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FREIGHT FORECASTING ALONG NORTH SOUTH ECONOMIC CORRIDOR BASED ON FUZZY LINEAR REGRESSION

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Abstract

This paper aims to make a prediction of freight volume along NSEC (North South Economic Corridor) in a quantitative approach. To start, a brief introduction to NSEC is presented, in which the reason why the prediction is critical important in this field of research is explained and the basic three notions for this research are indicated. Afterwards, parameters of the freight volume is analyzed through GRA (Grey Analysis), then the model is to be set up for forecasting based on data in the past ten years (2005 to 2015). The following sections are the testing of the model for adjustment of the data and the mode as well. Thereafter, the forecasting of freight volume is concluded after the predication of parameters. Some limitations and recommendations are also presented for further study at the ending section.

Keywords: NSEC (North South Economic Corridor), GRA (Grey Analysis), FLR (Fuzzy Liner Regression), Freight Forecasting.

1. Introduction and Purpose

North South Economic Corridor (NSEC), as one of the nine corridors[1] in GMS[2], remains to be the flagship project under economic cooperation program of ADB (Asia Development Bank) in terms of demographic situation, traffic volume, connectivity, processing, markets and export nodes. Along this corridor, the current traffic volume is likely the highest considering its endpoint, Bangkok, Thailand, although in northern section, part ofthe exports might divert toHai Phong, Viet Nam. In addition, the connectivity could be demonstrated by 5 airports along the route (5 are international airports), proximity to railroad[3]and access to sea ports[4].Further, large concentration of Economic Zones (EZ's) around Bangkok(The United Kingdom of Thailand) and Border Economic Zone (BEZ) at border crossings facilitate the

[1]Currently, nine corridors in the GMS are: 1)North-South Corridor: Kunming to Bangkok; 2) Eastern Corridor: Kunming to Ca Mau; 3) East-West Corridor:Mawlamyine to Da Nang; 4) Southern Corridor: Dawei to QuyNhon/Vung Tau; 5) Southern Coastal Corridor: Bangkok to Nam Can; 6) Central Corridor: Kunming to Sihanoukville/Sattahip; 7) Northern Corridor: Fangcheng to Tamu; 8)Western Corridor: Tamu to Mawlamyine; 9) North eastern Corridor: Thanh Hoa to Bangkok/Laem Chabang.

[2]The Greater Mekong Subregion (GMS) is a natural economic area bound together by the Mekong River, covering 2.6 million square kilometers and a combined population of around 326 million(2013).

3 Largely parallel, from Bangkok to Chiang Mai (Thailand), section planned parallel from Chiang Rai (Thailand) to Menyang (Yunnan Province of PEOPLE'S REPUBIC OF CHINA (PRC)) and again from Mo-Chiang to Kunming (partly under construction).

[4]Bangkok (Thailand): Connection from Tak (Thailand) to Mawlamyine (Myanmar) or Bangkok (Thailand) to Dawei (Myanmar) might reduce time to Europe.

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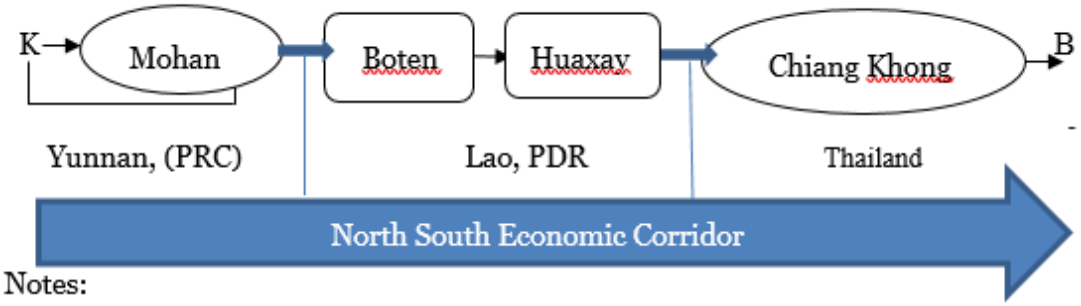
import or export of materials or semi-manufactures processed at BEZ or EZ and industrial compositions like electronics, car and car parts, food and food products, chemicals and timber (Lao PDR section) through exports nodes united by Kunming, People's Republic of China (PRC) (airport), Boten and Chiang Kong, Lao PDR (BEZ) as well as Bangkok, Thailand (airport, port).

In this paper, only one route Kunming–Bangkokvia the Lao PDR with two lines in Western Sub-corridor isstudied (See below Chart 1). The one route stretches as below two lines: Kunming–Yuxi -Xishuangbanna-Jinghong -Mohan-Boten, Louang Namthaprovince，Lao PDR-Houaxay, Bokeoprovince，Lao PDR- Chiang Khong, Thailand- ChiangMai - Lampang-Tak- KamphaengPhet-Nakhon Suwan-Ayutthaya–Bangkok. And the other one runs different from Chiang khong in Thailand as Chiang Khong -Phayao- Phrae- Uttaradit–Phitsanulok–NakhonSuwan -Ayutthaya–Bangkok.

Chart 1: Three Sections of NSEC



Notes:
K=Kunming, B=Bangkok,
[ ] represents points of border crossing.
Blue line indicates the boundary of economies.
Source: Authors.

This study is based on the three principal general notions. After its completion, NSEC would entail movement of people and goods along any node, which extends to the areas whose access to major economic centers and the movement could be strengthened through connecting these points as expected or planned. In addition, the study of this corridor is based on the general concept of making full use of the current or existing passage of NSEC, rather than complementing new access or investment into the corridor, which has been witnessed the completion in 2013. In other words, how to utilize this corridor to its utmost potentials, rather than investing complementarily, is one of the underlying purposes for this study. Further, solutions to the current physical connectivity should take the trend of cargo and passengers' volume at present and at future 5 or 10 years into account. So from the chronological aspects, the possible volume in the next 5 years or one or two decades could influence the regulations, cooperative strategies among members along this corridor and countermeasures for the obstacles quo. The existing researches, however, from the

perspectives of impact analysis in both positive and negative way, do not discuss how many freight or passengers could be expected after completion of this NSEC, or what is the difference between the real existing volume of cargo or passengers and the expected ones, which are what the policy makers of transportation planning should rely upon.

In addition, transportation planning plays an important role in a macro-level management system in every country, since its economic, social, cultural and political effects are quite obvious. In an efficient transportation network, all available modes are expected to operate consistently to decrease the traffic congestion on roadways. However, without using roadway networks, connecting all nodes is very expensive and to some extent impossible in practice. Therefore, the approximate estimation of road freight transportation (RFT) based on the current volume between various nodes is specifically remarkable in macro-level planning, which is particular the case in cross-border corridor with more than one members along NSEC.

This paper aims to make a prediction of freight volume along NSEC in a quantitative approach. Through Grey Analysis, setting-up the model, models testing and adjustment, and the forecasting of each parameter, can be concluded the forecasting of freight volume along NSEC for each calendar year in 2016 to 2015 based on the indicators in 2006 to 2015. Limitations and recommendation are also presented for further study.

2. Parameters

For the forecasting itself, the freight volume of road has close relations with the local economy so that the forecasting of freight volume along NSEC must take determinants or influencing factors into care consideration. From the theoretical way, more determinants will make the model of forecasting more accurate, which, however, would be complex and may go far away from the prediction. Further, too much determinants will result in the incomplete dependence among these determinants, which will lead to the distortion of the forecasting. Thus, it is critical to choose these determinants within manageable scope and with independent correlation.

Thus, some indicators are chosen to estimate the correlation with the road freight volume, such as GDP, POP, infrastructure investment, FDI (Foreign Direct Investment) and trade value. In this research, Grey Correlation (GRA, by Deng Julongin 1980s)[5] is adopted to calculate the correlation of freight volume with each parameters. More details of GRA application for correlation are as followed procedure.
Firstly, taking the initial value of road freight volume (m group) and 5 Parameters as a dimension; set

5Grey correlation analysis can quantitatively explain the uncertain relative situation during objects or the relative situation of system factors and main action which changes with time. It analyzes and confirms the influence degre e of factors according to the geometry approach degree of behavior actor list and data list, that is to say, it compar es them according to the similar degree of data list geometric relation and curves geometric shape, so takes the si milar degree of curves as the weigh yardstick of correlation degree.

$$Y= \{\frac{y(1)}{y(1)}, \frac{y(2)}{y(1)}, \dots \frac{y(i)}{y(1)}, \dots \frac{y(m)}{y(1)}\}$$

$$P(j)= \{\frac{x(j1)}{x(j1)}, \frac{x(j2)}{x(j1)}, \dots \frac{x(ji)}{x(j1)}, \dots \frac{x(5m)}{x(j1)}\} \quad (1 \le i \le m, \quad 1 \le j \le 5)$$

In above equations, Y is the first reference sequence of freight volume dimensions; $P_j$is the compared dimension of thej^{th} indicators' dimension (the first one); Y_i represents the actual data of freight volume in the i group; X_{ji} indicates the data of j^{th}indicator in the I group. I and j are integers.

Secondly, calculate the difference between the reference sequence and the comparison of sequences, that is,

$$\Delta(j\ i) = |Y(i) - P(ji)|$$

$$Y(i) = \frac{y(i)}{y(1)}$$

$$P(ji) = \frac{x(j\ i)}{x(j\ 1)}$$

For above equations, Y(i) is the data in I group of reference sequence; P(ji) is the value of the j^{th} indicator in the ithgroup in the sequence of comparison; and the $\Delta(j\ i)$ is the difference between the data in I group of reference sequence and the value of the j^{th} indicator in the ithgroup in the sequence of comparison.

Thirdly, working for the correlation coefficient, that is,

$$\varepsilon(j\ i) = \frac{\Delta\min + \rho\Delta\max}{\Delta(ji) + \rho\Delta\max} \qquad (\rho=0.5)$$

ρ is the recognition differential for avoiding the distortion due to high data of Δmax; $\varepsilon(j\ i)$ is the correlation coefficient between the value of the j^{th} indicator in the ithgroup and the freight volume in the ithgroup; Δmax is the maximum value of $\Delta(ji)$; and Δmin is the minimum among$\Delta(ji)$.

Lastly, getting the GRA, that is,

$$\varepsilon(j) = \frac{1}{m}\sum_{i=1}^{m} \varepsilon(j\ i)$$

$\varepsilon(j)$ refers to the GRA between the j^{th} indicator and the road freight volume y.

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3. Set-up of FLR Model

3.1 Parameters

The FLR model is needed to evolve to the forecasting model for road freight volume. In the classical regression analysis, the deviation between the forecasting value and the actual data is the observation error, which could be deemed as the fuzzy error since the input data and the output value are obfuscated. Thus, the relation between the road freight volume y and the social indicators is supposed as below

$$y=A_1x_1+A_2x_2+A_3x_3+A_4x_4+A_5x_5+ A_6x_6+A_7x_7 \quad (1)$$

In this equation, x_1, x_2, x_3, x_4, x_5 x_6 and $x_7$represent GDP in Thailand and Yunnan, POP in Thailand and Yunnan, road freight tonnage in Thailand and Yunnan and trade value between Thailand and Yunnan respectively. And A_1 to $A_7$are the coefficients of counterpart of x_1 to$x_7$accordingly.

In the equation (1), the A_1 should be regarded as the fuzzy coefficient in case of the regression analysis of this equation. Thus, the deviation of forecasting originates from the fuzzy amplitude, which can be demonstrated as a triangular fuzzy number

$(A_j \ (a_j, \ c_j))$ with the subordinate function like,

$$\mu A_j = \begin{cases} 1-\frac{|z-aj\ \ |}{cj} & a_j\text{-}c_j \le z \le a_j+c_j \\ 0 & \text{others} \end{cases} \quad (2)$$

For the above equation, z is the precise value of A_j; a_j is the central value of A_j and $c_j$is the fuzzy amplitude of A_j.

Therefore, the road volume $y_i$in the i^{th}group could be witnessed as the following subordinate function as

$$\mu_{y_i} = \begin{cases} 1-\frac{\left|y_i-\sum_{j=1}^{7} a_j X_{ji}\right|}{\sum_{j=1}^{7} c_j \left|X_{ij}\right|} \\ 0 \qquad\qquad others \end{cases} \quad (3)$$

$$\left(\sum_{j=1}^{7} a_j X_{ji} - \sum_{j=1}^{7} c_j \left|X_{ij}\right| \le y_i \le \sum_{j=1}^{7} a_j X_{ji} + \sum_{j=1}^{7} c_j \left|X_{ij}\right|\right)$$

3.2 Model Solution

When analysis is to be taken through the above equation (1), two assumptions should be met. Firstly, for any set of parameters (y_i,x_{1i}, x_{2i},..., x_{ji},...x_{5i}), set a parameter H (0≤H≤1), so,

$$\mu yi \geq H \qquad (4)$$

Secondly, fuzzy coefficient A_j has the fuzzy amplitude D as

$$D= \sum_{j=1}^{7} c_j X_{ji}$$

So to calculate the minimum D is to get fuzzy coefficient A_j.

$$\min D=\sum_{j=1}^{7} c_j X_{ji} \qquad (5)$$

$$\sum_{j=1}^{7} a_j X_{ji}\text{-}(1\text{-}H)\sum_{j=1}^{7} c_j \left|X_{ij}\right| \leq y_i$$

3.3 Goodness of Fit

Seeking for solutions to the equation (1), a certain standard should be adopted for the goodness of fit of the model through subordinate function μ_{y_i}, which represents a good degree of fitting in case that the value is bigger than 0.5.

$$\Phi=\frac{\left|y_i-\sum_{j=1}^{7} a_j X_{ji}\right|}{y_i} (6)$$

When the Φis within the scope of 30%, the goodness of fit is to be acceptable (Φis the ratio between the standard deviation (from the forecasting and actual value of road freight volume) and the actual value.

3.4 Deviation Analysis

When the deviation is compared with other methodology of forecasting, this paper adopts mean absolute deviation(MAD), maximum relative error (MMRE)and Mean Relative Error (MRE) for comparison.

Thus, the MAD in the fuzzy linear regression model is

$$\left|\ \bar{e}\ \right|=\frac{1}{m}\sum_{i=1}^{m} \left|e_i\ \right| = \frac{1}{m}\sum_{i=1}^{m} \left|\ y_i - y_{oi}\ \right| \qquad (7)$$

$e_i$is the absolute deviation in the i^{th}group and y_{oi} is the correspondent forecasting value.

And the MRE is to be

$$\bar{\varepsilon}==\frac{1}{m}\sum_{i=1}^{m} \left|\frac{ei}{y_i}\right|=\frac{1}{m}\sum_{i=1}^{m} \left|\frac{y_i-y_{oi}}{y_i}\right| \quad (8)$$

So, the relative deviation and the MMRE are respectively

$$\varepsilon_i=\frac{y_i-y_{oi}}{y_i} \quad (9)$$

$$\varepsilon_{max}=\max(\varepsilon_i) \quad (10)$$

4. Data and Result

4.1 Introduction to Data

In usual case, the data related with the freight volume in international trade are consisted of GDP, POP, FDI, and trade volume or value and road tonnage. The NSEC, however, are mainly the passage for vegetables and fruits in trade between Thailand and Yunnan (ADB, 2016), thus this predication deletes the parameter FDI, which is less involved in the trade of fruits and vegetables and occupies high percentage of GDP in Thailand case (see Table 1) and thus, is detrimental for the predication result provided that GDP and FDI are the two parameters for forecasting.

Table 1: FDI Inward Percentage of GDP, Thailand and Yunnan

	Thailand			Yunnan, PRC		
Year	GDP	FDI	Percentage	GDP	FDI	Percentage
2001	115.54	34.75	30.08	25.83	0.65	2.52
2002	126.88	39.92	31.46	27.94	1.12	4.01
2003	142.64	51.18	35.88	30.88	1.68	5.44
2004	161.34	55.15	34.18	37.24	1.42	3.81
2005	176.35	62.83	35.63	42.26	1.74	4.12
2006	207.09	80.54	38.89	50.02	3.02	6.04
2007	246.98	96.56	39.10	62.74	3.95	6.30
2008	272.58	96.64	35.46	81.92	7.77	9.56
2009	263.71	110.07	41.74	90.32	9.10	10.1
2010	318.91	142.50	44.68	106.70	13.29	12.50
2011	345.67	150.52	43.54	137.63	17.38	12.63
2012	365.97	159.12	43.48	163.32	21.89	13.40
2013	400.92	185.46	46.26	184.96	25.15	13.60
2014	422.29			198.82		
2015	413.00			216.12		

Notes: GDP and FDI are calculated in billion US$.
Percentage is indicated by %.
Source: calculation by authors based on www.tcpdf.org.

Thus, in this paper, the selected parameters for prediction are GDP, POP, road freight tonnage and trade value. Their statistics are shown in Table 2.

Table 2: Statistic Data-1

Economies	Thailand			Yunnan, PRC		
Year	GDP	Freight	POP	GDP	Freight	POP
2006	207.09	427,581	63.16	50.02	606,140	44.83

2007	246.98	428,123	63.32	62.74	655,370	45.14
2008	272.58	424,456	63.48	81.92	391,190	45.43
2009	263.71	423,677	63.63	90.32	407,650	45.71
2010	318.91	420,449	63.79	106.70	456,650	46.02
2011	345.67	406,538	64.08	137.63	541,860	46.31
2012	365.97	425,804	64.36	163.32	632,390	46.59
2013	400.92	426,086	66.75	184.96	986,750	46.87
2014	422.29	425,184	67.00	198.82	1,004,234	47.14
2015	413.00	426884	67.20	216.12	1,094,950	47.14

Table 2: Statistic Data-2

Year	Thailand-Yunnan's Trade	Thailand-Yunnan's Volume by Road
2006	1.31	235,640
2007	2.2	230,751
2008	2.5	328,088
2009	2.3	381,258
2010	4.63	619,729
2011	7.4	764,060
2012	10.85	911,845
2013	10.49	1,139,189
2014	10.73	1,531,529
2015	16.88	1,453,000

Notes:

GDP: Gross domestic product (current prices) (Billion US Dollar)

Freight: Road freight tonnage (1000 tones)

POP: Population (Total number of people living in a country / region in millions)

Trade: Thailand - Yunnan trade (current prices)（Hundred Million Us Dollar）

Volume: Cargo volume via Mohan Border Crossing (tones)

Source:

GDP, Freight and POP, GREATER MEKONG SUBREGION STATISTICS on Growth, Connectivity and Sustainable Development, Nay Pyi Taw, Myanmar, 20th Ministerial Conference,10 SEPTEMBER 2015; Thailand-Yunnan Trade, authors collection from the Year Book of Yunnan, 2006-2015; Volume, collection from field visit.

Table 3, from Appendix 1-Correlation Degree Analysis, is the grey correlation of each parameter to the cargo volume. The table indicates that all parameters represent close relation with the cargo volume to the percentage of more than 60%. In particular, the road freight in Thailand has closer correlation to the volume, reaching to 1.57.

Table 3: Correlation Degree

	Thailand			Yunnan			Yunnan-Thailand
Parameters	GDP	Freight	POP	GDP	Freight	POP	Trade
Correlation	0.66	1.57	0.68	0.70	0.61	0.65	0.70

Source: Authors' Calculation.

So, we can select those with more than 70% of correlation to set up the model as

$y= A_2x_2+A_4x_4+A_7x_7$

Then, we take the previous data in year 2006 to 2015 into the model (H=0.8). With the EXCEL software, the fuzzy coefficients are concluded to be (0.000,0.000), (3168.869,0.000) and (58570.933,84602.620) respectively. Thus, we can conclude the predictive model as$y= A_4x_4+A_7x_7$.

4.2 Model's Result

The result is shown in Table 4, with the comparison between the analogue value and true data (volume via Mohan Border Crossing (tones)) in Graph 1.

Table 4: Model Result-1

Year	Predicative Volume	True Volume	Deviation
2006	235234.7358	235640.00	0.001719845
2007	327670.8764	230751.00	0.420019313
2008	406021.0584	328088.00	0.237537058
2009	420925.369	381258.00	0.104043375
2010	609301.7128	619729.00	0.016825559
2011	869556.3071	764060.00	0.138073328
2012	1153034.264	911845.00	0.264506867
2013	1200523.047	1139189.00	0.053840098
2014	1258500.591	1531529.00	0.178271785
2015	1673533.259	1453000.00	0.15177888

Source: Department of Commerce of Yunnan Province, http://www.bofcom.gov.cn/bofcom/432926140726771712/20160518/398312.html; Ministry of Commerce of People's Republic of China, http://www.mofcom.gov.cn/article/resume/n/201509/20150901108031.shtml.
Authors' Calculation.

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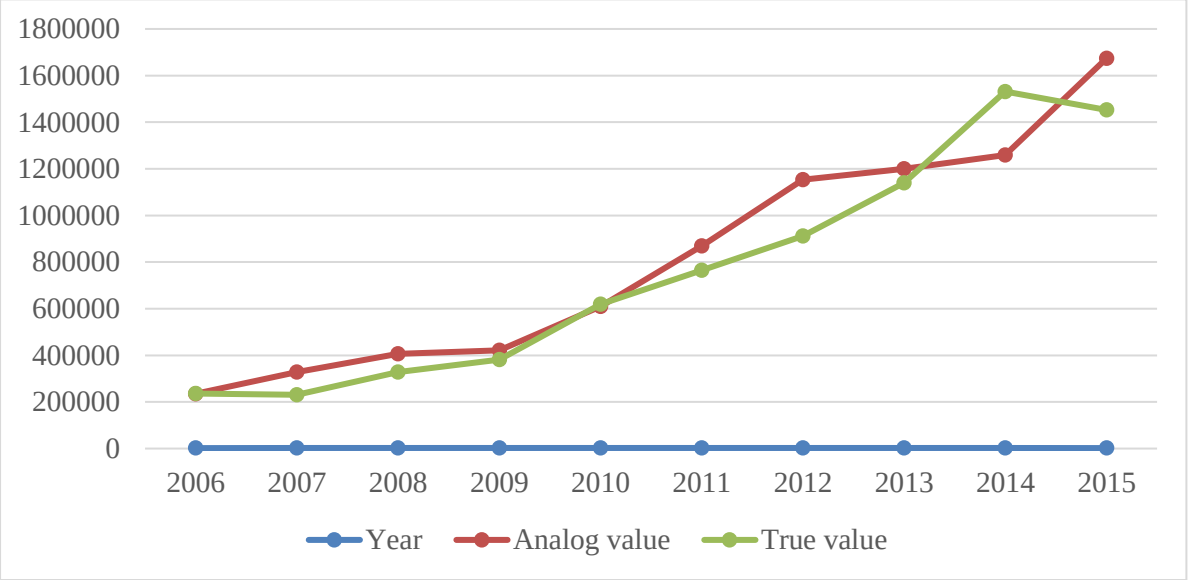
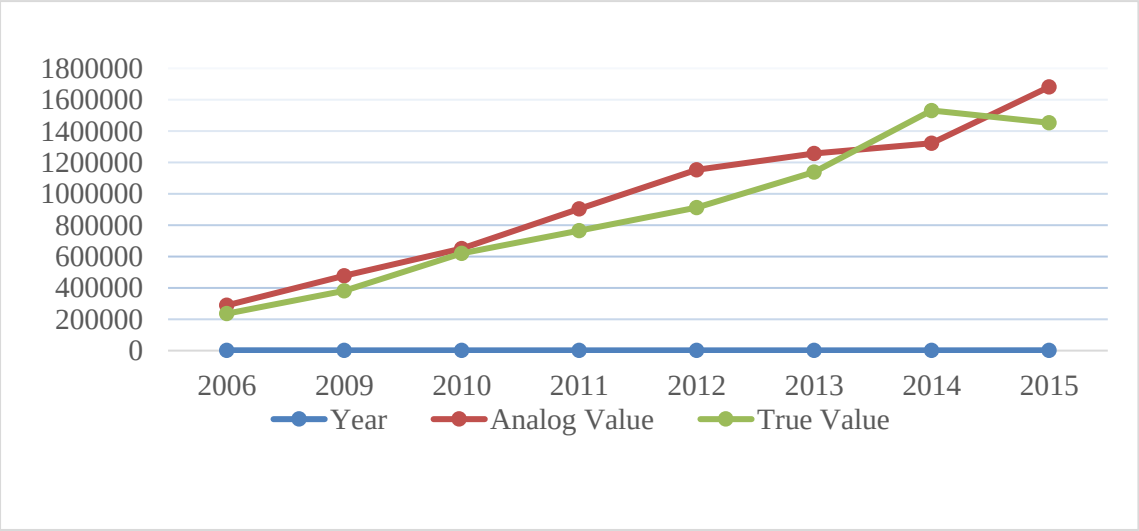
Graph 1: Comparison of Predictive and True Value-1



Notes: Volume means cargo volume via Mohan Border Crossing (tones)
Source: Authors' Calculation.

Graph 2: Comparison of Predictive and True Value-2



Notes: Volume means cargo volume via Mohan Border Crossing (tones)
Source: Authors' Calculation.

From both above charts, the two maximum deviation occurs in the year of 2007 and 2014, reaching to about 42 percent and 43 percent, higher than the acceptable benchmark 30%. It is understandable that the year of 2007 witnessed the signs for the financial crisis erupted in 2008, in which economies with certain extent of reliance on the export-orientation would be

detrimental and run in abnormal manners since the breakout of the crisis, and the year 2014 is the first year after the completion of NSEC in the end of the 2013. Thus, the data in the year of 2007 and 2014 can be deducted from the result as above two graphs. In addition, with the t-test as 0.148560805, we can conclude that the model is acceptable for the forecasting.

5. Predication of Freight

Therefore, the above model indicates that the fuzzy liner regression model could be adopted for the prediction expected. So, the first step is to estimatethe twoparameters so as to conduct the model for analog value of freight along NSEC.

5.1 Prediction of Parameters

In this paper, the predication of GDP in Yunnan and the trade value between Yunnan and Thailand could make access to the predication of freight volume along NSEC. The GDP growth rate in China has been adjust to about 6.7% by Chinese government. While Yunan's GDP growth rate is a little higher than that of the growth rate in China, so this paper will adopt 7% growth rate for forecasting of GDP in Yunnan. And 8% is to be adopted for forecasting the value of trade between Yunnan and Thailand, in accordance with the past data's trend.

Table 5: Forecasting Result of Parameters

Year	GDP(Yun)	GDP(Prediction)	Trade	Trade ((Prediction)
2006	50.02		1.31	
2007	62.74		2.2	
2008	81.92		2.5	
2009	90.32		2.3	
2010	106.70		4.63	
2011	137.63		7.4	
2012	163.32		10.85	
2013	184.96		10.49	
2014	198.82		10.73	
2015	216.12		16.88	
2016		231.2484		18.2304
2017		247.4358		19.688832
2018		264.7563		21.26393856
2019		283.2892		22.96505364
2020		303.1195		24.80225794
2021		324.3378		26.78643857
2022		347.0415		28.92935366
2023		371.3344		31.24370195
2024		397.3278		33.74319811
2025		425.1408		36.44265395

Notes:

GDP: Gross domestic product (current prices) (Billion US Dollar)

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Trade=Trade between Thailand and Yunnan

Source:

GDP, GREATER MEKONG SUBREGION STATISTICS on Growth, Connectivity and Sustainable Development, Nay Pyi Taw, Myanmar, 20th Ministerial Conference,10 SEPTEMBER 2015; Thailand-Yunnan Trade, authors collection from the Year Book of Yunnan, 2006-2015. Authors' Calculation.

5.2 Prediction of Freight Along NSEC

With the parameters estimate in the future each individual calendar year, the forecasting of freight along NESC could be concluded in Table 5, based on the model set up in equation (3).

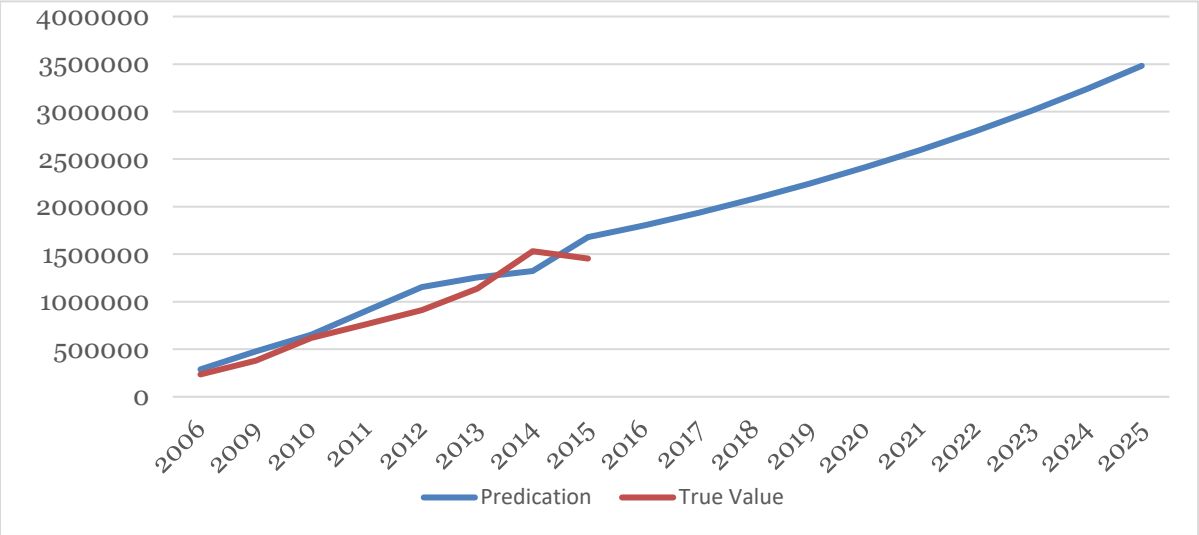
Table 6: Forecasting Result in year 2016-2025

Year	Predicative Volume
2016	1800567
2017	1937285
2018	2084427
2019	2242791
2020	2413237
2021	2596691
2022	2794148
2023	3006683
2024	3235450
2025	3481695

Notes: Volume means cargo volume via Mohan Border Crossing (tones)
Source: Authors' Calculation.

From the graphs below, the general trend of the analogue value is indicated. Except the data in the year of 2007 and 2008, the line shows a gradually increasing trend the nearly 2 decades, without too much fluctuation and obvious peak and bottom data. So the liner image from the diagram could be easily demonstrated, with the below chart (Chart 5-1) as a complementary information.

Graph 3: Forecasting Result-Line Graph in year 2016-2025



Notes: Volume means cargo volume via Mohan Border Crossing (tones)
Source: Authors' Calculation.

Conclusion

The general conclusion of this research could be summarized as below. For the freight volume along NSEC, which comes mainly from the trade between Thailand and Yunnan province, PRC, parameters like GDP, POP, Road Freight Tonnage and the trade between Thailand and Yunnan have the close relation with the freight volume, but the correlation degree vary among them and is distinguishing between economies. GDP and POP in both Thailand and Yunnan relates with the freight to the similar level at approximately 64 percent to 69 percent, which indicate that the macroeconomic levels of economies are one of the driving forces of foreign trade, entailing the transnational logistics demand and more freight volume. For the better interdependence of the parameters, FDI is deleted from such variables due to its high correlation with GDP. And road freight tonnage, with the one in Thailand as the most obvious performance, contributes to the freight along this corridor. In particular, the trade between Thailand and Yunnan relates with the cargo to nearly 70 percentages, a good demonstration of the reliance of freight on trade demand. And for the degree of the correlation in terms of the individual economy, Thailand makes the contribution bigger than Yunnan does.

For the freight prediction, the fuzzy liner regression performs well with the deviation within 30 percent, based on data in 2006 to 2015. Considering the financial crisis in 2008, the authors remove the data in 2007 and 2008 for a general testing and adjusting of the model. Afterwards, such predicative parameters are developed into the fuzzy liner regression model and thus, come to the conclusion of the forecasting of freight along NSEC. The total analogue value since 2006 to 2025 shows a gradually climbing up tendency, representing the slope into a liner manner. And the volume in 2025 would be about 1.26 times than the value in 2015 and 12.98 times than it in 2006.

This research, however, exists the following limitations. Firstly, in real practice, the actual freight volume in 2015 is more than 10 times of the one in 2006, a sharp increase in 10 years, in which the year 2014 witnesses the hoist with the biggest ratio. It can be concluded that there are some other factors, quantitative ones in particular, which may occur in the further uncertain years, must influence the freight. Thus, a further research should focus on the qualitative aspects affecting the freight along this corridor such as un-unified regulations, policies in both economic and political, road conditions and maintenance, security situations, officers' proficiency, language barriers and geographical conditions. Secondly, this corridor passes through three economies via border crossings, where some illegal and uncontrollable boundary trade occurs every day, so it is understandable data collection to the utmost accuracy cannot be reached. This is also even the case for customs of three members along this corridor. Therefore, another research is proposed for the control of the illegal trade for a better statistics. Thirdly, the trade value between Thailand and Yunnan province is the key parameters for the forecasting, the freight of this corridor are mainly from the trade, PRC, which may affected by trade complementarities and competitiveness of traded commodities as well as other political and economic factors. So, another separate research to study the bilateral trade in both quantitative and qualitative perspectives are also suggested. And fourthly, the data adopted in this research are mainly referred from Chinese sides, which may differ from the ones supposed they are statistics from Thai and Lao parts. This phenomenon implies that the sharing of the information and unified statistics access among members as well as its security, at least at the cooperative arenas, should be conducted as soon as possible.

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