Determinant Effects using OLS regression
On
Passenger Transportation in Thailand

Presented to

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Abstract

This research focuses on the factors that influence the transportation index in Thailand, the results are arising from the ordinary least squares (OLS) regression analysis. The data used time series data which comes from conventional and alternative indicators from 2010 to 2021. The conventional data come from ECI (Bank of Thailand) and alternative indicators come from Google trends. The additional variables of (Gasoline, plane ticket, Holiday, Taxi, Bus, Boat and Honda) are significant with a positive effect on the passenger transportation index. The elements that are projected to influence the Sales of Passengers Transportation Index were derived from prior research with comparable themes and methodologies, which this study attempts to adapt via the situation in Thailand.

Introduction

Generally, Thailand's economy is strongly reliant on foreign trade, with exports accounting for about half of the country's GDP (GDP). With recent structural developments toward a bigger share of value-added manufactured goods and a higher degree of global trading, Thailand's economy is export-dependent, necessitating a strong and integrated transport and trade facilitation infrastructure. Thailand's transportation sector accounts for 13.4% of the country's GDP in 2019, and it is the driving force behind the country's impressive export performance. With an estimated 95 percent of freight and 98 percent of passengers, the road sub sector dominated the transportation sector. The transportation system is critical to the country's physical development, both economic, social, and environmental. A country's transportation system will benefit it economically, socially, and environmentally if it is efficient, safe, and reliable. Thailand has several modes of transportation, but we will focus on three of them in this article: the road network, rail transportation, and urban transport.

Firstly, With a total length of 202,000 kilometers, the road network also takes the lead (km). The rail system is 4,043 kilometers long. The shoreline runs for 2,614 kilometers, with only roughly 1,750 kilometers of passable inland rivers. As a result, the road network is the most developed, with 98 percent of highways paved, including village access roads. Personal vehicles (mostly cars and pickup trucks) and motorbikes are the most common modes of passenger travel in Thailand. Personal automobile ownership has been increasing at an annual rate of 8%–10%

per thousand population, and this trend is projected to continue. Cars and pickup trucks are the most common vehicles in Bangkok, which has a population of 9.7 million cars. Outside of Bangkok, motorbikes predominate, with 159 motorcycles per 1,000 people and 112 cars or pickup trucks. Ownership of four-wheel vehicles is predicted to grow faster than motorbike ownership as per capita income continues to rise.

Second, Thailand's State Railway of Thailand (SRT) is the country's sole railway operator. Single-track lines account for 3,880 kilometers of the overall rail length of 4,130 kilometers. The network is mostly made up of main lines that radiate from Bangkok to the north, northeast, east, and south. The network connects 42 of the country's 76 provinces and has the potential to function as a robust land transportation backbone. Petroleum products, cement and other building materials, and containers are the most common railway goods. The majority of railway traffic is focused between Bangkok and its ports, particularly the Laem Chabang deep seaport and the Lad Krabang inland container depot. Thailand's rail assets, on the other hand, are often outdated and neglected, limiting the sub-sector's capacity to extend its role in land transportation. Despite its small market share, rail freight tonnage throughput is expected to grow.

Finally, in terms of urban transportation, the Bangkok Metropolitan Region (BMR) has a population of more than 12.0 million people, accounting for roughly 17% of Thailand's 69.8 million population in 2021 and accounting for more than half of the country's GDP. Because it accounts for about half of Thailand's gasoline and diesel use, the BMR is essential to the country's overall economic and energy efficiency performance. Bangkok's pervasive traffic congestion impairs the city's urban transportation network efficiency, resulting in long travel times, wasteful fuel use, and polluting emissions. The current distribution of road space and an imbalanced spatial design of distributor roads exacerbate congestion by requiring the mixing of long- and short-distance trips.

In Bangkok, public transportation accounts for approximately 40% of all daily personal trips, but only 4% of MRT journeys (MRT). Four- and two-wheel vehicles account for 46% of journeys, buses account for 36%, and walking accounts for 14%. Water transportation is used for a small percentage of trips. Even with the eventual building of an extended MRT system with

about four times the existing operational length, the estimated MRT mode share of total daily person journeys is only expected to climb to around 15%, 20% with the percentage of bus trips declining from 36% to 31%.

Thailand's transportation and logistics sector is expanding, putting the country on track to become ASEAN's transportation hub. Supply chains in every business rely on transportation and logistics infrastructure, and Thailand's growing urbanization creates a demand for transportation enhancements. Given Thailand's rapid rise as one of Asia's mobility and commercial centers, the transportation and logistics business has enormous potential to expand commerce, tourism, and investment.

Therefore, this research paper provides an objective to analyze the factors that will affect the transportation index in Thailand and can use alternative indicators to forecast the transportation trend in Thailand further. Moreover, this paper will offer the policy recommendation to increase the effectiveness of Thailand’s transportation.

Literature review

This research mainly focuses on the trend of the transportation index of Thailand. There are many analyses related to Thailand transportation. This research will separate the literature into two main categories of research methods and subtopics.

By research methods

1.Florian, Michael (2009) states that the quantitative investigation of transportation phenomena naturally leads to network models that describe the geographical properties of the transportation infrastructure. This paper examines the nonlinear cost models that occur in transportation analysis and identifies the main approaches for solving them in practice. The network equilibrium problem, the difficulty of predicting an origin/destination matrix, and various concave cost network flow problems are also discussed.

2.Erik and Nicole (2011) publish that the private ride-hailing companies Uber and Lyft have expanded into an increasing number of US cities using discontinuity regression analysis. We discovered that in a metropolitan region, public transportation use surged quickly after the first

admission. There is some indication, however, that monthly public transit ridership has fallen below pre-first entry levels.

3. Hilmi Berk (2007) used the generalized regression neural networks to analyze the Artificial neural networks are one of the recently explored advanced technologies, which show promise in the area of transportation engineering. The presented study comprised the employment of this seldom used ANN method, generalized regression neural network , in comparison to other methods such as feed-forward back-propagation and stochastic model of auto-regressive structure. The study is being conducted with the knowledge that simulating daily trips for available transportation modes will aid in the planning of successful public infrastructure improvements.

4.Yandong Yang (2015) In this work, different prediction models based on regression analysis methods are examined and successfully implemented for anticipating regional freight transportation demand. Regional freight transportation demand is an essential indicator of economic conditions such as production improvement and restructuring. Several Regional Freight Transportation Demand Prediction Models have been created in this work using Multiple Linear Regression and Non-Linear Regression based on distinct prediction models. The simulation results suggest that the RFTDPM based on NLR performs better than the other regression models in terms of fitting efficiency.

5. Qing su (2012) using data from the National Household Transportation to investigate the quantity of the reborn effect .Due to the diverse travelers, the quantile regression method is used to capture the variation in the rebound effect. The quantile regression method is used in this study to calculate the rebound effect of vehicle miles traveled. According to the regression results, the influence of income is positive but diminishes as one moves up the VMT distribution. The density of the road network and population density are also major factors in determining travel demand. According to the regression results, the rebound impact varies with VMT distribution. The predicted rebound effect ranges from 0.11 to 0.19.

By subtopics

1) Krirkchai and Sathaporn (2016) indicate the purpose performance of Thailand's transportation infrastructure. Thailand's transportation infrastructure performance metrics are proposed and gathered.The relationship between present transportation infrastructure performance and Thailand's economy is explored. As a result, Thailand's transportation infrastructure performance has steadily improved. As every increase in one unit of TPI results in an improvement, there should be a strong emphasis on improving the transportation infrastructure system.
2) Panudulkitti (2011) said that the goal of this research is to look at how urbanization affects infrastructure and transportation spending in Thailand. Previous research has demonstrated that the amount of urbanization is one of the tools that might influence urban growth. The purpose of this article is to investigate the link between provincial expenditure growth and several exogenous variables that might be regarded as causes of expenditure growth. The data show that urbanization has a favorable impact on infrastructure spending by provincial governments as well as transportation spending.
3) Jafari (2008) Fossil fuels account for the largest share of the world's energy supply. In light of limited natural resources, fuel consumption control and energy planning in end-user sectors are two critical issues. Among the fossil fuels, gasoline is the most commonly used in light-duty automobiles. In Iran, fuel use, particularly gasoline usage, has surged dramatically, with a 10.2 percent increase in 2006 compared to 2005. Subsidies for importing 40% of domestic demand are far too large to be met. The Iranian gasoline crisis has no simple answer, and basic methods and policies are required to address the issue.
4) Jame luk (2003) suggests that integrated public transportation has garnered a lot of attention in recent years as a way to improve public transportation and minimize dependency on cars. Improving public transportation systems alone may not be enough to reduce automobile traffic in Australia's car-dependent cities. Singapore and Hong Kong already have high modal shares of public transportation (63 percent and 90 percent of all motorized trips, respectively). The study explores the challenges involved, including those relating to the dilemma of an aging population.

5) Sakjakka(2016)The study's goal is to identify factors that influence the quality of public transportation and the demand for public transportation among students. Convenience was the most essential element in determining bus service quality, followed by service planning and bus network. Socioeconomic characteristics, including hometown, gender, and academic year, had an indirect effect on the intention to enhance bus travel through automobile ownership.

Research gap

This study examines time-series data from the past to identify the elements that influence Thailand's transportation sectors. The sets of data mainly come from two sources of data. The conventional data is coming from economic indicators from the Bank of Thailand and alternative indicators are coming from Google trends. The data is collected quarterly from October 2010 to 2021. The gap for this study is restricted because of data availability limitations and the fluctuation of indicators that cannot be completely used to predict the future trend of the transportation index. As a result, the indicators predicted by the research may not be concerned with influencing the trend of the transportation index in all aspects. Moreover, the COVID-19 pandemic has completely changed the transportation industries by introducing social distancing and remote work options. Therefore, further studies can explore the structural change when the data become more widely available.

Data and research methods

Data Set

This paper uses cross-sectional analysis based on monthly reported time series data set between October 2010 to October 2021. There are two different types of data set used in this paper: Conventional Economic Indicator and Alternative Economic Indicator
For Conventional Economic Indicators, this paper uses Sales of passenger transportations Index (Seasonally Adjusted) from Bank of Thailand (BOT). The index can be found in C_EI_003_S2 : Private Consumption Index and Component (Appendix I). This index reflects the monthly change of passenger transportation from aggregating data from multiple government agencies.

The importance of each element that affects passenger transportation in Thailand is determined in this article using Google Trends. This paper examines traditional transportation variables in Thailand, such as oil prices, public transit (bus, coach, vans, MRT, BTS, and train), private transportation (taxi, tuk tuk, and airplane), and behavioral change as a result of social, economic, and health concerns, such as public holidays and social distancing.

Methodology

This paper would explore the significance of possible factors which affect passenger transportation index using the ordinary least squares (OLS) regression. This paper uses both literature review to find potential factors affecting transportation in Thailand and trial and error to find significant of the explanatory variables in the model of Thailand. So, this paper explore wide possible range of factors which impacts passenger movement across the country from oil price, road uses, public transits including bus, vans, MRT, BTS, boats, and train, private transportation including taxi, tuk tuk, airplane and important social factor on passenger transportation such as holiday and public health restriction due to the pandemic.

Ordinary Least Square Regression (OLS) commonly known as simple linear regression is a method for estimating unknown parameters and coefficients of the relationships expressed in the model. By reducing the sum of square discrepancies between the observed and predicted values, this technique identifies significant factors. The technique may be used to explain single or multiple variables and also applicable for various types of quantitative variables from nominal to categorical. OLS is used in many fields such as economic, political science, medical science and biology.

OLS regression function: $Y_i = \alpha + \beta * X_i + U_i$

Where Y_i = Dependent variable

α = Intercept of the model

β = Coefficient of regression

X_i = Corresponds to i explanatory variable of the model

U_i = the random error with the expectation 0 and variance $\sigma 2$

With more explanatory variables of the model, the OLS regression function will be:

$$Y_i = \alpha + \beta_1 * X_1 + \beta_2 * X_2 + \ldots + \beta_n * X_n + U_n$$

The main model is the linear regression between transportation index and the 7 significant variables: Gasoline price, taxi, plane tickets, boat, bus, Honda and holidays (Appendix I).

Specification Model:

This paper explores the effects of several variables on sale of passenger transportation. Therefore, the extension variables including public transportation and additional variables are thoroughly examined based primarily on theoretical considerations rather than factual or procedural methods.

The specification model, also known as extended model with public transportation, public transportation and mass transit of buses, trains, boats, buses and rapid transit (MRT Metro or BTS Skytrain). In addition, the model incorporates major car brands in Thailand which are Toyota, Honda and Mazda to incorporate private car travel, car rental and car sales in Thailand.

Result analysis

The regression results using the monthly data from October 2010 to Oct 2021 which are represented in Table 1. The paper uses a sample size of 133 and data collected from population search in Thailand. There are 7 main independent variables which are gasoline price, taxi, plane tickets, boat, bus, Honda and holidays where there are significant effects on the relationship between dependent variables of sale of passenger transportation index. The paper removes other independent variables which are not significant to improve the accuracy of the model using theoretical reviews and experimental methods.

The base model indicates that the transportation index which is the dependent variable is affected by these independent variables of gasoline price, taxi, plane tickets, Honda, holidays, boat and bus, with R-squared of 0.7856. The R-squared represents the proportional variance of transportation index predicted by the independent variables. The variable with highest coefficient is the sale of plane tickets at 0.6053. This implies that 1 unit shift of plane ticket would increase

transportation index by 0.6053 while holding other variables constant. Holiday is the only factor with a negative coefficient which indicates that the sale of passenger transportation decreases as holiday increases. The full result of the regression for other variables are shown in Appendix I.

Specification Model:

This paper explores the effects of various factors on passenger transportation ranging from public transportation to private transportation. Recently, the government has promoted the use of public transportation over private transportation. Hence, public transportation options are expected to be the determinants of the model as in theoretical consensus. However, only buses and boats are significant public transportations shown in any of the search trends which are surprising as the urban and rural mass transit of coaches, trains and rapid transit (MRT Metro or BTS Skytrain) dominated the majority of developed countries. The result may reflect that public transportation could be a relatively small proportion of the total passenger transportation sale compared to private transport of gasoline price, taxi and plane tickets on the search trends. Yet, it might be possible that public transportations in Thailand is not properly updated or integrated with Google search.

The key advantages of the data and method is that the model is able to analyze multiple variables and compare their impacts, correlation and trend change over time. Moreover, this method can be used in conjunction with graphical data to analyze the major structural break to completely understand the significant and behavioral change of the factors on population. This method indicates a major structural change of transportation index in January 2020 from 2.22 points drop to 0.62 points by April 2021. The point of 2.22 can be interpreted as the sale of passenger transportation increased 2.22 times compared to October 2010 (Appendix II). The structural change in transportation is heavily implied to be caused by the COVID-19 outbreak and government policy to restrict the transportation of passengers.

The limitation for this method is that it is quite difficult to interpret some variables: Honda as people googling Honda can be interpreted in multiple ways such as renting a car for traveling or interest in buying a new car. Moreover, there could be spurious correlation or

confounding variables which invalidate the relationship between the independent variables and dependent variables.

Conclusion

Nowadays, Thai people still consider fossil-fuel based transportation as the main dominant mode of transportation from cars, taxis and planes over public transportation which could be a huge concern for the near future. Thailand has different public holidays for each subset of the population such as the public and private sectors.

From the OLS regression, the factors that affect Thailand's passenger transportation index are the fuel price, taxi, plane tickets, Honda, holidays, boat and bus . All exogenous variables are 5% level of significance with positive coefficient except holiday. So, these variables showed a significant and positive relationship with passenger transportation. The results also imply that the dramatic change of trend as the COVID-19 impacts the industry. On the other hand, there are some additional variables that cannot be explained or do not have the effect on the passenger transport which are the major public transportation of train, metro system (MRT) and skytrain(BTS). Government should introduce policies to boost adoption for public transportation over gasoline based private transportation.

For data collection and research methods, the paper consists of monthly data trends of traditional economic indicators of passenger transportation sales and alternative methods of google trends from October 2010 to October 2021. This paper only uses OLS which can easily analyze multiple variables and compare their impacts, correlation and trend change over time. Moreover, the paper identifies structural break by using graphical representation to understand the behavior change due to COVID-19 pandemic.

Thailand has a major focus on traditional, private transportation, mainly fossil-fuel transportation of gasoline, taxi, bus, boat and plane ticket over the mass transit system. So, it can be implied that public transit needs considerable improvement to be competitive. Moreover, Thailand has considerable focus on public holidays which are more frequent than most countries and led to more transportation of passengers.

Policy recommendations

Transportation has crucial structural changes due to COVID-19 pandemic. Hence, it is an opportunity to revamping the transportation system to be more sustainable by supporting public transport and reducing reliance on private transportation, especially on cars and motorcycles.

The government needs to focus on improving city planning and public transportation to be more connected, viable and affordable for the population. The first step is to subsidize public transportation to be cheaper, faster and more convenient than private transportation. So, the government needs to plan the city to be easily walkable, bike or get tough by mass transit as it is more efficient and viable in the long-term. The government should integrate and simplify all the major transportation systems into one system with one card to reduce the complexity. Moreover, the government should put an overall cap limit on the price of transportation under the system similar to the UK government which significantly improves the number of users using public transportation.

Secondly, the government policies should reduce the importance of fossil-fuel based transportation especially on cars and transition to sustainable transportation by using clean and renewable energy such as electric vehicles. The government can achieve a more environmentally friendly and feasible system by implementing carbon tax on carbon dioxide emission for all private transportation. Hence, this would severely reduce greenhouse gas emission by disincentive the public from using cars and generate revenue for the government to invest in green technologies and infrastructures which can substantially offset the effect caused by fossil fuel. Moreover, the price of gasoline would considerably increase which is the prime factor on transportation. This would likely encourage the driver to consider alternatives to gasoline-power vehicles like public transportation, electric vehicles and remote work options.

Lastly, the government should set clear goals on phasing out all gasoline vehicles like by 2030, all car manufacturing in Thailand will all be zero emission vehicles. Moreover, the government must support research and development of green transportation and infrastructure on mainly electric vehicles. The authority may grant tax incentives for buyers of electric cars and bikes similar to the model in the USA. The council can also promote green transportation by giving additional perks such as EV lanes, EV charging parking spots and free tolls.

Suggestions for future improvement from this research

1.The future improvement for this research is to track the long lasting behavior change after COVID-19 pandemic as people might adopt alternatives to traditional transportation such as remote work which significantly reduce passenger transport in the long-term. In addition, the technologies have improved significantly for the transportation industries with public transportation and electric vehicles.

2. This research does not include other factors such as political factors, economic factors and weather in consideration. Yet, these factors might affect the change of transportation in both short term and long term.

3. This research only uses one methodology which is Ordinary Least Square (OLS) regression to find the factors that affect Thailand transportation. So, future research should experiment with different methods to confirm the result. Moreover, that did not test for the causal effect. Hence, the effect could be spurious correlation. The future study can avoid the misspecification by running multiple robustness checks to improve the accuracy of the finding.

4. This paper did not survey the population about transportation, especially the structural change after the pandemic outbreak. The researcher should compare the data of before and after for both quantitative and qualitative data when the data become more complete and available to understand impact on transportation.

Appendix I

1) Data Set A

EC_EI_003_S2 : Private Consumption Index and Components

28 Sales of passenger transportations Index (Seasonally Adjusted)

https://www.bot.or.th/Thai/Statistics/EconomicAndFinancial/Pages/StatRealsectorIndices.aspx

https://www.bot.or.th/Thai/MonetaryPolicy/EconomicConditions/EconomicIndices/DocLib_EconomicIndex/revision_pci_th_28feb2018.pdf

2) Regression of Base Model

```
. reg transportationnormalized นั่งพน taxi พนักงานขับขี่ รถเมล์ honda เรือหางยาว รถไฟ
```

Source	SS	df	MS	Number of obs	=	133
				F(7, 125)	=	65.43
Model	26.3160375	7	3.75943392	Prob > F	=	0.0000
Residual	7.18195455	125	.057455636	R-squared	=	0.7856
				Adj R-squared	=	0.7736
Total	33.497992	132	.253772667	Root MSE	=	.2397

transportati~d	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
นั่งพน	.0959866	.0232646	4.13	0.000	.0499431	.1420301
taxi	.1629425	.0671098	2.43	0.017	.0301239	.2957611
พนักงานขับขี่	.6053622	.0875847	6.91	0.000	.4320211	.7787032
รถเมล์	-.1076283	.0181481	-5.93	0.000	-.1435456	-.0717109
honda	.4455691	.1685824	2.64	0.009	.1119235	.7792147
เรือหางยาว	.0635802	.0285779	2.22	0.028	.007021	.1201395
รถไฟ	.2545795	.1096361	2.32	0.022	.0375959	.471563
_cons	-.0786382	.1988244	-0.40	0.693	-.4721364	.3148599

3)Regression of Specification Model

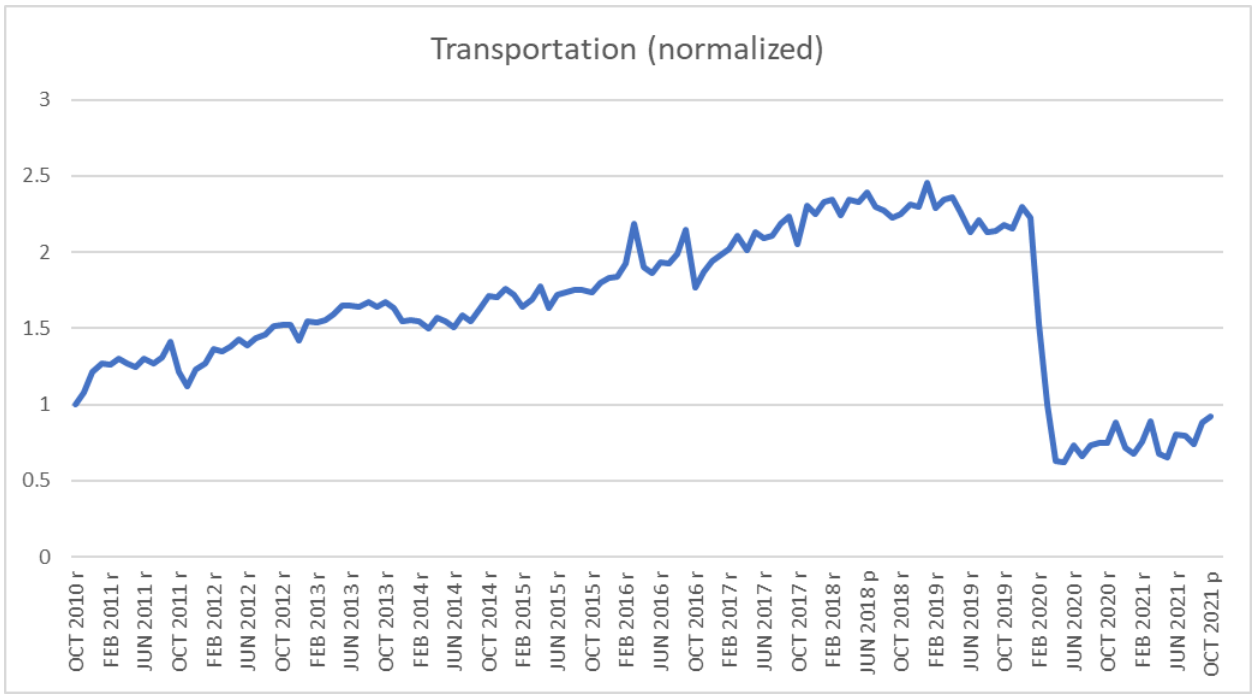
```
. reg transportationnormalized นั่งนน mrt bts taxi ศูนย์ราชการและนันทนาการ รถตาร วันหยุด ทะเลย
> า honda mazda ไฮโลตา เรือความเสาพระยา รถเมย
```

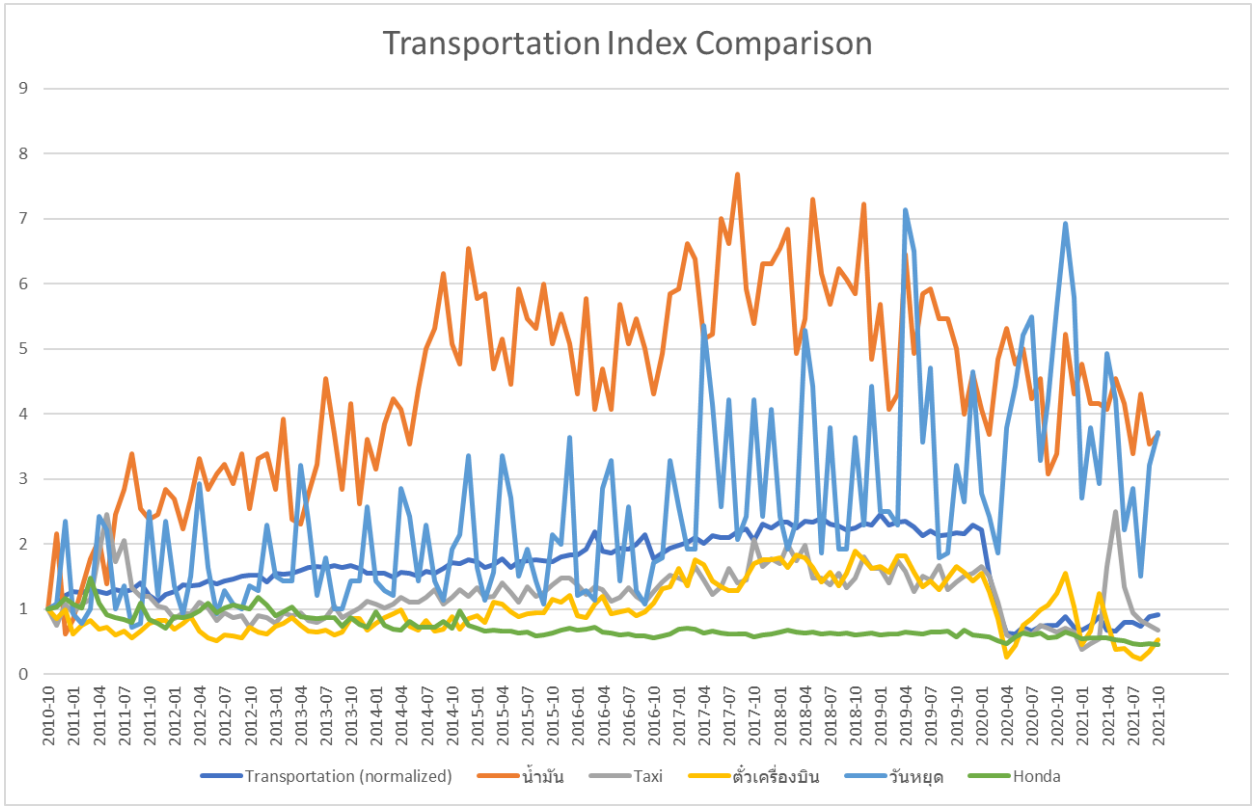
Source	SS	df	MS	Number of obs	=	133
				F(13, 119)	=	34.54
Model	26.4801953	13	2.0369381	Prob > F	=	0.0000
Residual	7.01779676	119	.058973082	R-squared	=	0.7905
				Adj R-squared	=	0.7676
Total	33.497992	132	.253772667	Root MSE	=	.24284

transportat~d	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
นั่งนน	.0943842	.0270575	3.49	0.001	.0408077	.1479607
mrt	-.0254584	.0368834	-0.69	0.491	-.0984912	.0475744
bts	-.0129284	.0682235	-0.19	0.850	-.1480179	.122161
taxi	.1526194	.0722676	2.11	0.037	.0095224	.2957164
ศูนย์ราชการและนน	.6681829	.1515646	4.41	0.000	.3680699	.9682959
รถตาร	-.0337967	.1408036	-0.24	0.811	-.3126019	.2450085
วันหยุด	-.1060241	.0275452	-3.85	0.000	-.1605664	-.0514818
ทะเลยา	.0439112	.0704091	0.62	0.534	-.0955059	.1833283
honda	.5368922	.2405832	2.23	0.028	.0605133	1.013271
mazda	-.1607992	.1551566	-1.04	0.302	-.4680249	.1464264
ไฮโลตา	-.0719806	.2719799	-0.26	0.792	-.610528	.4665668
เรือความเสาพระยา	.0643537	.0305724	2.10	0.037	.0038174	.1248901
รถเมย	.2511521	.1167262	2.15	0.033	.0200226	.4822817
_cons	.0600867	.2567826	0.23	0.815	-.4483685	.5685418

Appendix II

Graphical representation on structural change due to COVID-19.





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