional Variables – Future studies could explore the impact of factors such as government environmental policies, renewable energy consumption, and technological innovation on Green GDP.

3.2 Comparative Studies – A comparison between developed and developing countries could offer deeper insights into the effectiveness of different green economic policies.

3.3 Long-Term Effects of FDI on Green Growth – Further research should analyze how different types of foreign investment impact Green GDP in the long run, differentiating between sustainable and non-sustainable investments.

3.4 Sector-Specific Analysis – Examining the role of specific industries, such as renewable energy, transportation, and manufacturing, in contributing to Green GDP would provide more detailed policy recommendations.

3.5 Impact of Global Economic Shocks – Investigating how global crises (e.g., financial downturns, pandemics) affect Green GDP and green investment trends could offer insights into resilience strategies.

8. References

Ahmad, W., Ullah, S., Ozturk, I., & Majeed, M. T. (2020). Does inflation instability affect environmental pollution? Fresh evidence from Asian economies. *Energy & Environment,* 32(7), 1275-1291.

Christoforidis, T., & Katrakilidis, C. (2021). Does Foreign Direct Investment Matter for Journal Environmental Degradation? Empirical Evidence from Central–Eastern European Countries. *Journal of the Knowledge*, 13(4), 2665-2694.

Guler, I., Atan, M., & Adali, Z. (2024). The effect of economic growth, investment, and unemployment on renewable energy transition: evidence from OECD countries. *Environ Sci Pollut Res Int*, 31(39), 52001-52016.

Jiang, Y., Sharif, A., Anwar, A., The Cong, P., Lelchumanan, B., Thi Yen, V., & Thi Thuy Vinh, N. (2023). Does green growth in E-7 countries depend on economic policy uncertainty, institutional quality, and renewable energy? Evidence from quantile-based regression. *Geoscience Frontiers*, 14(6), 1-10.

Kamesh, T. M. (2023). Green GDP and Economic Openness in India. *International Journal of Environment and Climate Change,* 13(3), 216-223.

Krausmann, F., Gingrich, S., Eisenmenger, N., Erb, K.-H., Haberl, H., & Fischer-Kowalski, M. (2009). Growth in global materials use, GDP and population during the 20th century. *Ecological Economics,* 68(10), 2696-2705.

Lawn, P. A. (2003). A theoretical foundation to support the Index of Sustainable Economic Welfare (ISEW), Genuine Progress Indicator (GPI), and other related indexes. *Ecological Economics*, 44(1), 105-118.

Li, G., & Fang, C. (2014). Global mapping and estimation of ecosystem services values and gross domestic product: A spatially explicit integration of national 'green GDP' accounting. *Ecological Indicators*, 46, 293-314.

Mebratu, D. (1998). Sustainability and sustainable development: historical and conceptual review. *Environmental impact assessment review*, 18(6), 493-520.

Naseer, S., Song, H., Chupradit, S., Maqbool, A., Hashim, N., & Vu, H. M. (2022). Does educated labor force is managing the green economy in BRCS? Fresh evidence from NARDL-PMG approach. *Environ Sci Pollut Res Int, 29*(14), 20296-20304.

Phung, T. Q., Rasoulinezhad, E., & Luong Thi Thu, H. (2022). How are FDI and green recovery related in Southeast Asian economies?. *Economic Change and Restructuring,* 56(6), 3735-3755.

Saidi, K., & Hammami, S. (2015). The impact of energy consumption and CO2 emissions on economic growth: Fresh evidence from dynamic simultaneous-equations models. *Sustainable Cities and Society,* 14, 178-186.

Smaili, S. M., & Gam, I. (2023). Dynamic effect of exchange rate depreciation on carbon emission in the Mediterranean basin: fresh insights from linear and non-linear ARDL approaches. *Environmental Science and Pollution Research, 30*(21), 59481-59498.

Sonthi, C., Harnphatananusorn, S., & Santipolvut, S. (2019). Concepts and empirical calculation of the green GDP for Thailand. *International Journal of Green Economics,* 13(1), 68-85.

Stjepanović, S., Tomić, D., & Škare, M. (2017). A new approach to measuring green GDP: a cross-country analysis. *Entrepreneurship and sustainability issues*, 4, 574-590.

Stjepanović, S., Tomić, D., & Škare, M. (2019). Green GDP: an analysis for developing and developed countries. *E+M Ekonomie a Management*, 22(4), 4-17.

Tan, F., & Sun, C. (2024). How does factor market distortion affect green innovation? Evidence from China's sustainable development demonstration belt. *International Studies of Economics,* 19(3), 353-373.

คณะเศรษฐศาสตร์ มหาวิทยาลัยแม่โจ้
63 หมู่ 4 ตำบลหนองหาร อำเภอสันทราย
จังหวัดเชียงใหม่ 50290

Faculty of Economics Maejo University
63 Nong Han Subdistrict, San Sai District,
Chiang Mai Province, 50290

โทรศัพท์ 05-387-5265 โทรสาร 05-387-5266
E-mail: maejojournal.sd@gmail.com