Impact of COVID-19 outbreak on export values of industrial products from Thailand to China

Mr. Burapas Yotwilai

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

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By	Mr. Burapas Yotwilai
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INDEPENDENT STUDY COMMITTEE

.... Chairman
(Assistant Professor SAN SAMPATTAVANIJA, Ph.D.)

.... Advisor
(Lecturer DOUNGDAO MAHAKITSIRI, Ph.D.)

.... Examiner
(Assistant Professor NIPIT WONGPUNYA, Ph.D.)

บุรพรรษ ยศวิลัย : ผลกระทบการระบาดของโควิด 19 ต่อมูลค่าการส่งออกสินค้า
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การศึกษาผลกระทบของการระบาดของโรคติดเชื้อโควิด-19 ต่อการมูลค่าการส่งออก
ของสินค้าอุตสาหกรรมจากประเทศไทยไปยังสาธารรัฐจีนอย่างไรและปัจจัยอื่น ๆ ที่มีผลกระทบ
ต่อมูลค่าการส่งออก โดยใช้ข้อมูลรายเดือนในช่วงปี 2560 ถึง 2564 หลังจากนั้นใช้
Multiple regression ในการวิเคราะห์เพื่อหาปัจจัยที่ส่งผลกระทบต่อมูลค่าการส่งออก
โดยเฉพาะอย่างยิ่งสินค้าอุตสาหกรรม และงานศึกษานี้ยังแสดงให้เห็นถึงผลกระทบของการ
ระบาดของโรคติดเชื้อโควิด-19 ในระดับเศรษฐศาสตร์มหภาค ต่อมูลค่าการส่งออกของสินค้า
ส่งออกในแต่ละอุตสาหกรรม แต่หลังจากที่ทำการวิเคราะห์พบว่า การระบาดของโรคติดเชื้อโค
วิด-19 ไม่มีกระทบเชิงลบกับมูลค่าการส่งออกของสินค้าอุตสาหกรรม และผลการศึกษายัง
พบว่า อัตราแลกเปลี่ยนแท้จริงของประเทศไทยมีผลกระทบในทิศทางตรงกันข้ามกับมูลค่าการ
ส่งออกของสินค้าเกษตรกรรม และอัตราดอกเบี้ยนโยบายของไทยมีผลกระทบในทิศทางตรงกัน
ข้ามกับมูลค่าการส่งออกของสินค้าอุตสาหกรรมและสินค้าอุตหกรรมการเกษตร

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สาขาวิชา	เศรษฐศาสตร์ธุรกิจและการจัดการ	ลายมือชื่อนิสิต ....
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The study of impact of COVID-19 outbreak on export values of industrial product from Thailand to China focused on illustrating how large the effect is and investigating the influencing factors. The monthly data during 2017 to 2021 were used in the multiple regression model to analyze factors affecting Thailand export values to China especially industrial product. This study also indicated the impact of COVID-19 pandemic on other main exported products. The findings of this study showed that the COVID-19 pandemic had no statistically significant impact on export vales for all sectors. However, the result of this study also found real broad effective exchange rate has a negative impact on export values of agricultural product and Thailand's interest rate policy has a negative impact on export values of industrial product and Argo-industrial product.

Field of Study:	Business and Managerial Economics	Student's Signature ....
Academic Year:	2021	Advisor's Signature ....

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CHAPTER 1

INTRODUCTION

Background Information

China is currently one of the world's major economic markets, as it is the most populated country and has a wide range of products as well as more opportunities to expand globally, implying that the Chinese market can attract foreign investors and international corporations as David Goodman found in 2017 that China's rapid economic growth increased prosperity, and dominance of regional production networks posed challenges for the other economies. It had become a large economic partner, a considerable investor, and an increasing important regional and international political player for all the countries of the region (Kevin Hewison, 2018). On the other hand, responses to China's rise had viewed as both an opportunity and a threat. (David Goodman, 2017)

Thailand had been trading with China for many decades years ago by exporting and importing goods and services with each other but there were a lot of trade barriers and obstructions which affected the international trade such as tariff on imported and exported goods and quota for imported and exported goods to support domestic producers as well as increase their abilities to compete with imported goods. Until 2003, the China-Thailand free trade agreement which had a wide range of implications for China, including increased trade, increased gross domestic products and welfares, and strategic interests (Yanying Zhang, Gaiyan Zhang &Hung-Gay Fung, 2014) was signed and took an effect immediately. According to the agreement, trade barriers were eliminated and reduced to zero in many products causing there are huge number of goods sold and bought across international border. As a results, Thai goods and products have been exported to Chinese market which is open competitive and worldwide markets while lots of Chinese products also have been imported meaning that an increase in variety of products in Thailand and motivate domestic producers to improve their product quantities to compete with imported goods and keep market shares.

Figure 1: Export values from Thailand to China
Source: Developed by author based on data available from the Ministry of Thai commerce

This chart in figure 1 shows export values from Thailand to China from 1998 to 2021. Before 2003 that FTA had not been signed, trade values had been steady at very low volumes around 2,000 million dollars. Yet, two years after FTA was effective in 2003, there was a triple increase in trade volumes. It has been slightly increasing for years. Until 2021, exported values from Thailand to China are approximately 37,000 million dollars and about 20 times compared to in 1998. Like Baier, S. L., & Bergstrand, J. H. (2009) who found that the overall long-run average treatment effect of an FTA on trade between a pair of member countries is to roughly double their trade as well as that the average effect of an FTA tended to occur over 10–15 years, to account for lagged effects of FTAs on their terms of trade. This figure also demonstrates that Chinese markets are the main export market for Thailand.

Nowadays, one of the most important sectors of Thai's exports is the electronic components which employs nearly 400,000 people and includes 573 firms. The value of goods exported in 2018 was almost 50% of GDP, with the electronic components industry contributing for around 16% of total export value (Longtunman, 2020) shows that Thailand could produce electronic goods. This is due to government policies that support domestic producers and the efficient production processes. It also demonstrates that Thailand's electronic components sector is a significant hub in the world.
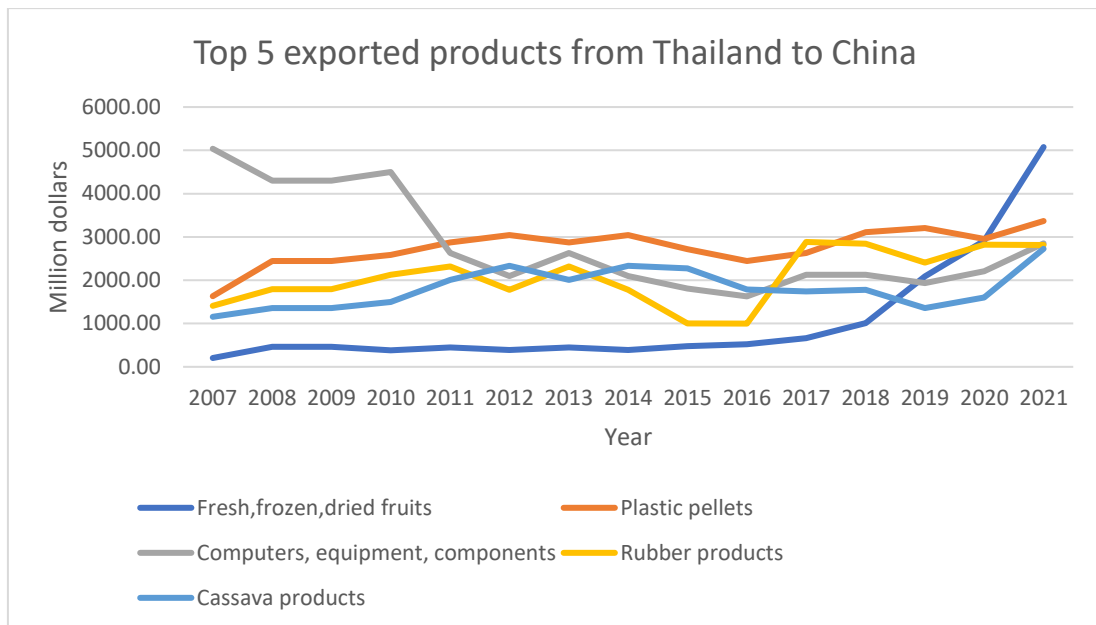
Figure 2: Top 5 exported products from Thailand to China categorized by total values
Source: Developed by author based on data available from the Ministry of Thai commerce

Figure 2 indicates top 5 exported products in term of export values from Thailand to China from 2007 to 2021, At the beginning of this chart, the export values of computers, equipment and components to China was ranked 1 in 2007 which was approximately 5,000 million dollars and more than rank.3 about 4 times. Meanwhile, the export values of Plastic pellets, Computers, Rubber products and Cassava products are approximately 1,600, 1,400 and 1,100 million dollars respectively. When the times passed, the export values of computers, equipment and components had dramatically dropped in 2010 and were steadily increasing until 2021. For fresh fruits, it had been exported about 203 million dollars at starting point and were steadily increasing until it was dramatically risen in 2018. After that, it was up to rank.1 in the end of this chart while for plastic pellets and computers were ranked 2 and 3 respectively.
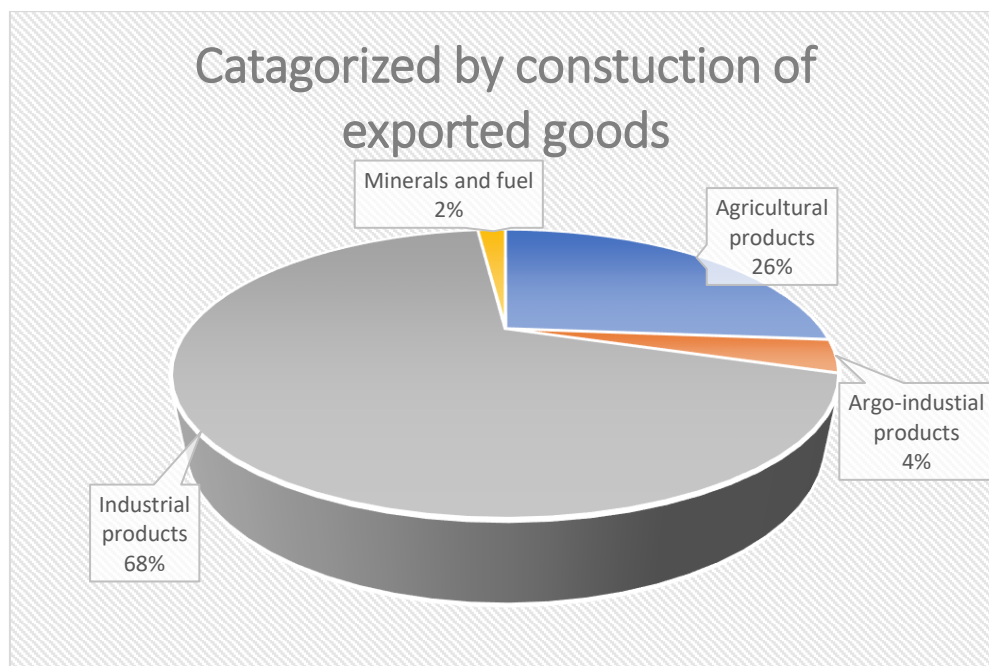
Figure 3: Proportion of exported values categorized by product construction as of December 2021
Source: Developed by author based on data available from the Ministry of Thai commerce

However, the export values are classified by a variety of criteria, such as categorized by total amount of export values (as shown in figure 2) and by the construction of exported goods (as shown in figure 3). There are 3 products from top 5 most export value that are categorized by product construction as industrial products. Computers, equipment, and components are included in industrial products as electric devices. In the meantime, plastic pellets and rubbery products are one of category of product construction in industrial products. This graph shows that industrial products account for 68% of Thailand's exports to global markets, implying that the industry sector is very important for Thailand as Longtunman noted in 2020. The remaining exported goods are agricultural products, agro-industrial products, minerals, and fuel, accounting for 26, 4, and 2 percent of total export values, respectively.
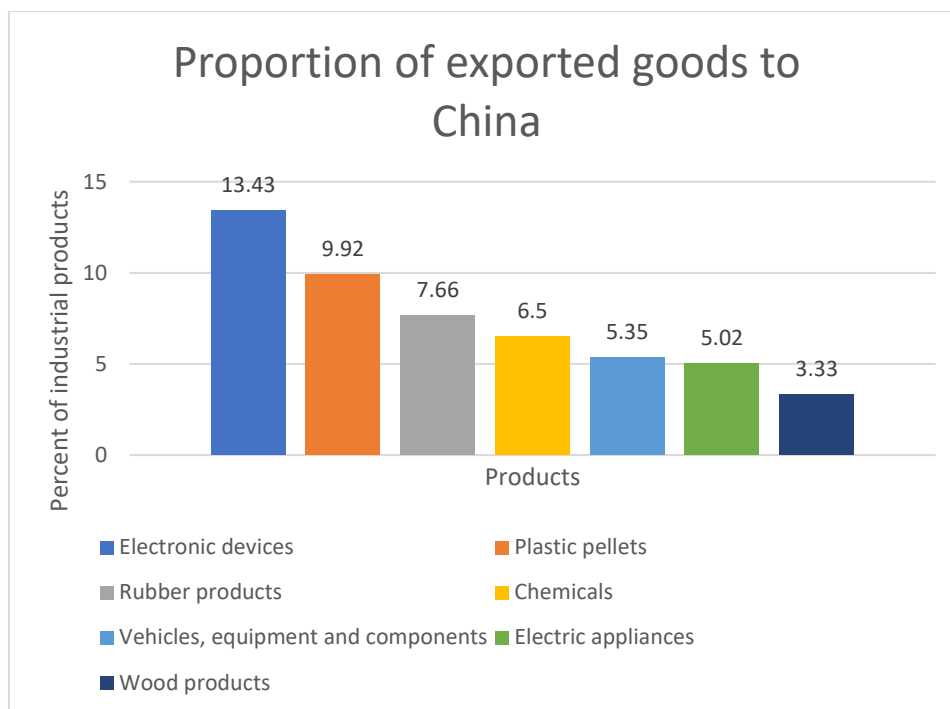
Figure 4: Proportion of exported industrial products to China as of the fourth quarter of 2021
Source: Developed by author based on data available from the Ministry of Thai commerce

For figure 4 shows proportion of exported industrial products, industrial products are divided into 48 types of exported goods while this chart shows only main exported products to China. It can be concluded that the highest proportion of the industrial products from Thailand to China is electronic devices accounting for approximately 13 percent. For the examples of those products are hard disks, components of computers, printed circuit boards (PCB), electric motors etc. Meanwhile, proportion of plastic pellets and of rubber products are around 9.9 percent and 7.6 percent of export values of industrial products. As well as proportion of rubber products and chemicals are at about 7.6 and 6.5 percent consequently. For proportion of vehicles and electric appliance are close at around 5 percent. The least compared to the other exported products is wood products, which is approximately 3.5 percent as of the fourth quarter of 2021.

According to the World Health Organization (WHO), on December 31, 2019, there was a case of a cluster of pneumonia with a new etiology in Wuhan City, Hubei Province, China, which later spread beyond China. Moreover, COVID-19 was declared a pandemic on March 11, 2020. (Susilawati, Reinpal Falefi &Agus Purwoko, 2020). Thailand had a first positive case reported on 13 January 2020 as well as it continued to increase overtime. Until 14 January 2022 based on information from Department of disease control of Thailand, there are 2,308,615 of total confirmed cases, 510 serious cases, 21,898 died from COVID-19 implying that Thailand are also facing with this pandemic. Although COVID-19 vaccination has been developed by many virologists,

this virus has been evolving and improving its immunity in order to spread leading to economic crisis which would create "new normal" for local government finances, employment and services as the same results in great recession in 2018 that followed have significantly and negatively affected local governments (e.g., Barkin 2010; Brooks 2011; Hoene and Pagano 2011; Levine and Scorsone 2011; Nicolosi 2010; Perlman 2010; Walker 2009). Not only Thailand but also country in all regions around the world are experiencing not merely another turn of the business cycle, but a restructuring of the economic order (Ian Davis, 2009). Moreover, it also creates disruption, uncertainty, complexity, and ambiguity in all organizations (Azizi, M. R., Atlasi, R., Ziapour, A., Abbas, J., & Naemi, R., 2021). That is a difficult time for businesses that need to choose and change their strategies properly to deal with crisis situations.
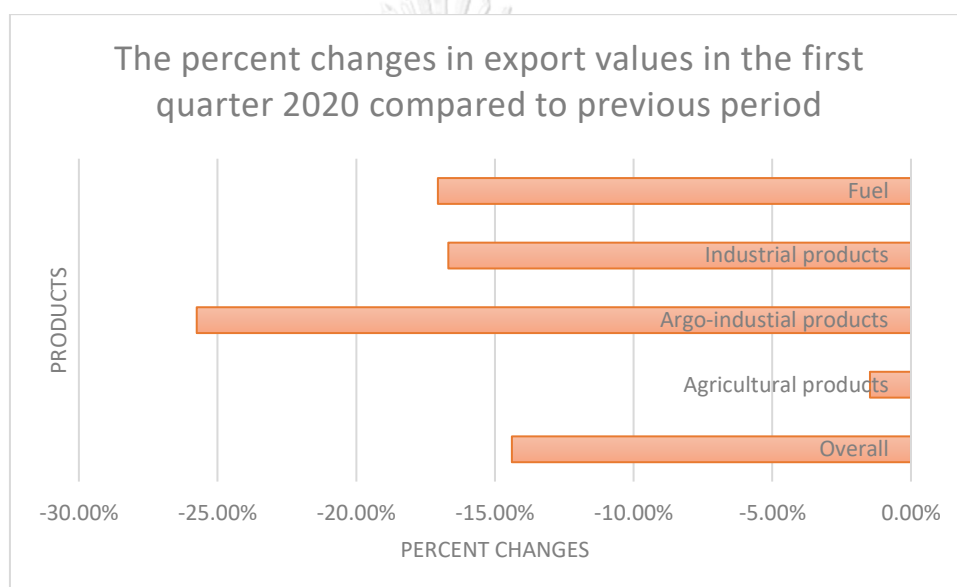
Figure 5: The percent changes in export values in the first quarter 2020 compared to the fourth quarter of 2019
Source: Developed by author based on data available from the Ministry of Thai commerce

For figure 5, it shows that the effects of COVID-19 pandemic in term of the percent changes in the export values in the first quarter 2020 compared to previous period in each product. The chart also demonstrates that the exports of agro-industrial products got the negative large effects from the outbreak with about 25 percent decrease from previous period while the export values of fuel and industrial products dropped by approximately 17 percent, but agricultural trade will be less affected because of its relatively low-income elasticities of demand while the trade of other sectors can be expected to dramatically drop during the deep recession (Richard Barichello,2020). However, there is a negative change in overall trade by approximately 15 percent compared to before pandemic.

This study will focus on export values of industrial products which are a core of total values due to the fact that exported industrial products are accounted for 65 percent of total export values from Thailand to China. In the meantime, impacts of COVID-19 pandemic seem to affect continuedly in many years during vaccination development (Chonlatan, 2021). Then, there are 3 objectives. Firstly, main purpose of this study is to evaluate impact of COVID-19 pandemic on export values of industrial products including understanding current recession. Secondly, the objective of this study is attempted to investigate influencing factors. Thirdly, to evaluate impact of COVID-19 outbreak on each main industrial products, which are selected in this paper. Finally, the scope of this research study about the influencing factors on export values of industrial products is found by investigating macro-economic factors and international economic factors. For samples of this study, gross domestic product in Thailand and China that is likely to affect on export values of these products.

The research questions for this study are COVID-19 pandemic has a negative impact on export values of industrial products and this sector has a least negative impact from the outbreak

There are six chapters in this study. Firstly, chapter 1 is an introduction as previously shown. Secondly, chapter 2 is a literature review of this paper. Thirdly, macroeconomics of Thai's export. Next chapter 4 and 5 is data and hypotheses, research results consequently. Last but not least, chapter 6 is conclusion and recommendation.

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CHAPTER 2

LITURATURE REVIEW

Research related to influencing factors on export values of electronic goods.

(Pisut, 2011) The factors that affect on the export values of computers, equipment, and components. Research objectives are to study the important information that relates to explanations of export values of computers, equipment, and components and to research influencing factors on export values of computers, equipment, and components. Researcher used multiple linear regression approach to evaluate the impacts of each factor. In this study, the secondary data was used as time series collected by Bank of Thailand and Ministry of Commerce from the first quarter in 2004 to the second quarter in 2010. Each category would have 26 samples. The results of this study were divided into 3 parts which are One-way ANOVA, R-Square and t-test found. This study found that dependent variables which are consumer index, quality of loans for machinery business, minimum loan rate and real effective exchange rate are statistically significant with export values of computers, equipment, and components. Meanwhile, consumer index and minimum loan rate have a positive impact, but real effective exchange rate has a negative effect at significant level of 0.05.

(Natthaponlawat, 2004) The influencing factors on the exports of computers, equipment, and components from Thailand to Japan. Research objective is to study demand for Thai's computers, equipment, and components in Japanese market. This study was be divided into researching influencing factors that related to the demand for these Thai's products and overview of industry. The multiple regression approach was applied for analyzing influencing factors by using time-series data collected from 1993 to 2002 to find the export function. The results indicated that the factor that was statistically significant and had a negative relationship with demand for these products was price per unit. Meanwhile, overview analysis found that the exports of computers, equipment, and components are important for Thai's economy due to being a top 5 of most export values. Moreover, it had an advantage in terms of wages including high technology compared to competitors in regional area as well as have supports from policymakers.

(Nilavan Niyom, 2018) The impact of the ASEAN trade agreement on the export of silver jewelry from Thailand to ASEAN. Research objectives is to evaluate the impact of the ASEAN trade in GOODs Agreement (ATIGA) on the Thai's export of silver jewelry to the members of ASEAN. The data in this study was the primary data collecting from 5 silver jewelry exporters and government representatives by doing survey as well as the secondary data from doing tariff and non-tariff research which affects on the silver jewelry exports to the members of ASEAN and imports of raw materials to produce silver jewelry from the members of ASEAN. According to the results of this study, exports of Thai silver jewelry to such major markets outside ASEAN such as the United States has decreased while exports to Germany have remained stable. Exports of Thai silver jewelry to ASEAN have surged with the

implementation of the ATIGA trade measures. Singapore and Malaysia are the top nations that import Thai silver jewelry as gems and jewelry trading hubs both serving as gems and jewelry trading hubs. Singapore's trade policies are rather free, and even before ATIGA, the country offered zero percentage of import taxes on silver jewelry imports. Another interesting ASEAN country are Indonesia, Vietnam and Philippines that have tendency to import silver jewelry from Thailand. Regarding importing raw materials for production.

(Sudarat, 2022) The industrial systems product influencing the value of Thailand's border trade. Research objectives are to investigate, examine and inspect the influence of industrial systems product value in Thailand's total border trade value. The multiple regression analysis was applied by using secondary data collected from 2011 to 2018. The study found that the export value of computer, equipment and components and the import value of industrial machinery and components affected on the total value of Thailand's border trade and the export values of Thailand's border trade were affected by the export value of computer, equipment, and components. Moreover, the import value of industrial machinery and components had an impact on the import value of Thailand's border trade. This study also demonstrated how those products in the industry influenced Thailand's border trade values as Thailand has the capacity to meet the needs of neighboring markets.

Research related to other methodologies to analyze effects on export values.

(Jenrob, 2013) has studied export of computer part and accessories from Thailand to the people republic of China. Research objectives are to study Revealed Comparative Advantage (RCA) for Thailand's computers, computer part and accessories exports compared to its major competitors and to study important factors that affect the exports of computers, computer part and accessories which are floppy disk drives (Harmonized System Code: 84717010) and hard disk drivers (Harmonized System Code: 84717020) by applying constant market share model. For this study, the secondary data collected by relevant government departments were used as time series data in model between 1996 to 2011. The results of study were explained in term of both descriptive and quantitative analysis as well as were divided into 2 cases. Case 1: the export value of computers, computer part and accessories from Thailand to China during consideration period increased by a small margin and comparative advantage of Thailand for these products tended to decrease compared to another 2 competitors which were Philippines and Malaysia, but Thailand still had comparative advantage in hard disk drivers and floppy disk drivers because RCA was still more than one. Meanwhile, case 2: Under Constant Market Share theory, although an increased capacity in the Thailand's exports for these products compared to Philippines and Malaysia, market share of Thailand was remaining the same while of 2 competitors tended to increase annually.

(Changzhou Liang, 2021) has studied analysis on the influencing factors of China's export by applying multiple regression approach. Research objectives are to find out the factors that influence China's export and causes of China achievement in economic development and to find the parts of China's export that should be improved. In this

study, time-series data from 1990 to 2019 are used to construct in a multiple linear regression approach. VIF test is used to rule out factors that could cause multicollinearity problems. The results of this paper also indicate that the exchange rate and GDP have a significant impact on China's export volume.

Research related to impacts of COVID-19 pandemic on exports

(LIN, B. X., & Zhang, Y. Y., 2020) has studied impact of the COVID-19 pandemic on agricultural export. The objective of this study is to evaluate effects of COVID-19 outbreak to provide useful guidance and implications for agricultural businesses and policy makers on their COVID-19 mitigation efforts to navigate this global pandemic. Data for analysis in this study contains data from 102 agricultural companies that export a total of 12 product categories collected since 3 March 2020 to 20 April 2020 by doing the survey. The findings of this study revealed that, while agricultural businesses' overall exports declined, exports of some agricultural products, particularly grain and oil, remained strong and even increased, implying the important demand for staple food during the pandemic. Unsurprisingly, medicinal herb exports increased significantly during the disease outbreak. On the other hand, exports of edible fungus and horticultural products dramatically dropped.

Research related to impacts of COVID-19 pandemic on industrial sectors

(Purwanto, A., Fahlevi, M., Zuniawan, A., Kusuma, R. P., Supriatna, H., & Maryani, E., 2020) has researched the COVID-19 pandemic impact on industries performance: an explorative study of Indonesian companies. The objective of this study was to identify information about the positive and negative impacts of COVID-19 pandemic to company performance in Indonesia. The data for this paper were collected from the case study method of exploration and research approaches using qualitative case study method to obtain information advantages and disadvantages impacts of COVID-19 pandemic on company performance. There are 7 participants, who are the company top management in this survey. They all were asked that "Explain the advantages impacts of Covid-19 pandemic to your company performance?" and "Explain the disadvantages impacts of Covid-19 pandemic to your company performance?". The findings of this study found that the Covid-19 Pandemic has had some effects such as reducing raw material imports, decreased sales, lowering production capacity, demand in the market has decreased and sales turnover has also decreased, difficulty in sending and distributing goods, working hours are divided into 2 shifts, some of employees are on vacation and only earn 70% of their salaries, having difficulty distributing goods, and some employees have only earned 80% of their salaries.

CHAPTER 3

MACROECONOMIC AND THAILAND EXPORT

3.1 Thailand economy

In the opening country, the export and import goods and services with other countries are available meaning that international trades are occurred. Particularly, in those countries, which signed the free-trade agreement with each other to reduce import tariffs. Thailand has signed a lots of free trade agreements with many counties to be beneficial for domestic producers and consumers. Thai's exports mainly provide and produces lots of industrial goods to export to the global market. Thai's export values are categorized by product construction into 4 categories, which is an agricultural products, Argo-industrial products, industrial products, and fuel.

3.1.1 Agricultural products

Agriculture has played an important role in Thailand from time immemorial (Jasper Goss & David Burch, 2010) due to appropriate location and climatic circumstances for agriculture. It is unsurprising that Thailand is able to export agricultural products to the world market, especially Chinese market. For examples, cassava and fresh fruits are the main exported products to Chinese market in this sector (Agricultural Research and Development Agency, 2019). Although the proportion of agricultural production was not at high level, it still has been increasing in a growth rate for years. As of December 2021, total export value of agricultural product accounted for approximately 29 percent of total export value (as shown in figure 3), which is around 10,800 million US dollars. Moreover, it has played an important role in a local economy due to being the main workplace and generate lots of career opportunities in that area, especially for the people who live in rural areas (National Statistical Office of Thailand, 2015). The Agricultural sectors generated the most of career opportunities for Thai people by accounting for 32.3 percent of total labors, which were categorized by industry. When the globalization of COVID-19 outbreak occurred, it has negatively affected international trade and supply chain leading to an economic slowdown. It also affected on Chinese import demand especially a significant rise in essential commodities imports. (Bloomberg, 2020b)
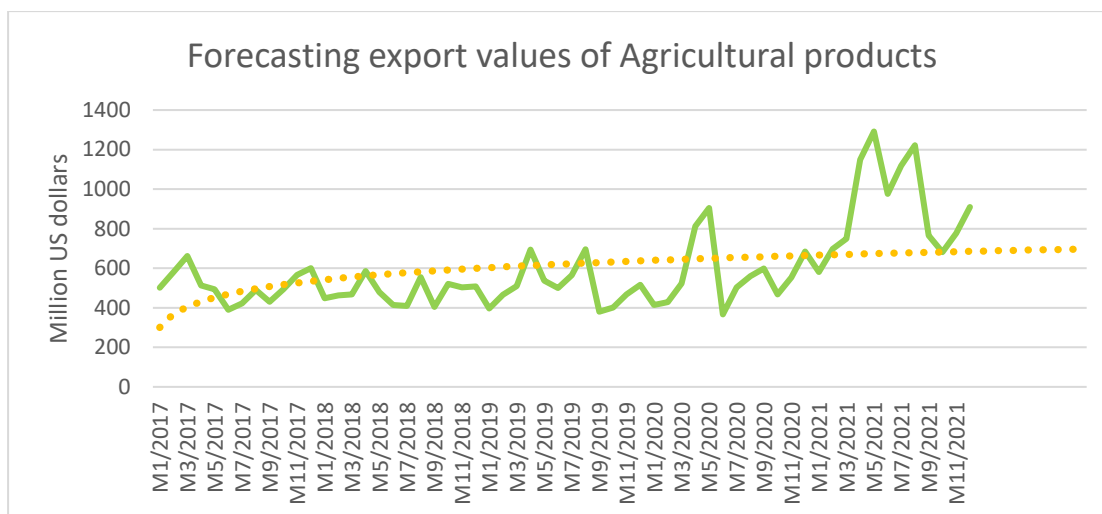
Figure 6: The actual export values of agricultural products from 2017 to 2021 by monthly and forecasting values from the past to next 8 periods
Source: Developed by author based on data available from the Ministry of Thai commerce

According to the line chart in figure 6, it indicates export values of agricultural products since 2017 to 2021 quarterly. For the green line, during the COVID-19 outbreak that occurred in December 2021, exports values for these products slightly dropped in the first month of 2022 and steadily increasing. Until the third month of 2021, there was a dramatic increase in export values of agricultural products that rosed to approximately 1,300 million US dollars and had a fluctuation afterward. Chantanon, a secretary of Office of Agricultural Economics, said in 2021 that the reason that why there was a large increase in these products is consumers and producers in both countries are getting used to the outbreak leading to an increase in new opportunities. It's also a positive signal for the export market including expanding policies from the government that are able to assist reach new target group though online and offline platform. In the meantime, orange dash line represents an 8-period forecast of export values for this sector. It seems to be a flat line, but it still has a slight increase in next 8 period, which means that although there was an enormous drop in the end of 2021, the slope of forecasting trend keeps increasing.

3.1.2 Argo-industrial products

Argo-industrial products relate to farmers and farming manufacturers and these products are made up of or processed from farmers' goods such as instant noodles, processed food, or canned food. According to the figure 3 mentioned in chapter 1, Argo-industrial products accounted for around 3 percent of total export value meaning that these products are not the main exported goods to Chinese market. Due to agricultural products which are used as raw material to produce Argo-industrial products are exported to the Chinese market as the second rank of the proportion of total export values. It has a possibility that China imports those products to be used as raw materials to produce Argo-industrial products and sell its by themselves implying that Chinese people will get the lower price than importing from Thailand as well as they have to import in only the rest of demand, which do not provide. When it is facing globalization of COVID-19 pandemic, it will have less effects on total of export values due to only

account for 3 percent. However, it does mean that the COVID-19 pandemic will have less negative impact on these products.

Figure 7: The actual export values of Argo-industrial products from 2017 to 2021 by monthly and forecasting values from the past to next 8 periods
Source: Developed by author based on data available from the Ministry of Thai commerce

Line chart in figure 7 shows the total export values of Argo-industrial products since 2017 to 2021 by quarter. Blue line represents actual values observed in the past while dash orange line represents a forecast value both the past and present including next 8 periods. In blue line in this figure, the outbreak seems to have a huge negative effect on the overall export values of this sector, which consists of 17 categories. It had around 20 million US dollars dropped at the end of 2019. This figure also shows the export values of these products has been increasing for years from only 40 million US dollars in 2017 to approximately 115 million US dollars in 2021. Meanwhile, even though there were a dramatic decrease at the beginning of 2021, the slope of forecasting line is exponentially positive meaning that it is a good signal for export values of these products. The export values are able to increase in next 8 period.

3.1.3 Industrial products

Thailand has been mainly producing industrial products to export to the world market for many years, especially, to China and United States. That lead to the majority of export values to Chinese market is industrial products as shown in figure 4. Due to the pandemic's effect, Chinese factories are affected by human lockdowns and quarantines at home and slowdown in production sites in other countries mainly due to shortage of inputs from China, for example, raw materials, machineries, and equipment (Fernandes, 2020). Meanwhile, A decrease in demand for imported non-essential goods is significantly greater than for essential goods (Suborna Barua, 2020)
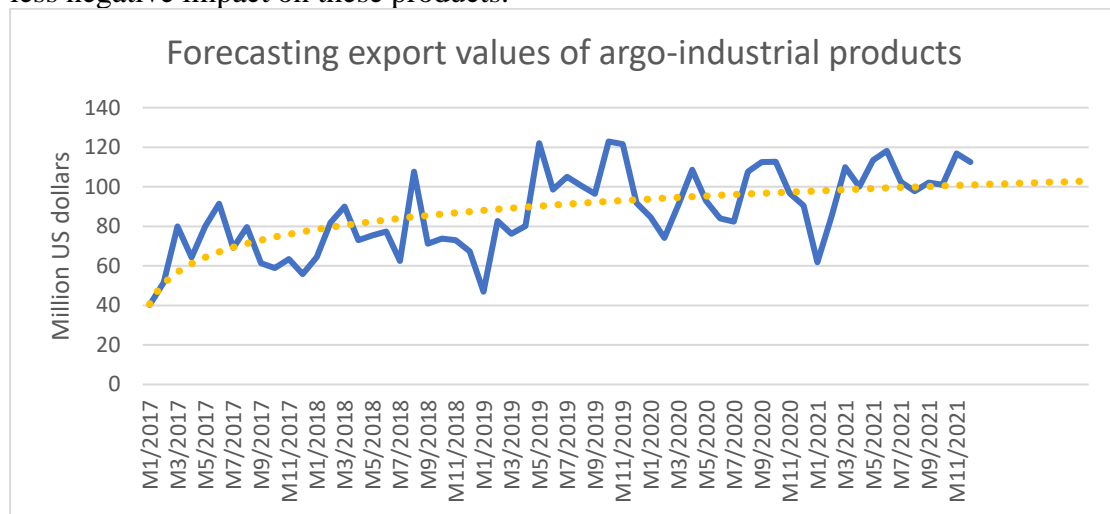
Figure 8: The actual export values of industrial products from 2017 to 2021 by monthly and forecasting values from the past to next 8 periods
Source: Developed by author based on data available from the Ministry of Thai commerce

As these line charts shown in figure8, a blue line shows actual data collected since 2017 to 2021 while a dash orange line is a forecasting line from 2017 to present including next 8 periods, which are a predicted value. According to the blue line, during the outbreak of COVID-19 in the end of 2019, export values of industrial products slightly dropped from 2,000 to 1,500 million US dollar. Yet, overall export values of this sector had been recovering and steadily increasing afterward. Until the end of 2021, it values around 2,200 million US dollars. It can be implied that the pandemic's effect occurred in just short-run period. Meanwhile, an orange dash line has a positive slope meaning that export values' industrial products tend to increase in next 8 periods. However, predicted values are likely to have less accuracy due to the large gap between actual values and predicted values in the past.

3.1.4 Mineral products and fuel

According to the figure 4 as shown in chapter 1, it shows that export values of mineral products and fuel account for only 3 percent of total, similarly Argo-industrial products implying that this category is not an essential exported goods. Therefore, even it gets a large outbreak's impacts, it will quite result in total export values.
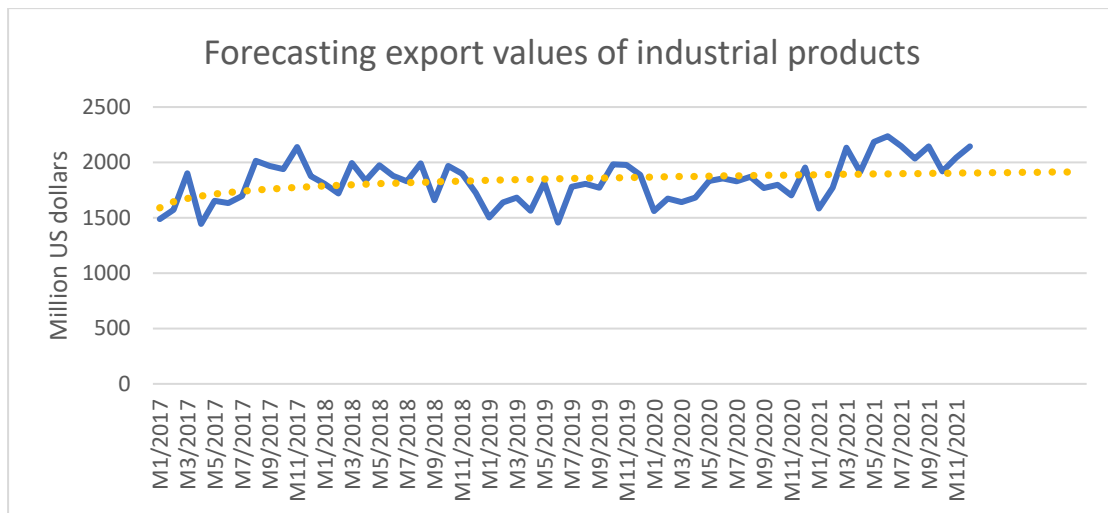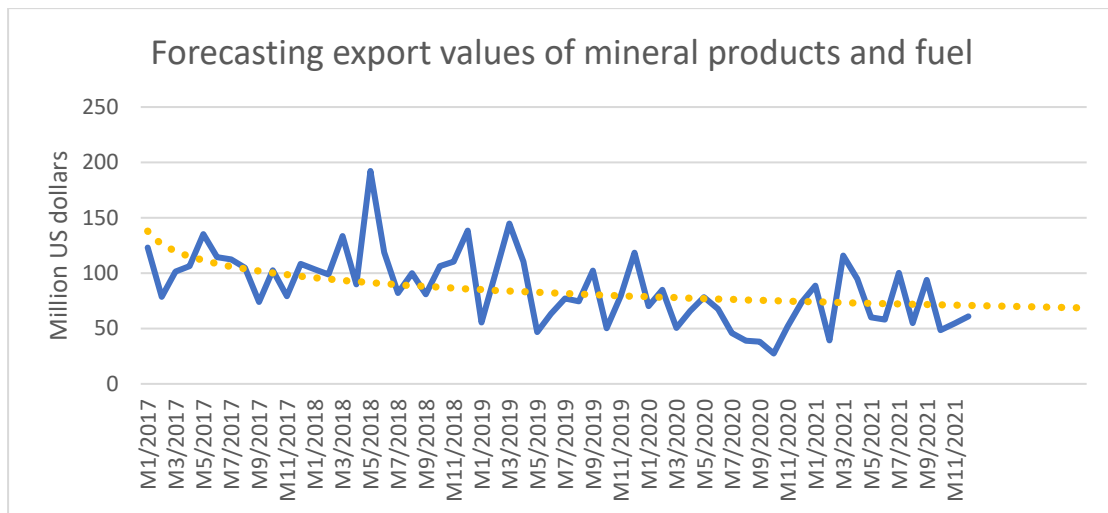
*Figure 9: The actual export values of mineral products and fuel from 2017 to 2021
by monthly and forecasting values from the past to next 8 periods*
*Source: Developed by author based on data available from the Ministry of Thai
commerce*

As shown in figure 9, there are 2-line charts, which are blue and orange. Blue line represents actual data of export values' these products. The export values were not steady and seemed like in down trend due to the fluctuation in brent crude oil's price. However, the COVID-19 pandemic seems to have a quite negative impact in overall export values of these products. In the meantime, a dash orange line indicates that a trend in the past toward forecasting values in next 8 periods. It shows that the export values of these categories are likely to be a downward trend meaning that the total values of these products will decrease in next 8 period based on the observed data.

CHAPTER 4

DATA AND HYPOTHESIS

4.1 Data source

For this study, researcher used the secondary data which are the quarterly observation and have been already collected by Bank of Thailand (BOT), Federal Reserve Economics Data (FRED), World Heath Organization (WHO), and the Ministry of Thai commerce (MOC). All existing data during January 2017 to December 2021 are observed in Thailand as well as available on BOT, FRED and MOC website.

The analysis of exported products categorized by product construction are separated into 4 main parts: analysis of industrial products, agricultural products, Argo-industrial products, and mineral products regarding the factor influencing export value in each category. The main methods of this study are the multiple regression analysis and the distribution comparison between the export value in each sector to examine impacts of COVID-19 pandemic on export goods, especially industrial products.

4.2 Economic analysis

4.2.1 The AD-AS model

The aggregate demand and aggregate supply (AD-AS) model is a macroeconomics model, which indicates a relationship between price level and national income and provide overall view of economy to analyze multiple economic factors. It is applied for this study to analysis the effect of COVID-19 outbreaks on economy in term of macroeconomic aspect.

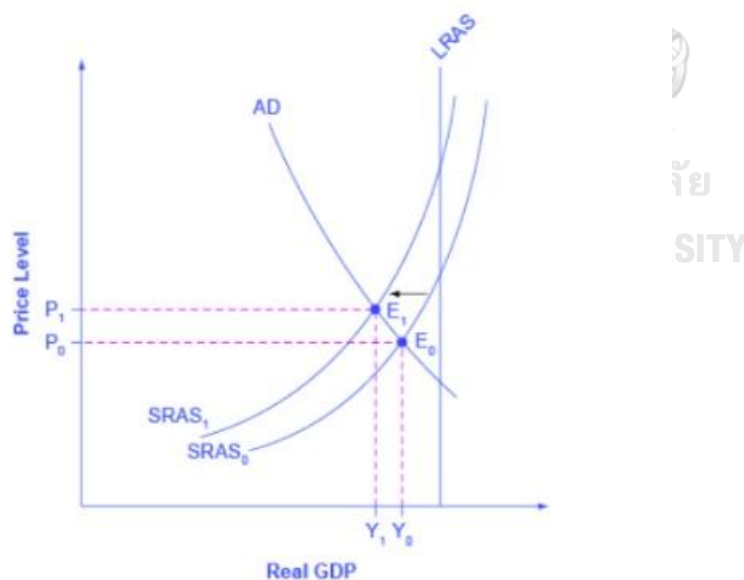*Figure 10: Lower productivity due to the outbreak of COVID-19 shifts SRAS to the left*
Source: *OpenStaxCollege, CC BY 4.0*

According to figure 10, when COVID-19 outbreak occurred in the end of 2019, it globally caused a negative impact to economic system by lowering productivity of firms. This situation leads to a left shift in aggregate supply from $SRAS_0$ to $SRAS_1$. Those causes price level increases to P_1 and real GDP decreases to Y_1. It can be called this situation as "Stagflation"

4.2.2 Materials and the explanation of economic variables

The whole variables in this paper are considered based on the theoretical economic knowledge and from literature to analyze the impacts of COVID-19 outbreak on Thailand's export values. Particularly industrial products such as electric devices, electric appliance, or plastic pellets. The value of exports is represented as a dependent variable while quantity of those products, exchange rate and consumer price index are taken as an independent variable. Moreover, researcher also includes dummy variables to represent COVID-19 pandemic.

Exchange rate: the value of a country's currency in relation to the currency of another country. When countries use gold or another agreed-upon standard, the exchange rate is "fixed," and each currency is worth a specified amount of the metal or other standard. An exchange rate is "floating" when supply and demand or speculation sets exchange rates called conversion units (Britannica,2010).

Consumer Price Index: The Consumer Price Index (CPI) is an economic indicator that measures the average change in prices of typical consumer expenses that urban consumers pay for "a market basket" of goods and services over a specified period. This market basket includes food products like cereal, milk, and coffee, housing costs, gasoline, clothing, medical care, communications services, personal care services, transportation costs, and more (Rebecca Baldridge, 2021)

4.2.3 The explanation of the multiple regression model

To explain the impacts of COVID-19 outbreak, researcher decided to apply econometric method to figure out this problem, which is a multiple linear regression approach. It means that the multiple linear regression approach can explain the linear relationship between explained variable or dependent variable, which is y and several independent variables, which is $X_1, X_2, X_3, \ldots, X_n$. The multiple linear regression equations of these independent variables can be expressed as the following formula:

Model 1: $Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_k X_k + \varepsilon_i$

Where ε_i is error term, and α, β_1, β_2, $\beta_3 \ldots \beta_k$ are the true parameters of the regression. The parameter b represents the variation of the dependent variables when the independent variable has a unitary variation meaning that if β_1 is equal to 0.5, when β_1 increases by 0.5, dependent variable Y will increase by 0.5 and other factors are remained. On the other hand, the parameter α represents the value of our dependent variable when the independent variables β_1 and β_2 are equal to zero.

The goal of multiple linear regression is to discover the unknown parameters and for which the error term is the smallest. To be more accurate, the model will minimize squared errors because the positive errors to be compensated by negative errors, because both are equally punishing to the model.

$$\min \sum_{i=1}^{n} \varepsilon_i^2 = min \sum_{i=1}^{n} (y_i - \alpha - \beta_1 x_i - \beta_2 x_2 - \ldots - \beta_k x_k)^2$$

Let assume that the squared error sum is $S = \min \sum_{i=1}^{n} \varepsilon_i^2 = min \sum_{i=1}^{n}(y_i - \alpha -\beta_1 x_i - \beta_2 x_2 - \ldots - \beta_k x_k)^2$, and take the partial derivative of β_1, β_2, $\beta_3 \ldots$, β_k with S

and set them equal to zero. The coefficients of this equation are found as $\hat{\alpha}$, $\widehat{\beta_1}$, $\widehat{\beta_2}$, $\widehat{\beta_3}$ and $\widehat{\beta_k}$. Those independent variables represent the estimated value of parameter α, β_1, β_2, β_3, …, β_k that meet the minimizing squared error term and make the formula more precise. And then researcher constructs the multiple linear regression equations as the following:

$$\text{Model 2: } EV_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_k X_k + \varepsilon_i$$

Researcher adjusts the model by taking the natural logarithm form to all of variables in the equation in order to alleviate the skewness of sample data that might less the accuracy of the model called the heteroskedasticity problem of the sample data as the following equation:

$$\text{Model 3: } \ln EV_i = \alpha + \beta_1 \ln(X_1) + \beta_2 \ln(X_2) + \beta_3 \ln(X_3) + \ldots + \beta_k \ln(X_k) + \varepsilon_i$$

Finally, based on the idea of multiple regression approach as shown in model 3 and economic theory, it can be concluded that the multiple regression model, which is applied to all selected Thailand's export goods to analyze the impacts of COVID-19 pandemic in each product categorized by product construction is an equation below:

$$\text{Model 4: } \ln EV_i = \alpha + \beta_1 \ln(PI_i) + \beta_2 \ln(RBEER_i) + \beta_3 \ln(GDPth_i) + \beta_4 \ln(GDPch_i) +$$
$$\beta_5 INTth_i + \beta_7 MR + \beta_7 COVID + \varepsilon_i$$

In the model 4, EV is an export values as an dependent variable, α is a constant value representing all observed factor that affects export values, PI is price index that is calculated from overall price of exported products, RBEER represents a real broad effective exchange rate, GDPth represents the gross domestic product in Thailand, $GDPch_i$ represents the gross domestic product in China, $INTth_i$ represents an interest rate policy in Thailand, MR is a mortality rate, and COVID represents the number of COVID-19 cases. In the meantime, β_i is a coefficient of each independent variable as well as ε_i is an error term representing the external factors that does not include in the model. Those variables in the model 4 are taken natural log excepting $INTth_i$, MR, and COVID.

4.3 Research Variables

4.3.1 Dependent variable

$\ln EV_i$ is the natural log of export value, which consists of 4 sectors as the followings below:

- IP represents industrial products (aggregated values of all industrial products)
- AP represents agricultural products (aggregated values of all agricultural products)
- AGP represents Argo-industrial products (aggregated values of all Argo-industrial products)
- MP represents mineral products (aggregated values of all mineral products)

4.3.2 Independent variable

For independent variable, it consists of 7 variables as shown below:
- Thailand's price index is calculated from overall price of exported products in each quarter using the index in 2012 as base index, which equals to 100. It represents the overall price of each exported product. Therefore, it is expected to have a negative relationship with export value due to law of demand. That means the higher price, lower quantity, and export value.
- Thailand's gross domestic product is calculated from sum of total finished product within a country in each year using the index in 2010 as base index,

which equals to 100. It represents the big picture of economic system. Therefore, it is expected to have a negative relationship with export value due to law of demand. That means the higher, lower quantity, and export value.

- China's gross domestic product is expected to have a positive sign because it can be implied when an increase in China's GDP, leads to higher demand for importing foreign products.
- Real broad effective exchange rate for Thailand is weighted averages of bilateral exchange rates adjusted by relative consumer prices in Thailand. It is expected to have a negative sign due to higher RBEER meaning domestic products are more expensive than other countries.
- Number of COVID-19 cases is a number of people, who infected the coronavirus and need to take medicines to heal. If the number is high and not enough vaccination, it will lead to an economic slowdown. Therefore, the sign of efficient is expected to be a negative.
- Mortality rate in Thailand is calculated from the number of deaths from the COVID-19 outbreak divided by total COVID-19 cases in each month. When this number is low, it means the outbreak has less effect or people can access the vaccination. Therefore, it's expected to have a negative effect.
- Last but not least, interest rate policy is one of the tools of national bank to be used in order to control the direction of economy including the expectation of inflation. When the economy has extreme growth in short time causing an enormous increase in inflation rate, which is greater than national bank's target, they are likely to rise interest policy rate to slow down that growth and control the inflation rate in the target range vice versa. Therefore, the sign of coefficient of interest rate policy is expected to have a negative impact on export value.

4.4 Hypotheses

4.4.1 Overall F-test

This study used the F-test of overall significance to identify whether all independent factors in model 4 is statistically significant. Given null hypothesis stated that all the model has no statistically significant independent variables included. Otherwise, it has at least 1 statistically significant independent variable. Therefore, the null hypothesis and alternative hypothesis as shown the 2 followings below:

$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = 0$

$H_0:$ Otherwise, at least 1 beta not equal to 0

The expected result from overall F-test is, the null hypothesis is rejected at significant level meaning that at least 1 independent variable is statistically significant in model 4. However, although the result in the F-test of overall significance is the same as expected, it does not indicate that which these independent variables affect the dependent variable. Therefore, T-test approach is applied to solve this problem.

4.4.2 T-test

As it was mentioned, this approach is used to find the significant variable in model that which ones has a relationship with dependent variable by testing one by one. Given null hypothesis states that selected variable is not statistically significant meaning that it has an no impact on dependent variable while alternative hypothesis

states that it significantly affects the dependent variable. Therefore, these 2 hypotheses are stated the followings below:

H$_0$: β$_i$ is equal to zero

H$_1$: β$_i$ is not equal to zero

Rejecting null hypothesis in all factors is an expected result from the T-test implying that independent variables, which is a category i, has a relationship with dependent variable. Otherwise, it has no effect on dependent variable.

Table 1: Expected sign of coefficient in each independent variable.

Independent variable	Expected sign of coefficient
PI	Negative
RBEER	Negative
GDPth	Negative
GDPch	Positive
INTth	Negative
MR	Negative
COVID	Negative

Source: Developed by author

CHAPTER 5

RESEARCH RESULT

5.1 Summary and Descriptive Statistics

The analysis of basic statistical data, which are a number of sample data, mean, standard deviation, minimum value, and maximum value for each variable will be shown in this part. The dataset consists of 60 sample data in each variable. There are 9 variables by the meaning of each variable representing the same as shown in chapter 4

Variable	Mean	Standard Deviation	Minimum	Maximum
IP	1831.819	193.7425	1444.533	2236.479
PI	109.0555	9.703732	81.99	138.5
RBEER	107.0785	4.119694	99.45	115.38
lnGDPth	26.93893	.0564275	26.84654	27.02236
lnGDPch	30.29806	.1187797	30.14147	30.50651
INTth	1.154167	.5023075	.5	1.75
MR	.0063911	.026610	0	.2019868
COVID	37157.42	113337.1	0	665220

Table 2: Summary and descriptive data in each variable from 2017 to 2021 by quarter
Source: Developed by author

According to table 2, an average export values of industrial products (aggregate value) from Thailand to China is approximately US$ 1,831.819 million in one month while standard deviation is around US$ 193.7425 million. Minimum and maximum values in one month is approximately US$ 1,444 and 2,236 consequently.

Based on table 2, An average of price index in Thailand is equal to 109 using year 2012 as a base with an 9.7 standard deviation. Meanwhile, minimum, and maximum values is about 81.99 and 138.5 respectively.

As shown in table 2, A minimum and maximum value of real broad effective exchange rate in one month is approximately 99 and 115 consequently while an average of this variable is equal to 107 with a 4.11 standard deviation.

An average gross domestic product of Thailand is equal to 26.93893 while of China is equal to 30.29806 with .0564275 and .1187797standard deviation respectively. A minimum and maximum value of this variable of Thailand is approximately 26.85 and 27.02 while of China is equal to 30.14 and 30.51 consequently.

Interest rate policy for Thailand. An average of this variable is around 1.1541 percent. Standard deviation is equal to 0.5023 percent. A minimum and maximum value in one month is 0.5 and 1.75 percent.

A mortality rate has an average equal to 0.0064 with 0.266 standard deviation while minimum and maximum values are 0 and 0.2020 respectively.

Last but not least for this part of the analysis, an average of the number of COVID-19 cases is equal to 37,157 with 113,337 standard deviations. Maximum and minimum value are equal to 0 and 665,220 consequently.

5.2 Empirical Results

The objectives of this paper are to identify the COVID-19 outbreak on export values of industrial products including other sectors and to seek influencing factors that have an impact on export values. This part indicates that the results of multiple regression model, which shows the effect of COVID-19 pandemic and other influencing factors on export values of industrial products from 2017 to 2021.

5.2.1 Industrial product

Independent variable	Coefficient
lnPI	-0.1310231
lnRBEER	-0.5856193
lnGDPth	0.1061959
lnGDPch	-0.0937962
INTth	-0.1205279**
MR	-0.6561782
COVID	1.29e-07

Table 3: Regression results for industrial product
Source: Developed by author

According to table 3, the regression results show that there is 1 significant variable to export values of industrial product, which is Thailand's interest rate policy that has a coefficient is equal to -0.094 meaning that it has a negative effect as previously expected. It can be implied that an increase in interest rate leads to a decrease in export values of industrial products due to higher domestic interest rate causing domestic currency to appreciate.

5.2.2 Agricultural product

Independent variable	Coefficient
lnPI	0.6106022
lnRBEER	-7.653193***
lnGDPth	3.775334*
lnGDPch	-1.294981
INTth	1.276499***
MR	-.2823726
COVID	-5.48e-07

Table 4: Regression results for agricultural product
Source: Developed by author

      Based on results in table 4, there are 3 significant variables that are real broad effective exchange rate, China's gross domestic product, and Thailand's interest rate. For RBEER, coefficient is equal to 0.6106022 implying that a rise in RBEER by 1 percent leads to a decrease in export values of agricultural products by 0.6106022 percent, which is a negative sign as expected because exported product from Thailand will be more expensive than other countries. Surprisingly, Thailand's gross domestic product and interest rate policy has a significantly positive effect, which is different from expectation. It might be from lack of appropriate independent variable and model of estimated equation leading to a deviation of results from theory.

5.2.3 Argo-industrial product

Independent variable	Coefficient
lnPI	-1.265287
lnRBEER	11.37549***
lnGDPth	-3.613679
lnGDPch	2.024066
INTth	-2.613596***
MR	1.23e-06
COVID	-5.48e-07

Table 5: Regression results for Argo-industrial product
Source: Developed by author

      The regression results for Argo-industrial products are shown in table 15. It indicates that there are 2 significant variables for these products, which are real broad effective exchange rate and Thailand's interest rates policy. The coefficient of

Thailand's interest rate is equal to -2.613596, which has a negative effect as expected and is implied that an increase in interest rate by 1 percent will lead to a decrease in export values of Argo-industrial product by 2.613596 percent. For the RBEER, it is different from previous expectation due to insufficient appropriate independent and method of estimation.

5.2.4 Mineral products and fuel

Independent variable	Coefficient
lnPI	-.2654399
lnRBEER	-1.407019
lnGDPth	-0.7337034
lnGDPch	-0.0286405
INTth	-0.1089496
MR	0.4542043
COVID	-3.71e-07

Table 6: Regression results for mineral product and fuel
Source: Developed by author

According to table 6, it can imply from regression results that surprisingly, there is no significant variables for these export values. Because the estimated model is not appropriate and need to add more related independent variables.

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CHAPTER 6

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The main objectives of this paper are to demonstrate impacts of COVID-19 outbreak on export values of industrial products from Thailand to China between 2017 to 2021 and to compare impacts of COVID-19 pandemic in each sector. The multiple regression equation is applied to estimate the problem in this study included relevant dependent variables as well as dummy variable, which represents the outbreak. The results of this study are mainly based on export values of industrial products from Thailand to China over a 5-year period or 60 months. Regression analysis was applied for each sector to analyze separately.

For export values of industrial products, the results of estimation indicate that the number of COVID-19 cases is not statistically significant on export values for these products. In the meantime, an independent variable of interest rate policy has a negative impact on export values of this sector as expected and is statistically significant at 5 percent significance level.

The results of this study also found that the real broad effective exchange rate has a negative effect on export values of argo-industrial products as expected. Meanwhile, for the agricultural product, the results deviate from economic theory. And for mineral products and fuel, it has no statistically significant variable. Those are from lack of appropriate independent variables and model for these products.

6.2 Recommendation

The policy implications can be suggested from this study is that the central bank should control interest rate policy carefully because it has an impact on main exported products, which is industrial product. Moreover, Thai government should state a new policy carefully, especially during the outbreak. Because sometime government's policy force central bank to adjust interest rate policy to address its inflation targeting and other economic target. Therefore, the monetary and fiscal policy should be used to support with each other to recovery economic system.

However, export value in each sector of this study is explained by only 7 independent variables. Therefore, for further developments of this study is to include more independent variables, which are already proved by previous research such as dummy variable representing Covid-19 policy implication or independent of the number of vaccination and increase a frequency of data to improve the analysis efficiently.

APPENDIX

Appendix 1: Monthly sample data used in the analysis of this study

PERIOD	AP	AGP	IP	MP	VI	RBEER	lnCPIth	lnCPIch	INTth	MR	COVID
1	501.005	40.2358	1488.275	123.0791	138.5	102.32	4.614229	4.639249	1.5	0	0
2	580.411	51.6913	1572.721	78.5958	128.03	102.42	4.614229	4.639249	1.5	0	0
3	661.0875	79.9124	1901.765	101.5265	115.84	102.26	4.614229	4.639249	1.5	0	0
4	512.5595	64.2436	1444.533	106.1926	133.86	102.78	4.613138	4.636669	1.5	0	0
5	492.7113	80.1456	1652.557	135.2676	125.8	102.59	4.613138	4.636669	1.5	0	0
6	390.4256	91.3826	1633.053	114.4835	119.39	103.18	4.613138	4.636669	1.5	0	0
7	422.6372	69.0251	1697.679	112.5356	120.83	103.5	4.614823	4.639894	1.5	0	0
8	490.1955	79.5609	2015.694	104.8427	107.86	103.55	4.614823	4.639894	1.5	0	0
9	429.6788	61.3241	1967.371	74.0918	119.43	103.53	4.614823	4.639894	1.5	0	0
10	494.0089	58.9211	1938.72	102.4849	121.2	104.44	4.620453	4.647271	1.5	0	0
11	566.323	63.4947	2139.907	79.1828	119.01	105.28	4.620453	4.647271	1.5	0	0
12	600.6799	55.8029	1875.539	108.4535	120.07	105.22	4.620453	4.647271	1.5	0	0
13	448.1956	64.4145	1806.969	103.4692	116.88	105.45	4.61858	4.660289	1.5	0	0
14	462.6401	81.946	1719.911	98.8627	110.46	105.06	4.61858	4.660289	1.5	0	0
15	467.7818	89.9069	1995.067	133.5536	107.54	105.8	4.61858	4.660289	1.5	0	0
16	586.2678	72.9406	1833.982	89.9786	108.98	106.4	4.626149	4.653643	1.5	0	0
17	478.2629	75.3474	1975.33	192.2649	101.11	106.57	4.626149	4.653643	1.5	0	0
18	414.8771	77.3582	1879.972	118.6458	101.9	105.75	4.626149	4.653643	1.5	0	0
19	409.2586	62.422	1828.25	82.0826	102.21	104.6	4.629472	4.662495	1.5	0	0
20	555.0623	107.579	1991.957	99.845	99.59	106.23	4.629472	4.662495	1.5	0	0
21	405.1046	71.2173	1660.165	80.8771	98.51	108.03	4.629472	4.662495	1.5	0	0
22	520.6401	73.8725	1967.421	106.4287	82.77	108.04	4.629277	4.668771	1.5	0	0
23	503.8915	73.0121	1900.014	110.2649	81.99	107.46	4.629277	4.668771	1.75	0	0
24	507.5421	67.254	1726.365	138.4075	100.95	107.29	4.629277	4.668771	1.75	0	0
25	395.6505	46.9478	1503.972	55.511	101.61	109.02	4.625953	4.678421	1.75	0	0
26	465.3683	82.7511	1639.261	100.1343	111.1	110.53	4.625953	4.678421	1.75	0	0
27	509.5608	76.1933	1681.956	144.6596	108.55	109.58	4.625953	4.678421	1.75	0	0
28	693.5888	80.1566	1562.742	110.3865	104.17	109.58	4.63725	4.679968	1.75	0	0
29	537.3019	122.0382	1817.679	46.8012	103.22	111.03	4.63725	4.679968	1.75	0	0
30	500.74	98.5643	1457.756	63.1393	107.73	112.57	4.63725	4.679968	1.75	0	0
31	565.0766	105.0422	1780.216	77.2462	105.4	113.44	4.638218	4.690736	1.75	0	0
32	695.1526	100.6774	1806.908	74.627	108.45	114.51	4.638218	4.690736	1.5	0	0
33	380.5845	96.4551	1773.017	102.1545	112.1	115.38	4.638218	4.690736	1.5	0	0
34	401.5224	122.9025	1983.242	50.2105	109.26	115.3	4.637734	4.710131	1.25	0	0
35	468.1223	121.5585	1978.074	79.4187	106.83	115.04	4.637734	4.710131	1.25	0	0
36	516.2775	91.8214	1887.959	118.3347	106.28	114.76	4.710131	2.9	1.25	0	0
37	413.84	84.5622	1560.449	70.0682	104.31	113.2	4.726798	2.9	1.25	0	24
38	428.7758	74.1878	1672.707	84.9307	107.2	110.81	4.726798	2.9	1.25	0	23
39	522.7709	90.9351	1640.398	50.6532	105.4	108.89	4.726798	2.9	0.75	0.010363	2123
40	811.8025	108.6043	1681.436	65.9144	106.23	106.39	4.706824	2.9	0.75	0.041169	753
41	905.3921	92.8962	1832.318	78.4032	111.47	108.03	4.706824	2.9	0.5	0.026786	112
42	366.4804	84.03	1856.048	67.5584	113.54	111.27	4.706824	2.9	0.5	0.010526	95
43	502.7929	82.3286	1830.322	45.7726	106.39	109.97	4.710131	2.9	0.5	0	127
44	559.8857	107.7037	1869.723	38.9193	111.49	109.63	4.710131	2.9	0.5	0	94
45	598.6834	112.4688	1767.661	38.152	108.17	108.23	4.710131	2.9	0.5	0.007092	141
46	468.2716	112.5989	1798.526	27.4006	111.5	108.17	4.71133	2.9	0.5	0	199
47	554.063	96.8001	1701.993	51.6034	114.86	109.84	4.71133	2.9	0.5	0.201987	302
48	685.1752	90.408	1952.854	73.7486	110.61	109.64	4.71133	2.9	0.5	0.001109	3608
49	580.2046	61.8845	1583.609	88.596	109.45	109.04	4.725707	2.9	0.5	0.001172	11088
50	697.4588	84.8546	1771.586	39.1342	109.26	107.81	4.725707	2.9	0.5	0.000557	7179
51	748.8726	109.9555	2132.16	115.9765	112.09	106.72	4.725707	2.9	0.5	0.003778	3176
52	1148.794	100.0448	1912.806	94.7539	106.98	106.23	4.719425	2.9	0.5	0.004265	39857
53	1291.573	113.4126	2186.37	60.0734	110.22	104.4	4.719425	2.9	0.5	0.009135	108483
54	976.3722	118.1155	2236.479	58.1955	103.76	104.34	4.719425	2.9	0.5	0.009375	105600
55	1118.065	102.3767	2147.552	100.3274	110.52	101.17	4.720088	2.9	0.5	0.008319	332247
56	1221.639	97.7448	2034.567	54.7537	105.99	99.45	4.720088	2.9	0.5	0.011823	665220
57	764.6865	102.1333	2145.763	93.7652	99.4	100.71	4.720088	2.9	0.5	0.011654	356868
58	681.2508	101.0253	1917.964	48.4627	100.75	100.38	4.728998	2.9	0.5	0.007983	274592
59	777.3574	116.8479	2044.319	54.669	100.33	101.79	4.728998	2.9	0.5	0.007587	229217
60	910.1844	112.4304	2145.523	60.8274	96	100.11	4.728998	2.9	0.5	0.008787	88317

REFERENCES

VITA

NAME	Burapas Yotwilai
DATE OF BIRTH	18 July 1997
PLACE OF BIRTH	Loei province
INSTITUTIONS ATTENDED	Faculty of Economics, Chulalongkorn University 254 Phayathai Road, Pathumwan ,Bangkok 10330 Thailand
HOME ADDRESS	157/6 Loei-Dansai Road, Kutphong district, Loei 42000 Thailand