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# THE TIME SERIES ANALYSES AND PATTERN IDENTIFICATION OF TRADING VALUES FOR TAIWAN

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# ABSTRACT

The monthly exporting and importing data from January 1988 to April 2019, totally 376 months, were used to systematically study the trading time series of Taiwan. The data used to analyze were obtained from the public archives of Directorate-General of Budget, Accounting, and Statistics (DGBAS), Ministry of Finance (MOF), and Bureau of Foreign Trade (BFT) of Taiwan, Republic of China. After analyses, the author found that Asia was the most important trading continent for Taiwan in exporting and importing. The average exporting values from Taiwan to Asia was accounted for 71.67% of Taiwan's total exporting amount. China was the most important country for the exportation of Taiwan in Asia, and it shared an average of 56.37% of exporting values in Asia. ASEAN (10 nations) became the second largest trading zone for the exporting of Taiwan in Asia, and it grabbed 24.98% of the exporting amount in Asia. After scrutinizing ASEAN, the author found that the most important exporting country was Singapore, and it shared 30.58% of exporting values from Taiwan to ASEAN.

As for the importing values, Asia grasped champion, 59.13%, of the total importing values from the whole world. China held the pinnacle in Asia, with 33.14% of total importing values from Asia. Singapore crowned the throne in ASEAN, and it shared 26.40% of the total importing values from ASEAN to Taiwan.

The autoregressive integrated moving average (ARIMA) method was used to identify the trading patterns between Taiwan and the whole world. With the help of autocorrelation function (ACF) and partial autocorrelation function (PACF), the author found that  $ARIMA(3,1,1)(1,1,1)_{12}$  model can be used to simulate and to do the short-term forecast of the total exporting and importing values of Taiwan. By using the proposed  $ARIMA(3,1,1)(1,1,1)_{12}$  model to do the error analyses for the total exporting and importing values, the average monthly trading amount biased 5.81% and 4.55%, respectively.

Key Words: ARIMA, Forecast, Pattern Identification, ASEAN

# 1. Introduction

The legacy of David Ricardo who developed the principle of comparative advantage as we know today in 1817, more than 200 years ago [1]. He showed that the two countries can get mutual benefits by opening up trade and specializing based on comparative advantage [1]. One of the ten economics principles- trade can make everyone better off, also given by the well know Harvard University Professor N. Gregory Mankiw in his famous textbook [1]. Trading between two countries can be a double-wins condition as long each side has its own relative advantage. As

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long as the opportunity cost of one country is less than the other one, that country has the advantage of that merchandise. Gains from trade does not depend on the absolute advantage, that is, the ability to produce a good using fewer inputs than another producer, but on relative advantage [1].

Taiwan is a small country, lack of bountiful natural resources, but brilliant government selected free-trade policies, that is, open-door to the whole world. The legacy of David Ricardo really fulfilled in Taiwan, that is, with the advantage of opportunity cost in producing, can gain profits from the world. Based on the Directorate-General of Budget, Accounting and Statistics (DGBAS) of Taiwan's archive, the nominal GDP per capita was only 154 USD in 1951, but in 2018 reached 21,566 USD, that is, 140 times increasing [3]. DGBAS Taiwan even forecasted that GDP per capita can reach 24,827 USD in 2019 [3]. China became an open- trade country in the late 60s of last century, in less than 50 years, it already became the largest world economy based on the purchasing power parity (PPP) calculation [2]. History is a mirror, those open-door and free-trade countries such as Taiwan, Hong Kong, Korea, and Singapore are more prosperous than those imply protectionism ones. Taiwan wisely adopted open-door free-market policies, making this country became one of the richest nations in Asia.

The author subtracted time series data from the public archives of reliable governmental organizations such as Directorate-General of Budget, Accounting and Statistics (DGBAS) [3], Ministry of Finance (MOF), R.O.C. [4], and Bureau of Foreign Trade (BFT) [5]. To systematically analyze the global trading, find out trading patterns, and use those patterns to do short-term forecasting are the purposes of this paper. At least 50 data are needed to find out exporting and importing patterns [11,12], hence, monthly data from January 1988 to April 2019 were used, totally 376 months.

In the first section, exporting and importing values and ratios (%) of Taiwan and the whole world (eight continents) were discussed. From this section, one can find whether Taiwan was a trade surplus or deficit country.

In the second section, the exporting and importing values and ratios of eight continents (Asia, Middle East, Europe, North America, Central America, South America, Oceania, and Africa), Asia and ASEAN were analyzed to find out the important trading partners.

In the third section, the total exporting (from Taiwan to the world) and importing (from the world to Taiwan) patterns were obtained by judging autocorrelation function (ACF) and partial autocorrelation function (PACF) [11]. As long as suitable patterns were identified, then use them to do short-term forecasting. It is important to forecast the trading values of Taiwan so that the government can adjust suitable policies accordingly.

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# 2. Total exporting and importing values of Taiwan

In this section, the total exporting and importing values of Taiwan were discussed. The monthly trading time series were obtained from the public archives of DGBAS [3], MOF [4], and BFT [5] from January 1988 to April 2019, totally 376 months.

# 2.1 Monthly total exporting and importing values



Figure 1: Total exporting and importing values per month in million USD of Taiwan from January 1988 to April 2019

The exporting and importing values per month of Taiwan from January 1988 to April 2019 (376 months) had a trend of increasing. There was a drop in January 2009 because of the financial crisis around the world [1,6].

In the past 40 months (January 2016 ~ April 2019), the average exporting values per month of Taiwan was 25891.96 million USD; and for the average importing values per month was 21668.01million USD. The balance value was positive, it means that Taiwan was a trade surplus country [1].

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Figure 2: The ratios (%) of total exporting and importing values of Taiwan from January 1988 to April 2019

In the past 40 months (January 2016~ April 2019), the average exporting value was about 54.5% of the total trading values of Taiwan, and importing values was accounted for the rest 45.5%.



Figure 3: Trade balance (exporting values minus importing values) of Taiwan from January 1988 to April 2019

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There were 14 months in the past 376 months with trade deficits (14/376=3.72%), that is, the exporting values less than the importing values. Basically, Taiwan was a trade surplus country [1].

Table 1: The average total trading, exporting, importing values per month of Taiwan from January 2016 to April 2019 (40 months)

Average values of the past 40 months	Total trading values	Total exporting values	Total importing values
Million USD	47559.97	25891.96	21668.01
(Percentage %)	(100%)	(54.5%)	(45.5%)



Figure 4: Average total exporting and importing values per month



Figure 5: Total exporting and importing values expressed in percentage (%)

From the above figures, it is easily found that Taiwan was a trade surplus country.



# 2.2 Monthly total exporting values from Taiwan to the world

Figure 6: Exporting values per month from Taiwan to eight continents from January 1988 to April 2019

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From the figure above, obviously, Asia was the most important continent of Taiwan's exportation, and North America was accounted for the second, followed by Europe. The average exporting values from Taiwan to eight continents from January 1988 to April 2019 were listed in the following table.

Table 2: Average exporting values in million USD from Taiwan to eight continents per month from January 2016 to April 2019 (40 months)

Average exporting values	Asia	Middle East	Europe	North America	Middle America	South America	Oceania	Africa	Unidentified
Million USD	18582.30	505.18	2422.12	3300.97	258.44	210.40	342.08	165.90	104.58



Figure 7: The average exporting values per month from Taiwan to eight continents from January 2016 to April 2019

The definition of unidentified countries given by FRED is: First, missing observations can appear because no exports were made to the listed country that year. Secondly, it could signify a low number of exporters thus giving away proprietary data away [7]. The small amount of exporting values from Taiwan to the unidentified country only shared 0.4% and can be neglected without damage the accuracy of the analysis.

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Figure 8: The exporting values in ratios (%) from Taiwan to eight continents from January 1988 to April 2019

From January 1988 to February 1990, North America was the champion of the ratio of exporting of Taiwan. However, after March 1990 Asia became the leading sheep, and its ratio increased continually. In contrast with Asia, the ratio of exporting values from Taiwan to other continents dwindled gradually.

The average ratios (%) of exporting values from January 2016 to April 2019 (40 months) shows that the share of Asia was accounted for 71.69%, which was too big to be ignored.

Table 3: Average exporting values in ratios (%) from Taiwan to eight continents per month from January 2016 to April 2019 (40 months)

Average exporting values in ratio	Asia	Middle East	Europe	North America	Middle America	South America	Oceania	Africa	Unidentified
Percentage (%)	71.69	1.97	9.38	12.77	1.00	0.81	1.32	0.65	0.40

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Figure 9: Average exporting values in ratios (%) from Taiwan to the eight continents (January 2016 to April 2019)

#### 2.2.1 Monthly exporting values from Taiwan to Asia



Figure 10: Exporting values from Taiwan to Asia from January 1988 to April 2019

From January 1988 to July 1990, Japan was the number one country for Taiwan's exporting values in Asia. After August 1990, China (including Hong Kong and Macau) excelled Japan to be the champion of Taiwan's exporting values in Asia. ASEAN also surpassed Japan, the 10 nations union, became the second largest area of the exporting values of Taiwan after June 1993. Japan was the third largest of the exporting country for Taiwan in Asia.

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Table 4: Average of 40 months (2016/1~2019/4) exporting values per month from Taiwan to Asian countries

Exporting	China	Japan	Korea	ASEAN	Other Asian
countries					Countries
Million	10508.15	1772.04	1230.04	4621.71	449.85
USD					



Figure 11: The average exporting values per month from Taiwan to Asia (January 2016 to April 2019)

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Figure 12: The exporting values in ratios (%) from Taiwan to Asia from January 1988 to April 2019

The ratios expression of the exporting values from Taiwan to Asia was expressed in the above figure. The 40 months' average ratios of exporting from Taiwan to China, ASEAN, and Japan were 56.37%, 24.98%, and 9.58% respectively. China and ASEAN totally were accounted for 81.35% of the exporting values of Taiwan in Asia. The detailed percentages of each major trading partners were shown in the following table.

Table 5: Average of 40 months (2016/1~2019/4) exporting values per month in ratios (%) from Taiwan to Asian countries

Exporting countries	China	Japan	Korea	ASEAN	Other Asian Countries
Percentage (%)	56.37	9.58	6.64	24.98	2.43

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Figure 13: The average exporting values in ratios (%) from Taiwan to Asia (January 2016 to April 2019)

# 2.2.2 Monthly exporting values from Taiwan to ASEAN

ASEAN was the second most important areas in Asia for the exportation of merchandises of Taiwan. This subsection was dedicated to further discussing the trades between Taiwan and ASEAN.



Figure 14: Exporting values from Taiwan to ASEAN from January 1988 to April 2019

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Table 6: The average exporting values per month of the past 40 months (2016/1~2019/4) from Taiwan to ASEAN

Countries	Singapore	Malaysia	Indonesia	Viet Nam	Thailand	Philippines	Cambodia	Myanmar	Brunei Darussalam	Laos
Million USD	1409.70	795.37	255.78	859.03	497.59	727.10	55.63	19.95	1.05	0.51



Figure 15: The average (January 2016 to April 2019) exporting values per month in million USD from Taiwan to ASEAN

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Figure 16: Exporting values from Taiwan to ASEAN in ratios (%) from January 1988 to April 2019

Table 7: The average exporting values in ratios (%) of the past 40 months ( $2016/1 \sim 2019/4$ ) from Taiwan to ASEAN

Countr ies	Singap ore	Malay sia	Indone sia	Viet Nam	Thaila nd	Philippi nes	Cambo dia	Myan mar	Brunei Darussa lam	La os
Millio n USD	30.58	17.15	5.53	18.5 9	10.78	15.70	1.21	0.43	0.02	0.0 1

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Figure 17: The average exporting values (January 2016 to April 2019) in ratios (%) from Taiwan to ASEAN

Singapore, Viet Nam, and Malaysia were the three most important exporting partners for Taiwan in the past 31 years. The average exporting values in ratios (%) of these three countries were 30.58%, 18.59%, and 17.15%, respectively.

# 2.3 Monthly total importing values from the world to Taiwan



# Figure 18: Importing values in million USD from the world to Taiwan from January 1988 to April 2019

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Asia was the most important continent for importing merchandises to Taiwan. The time series of the importing values from eight continents to Taiwan had a trend of increasing. Similar to the exporting curves, the importing time series had a drop around January 2009 due to financial crisis [6], and it was obviously observed especially in Asia.

The average importing values from the eight continents to Taiwan from January 2016 to April 2019 (40 months) were summarized in the following table.

Table 8: Average importing values per month from the eight continents to Taiwan from January 2016 to April 2019 (40 months)

Average exporting values	Asia	Middle East	Europe	North America	Middle America	South America	Oceania	Africa	Unidentified
Million USD	12806.77	1895.20	2648.38	2775.92	139.59	331.71	816.64	245.97	7.83



Figure 19: The average importing values per month from the eight continents to Taiwan from January 2016 to April 2019 (40 months)

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Table 9: The average importing values in ratios (%) from the eight continents to Taiwan from January 2016 to April 2019 (40 months)

Average exporting values	Asia	Middle East	Europe	North America	Middle America	South America	Oceania	Africa	Unidentified
Million USD	59.13	8.67	12.24	12.83	0.65	1.55	3.75	1.15	0.04



Figure 20: The average importing values in ratios (%) from the eight continents to Taiwan from January 2016 to April 2019 (40 months)

#### 2.3.1 Monthly importing values from Asia to Taiwan

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Figure 21: The average importing values from Asia to Taiwan from January 1988 to April 2019

Table 10: The average importing values per month from Asian countries to Taiwan

Importing	China	Japan	Korea	ASEAN	Other Asian
countries					Countries
Million USD	4256.05	3521.47	1406.96	2591.37	1030.88



Figure 22: The average importing values per month from Asia to Taiwan from January 2016 to April 2019 (40 months)

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The average importing values from China to Taiwan was 4256.05 million USD per month, followed by Japan, 3521.47 million USD. The third largest area of importation in Asia was ASEAN, 2591.37 million USD per month.



Figure 23: The importing values in ratios (%) from Asia to Taiwan from January 1988 to April 2019

The above figure was interesting. Japan was the most important country in Asia for Taiwan's importation from January 1988 to October 2012. From November 2012 China began to surpass Japan to be the number one country for Taiwan's importation. China also excelled ASEAN from November 2005, and ASEAN was the third largest area in Asia for Taiwan's importation.

Table 11: The average importing values in ratios (%) from Asian countries to Taiwan

Importing countries	China	Japan	Korea	ASEAN	Other Asian Countries
Percentage (%)	33.14	27.73	10.93	20.20	8.01

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Figure 24: The average importing values in ratios (%) from Asia to Taiwan from January 2016 to April 2019



# 2.3.2 Monthly importing values from ASEAN to Taiwan

Figure 25: The average importing values per month from ASEAN to Taiwan from January 1988 to April 2019

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Table 12: The average importing values per month of the past 40 months (2016/1~2019/4) from ASEAN to Taiwan

Countr ies	Singap ore	Malay sia	Indone sia	Viet Nam	Thaila nd	Philippi nes	Cambo dia	Myan mar	Brunei Darussa lam	La os
Millio n USD	681.83	651.5 6	404.89	273. 93	352.1 2	194.71	7.20	5.54	18.25	1.3 5



Figure 26: The average importing values from ASEAN to Taiwan from January 2016 to April 2019 (40 months)

Singapore, Malaysia, and Indonesia were the three most important countries in ASEAN for Taiwan's importation. The average importing values per month were 681.83, 651.56, and 404.89 million USD, respectively.

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Figure 27: The importing values per month in ratios (%) from ASEAN to Taiwan from January 1988 to April 2019

Table 13: The average importing values per month in ratios (%) of the past 40 months  $(2016/1 \sim 2019/4)$  from ASEAN to Taiwan

Countries	Singapore	Malaysia	Indonesia	Viet Nam	Thailand	Philippines	Cambodia	Myanmar	Brunei Darussalam	Laos
Million USD	26.40	24.92	15.65	10.49	13.72	7.59	0.28	0.22	0.68	0.05



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Figure 28: The average importing values in the ratios (%) from ASEAN to Taiwan from January 2016 to April 2019 (40 months)

Singapore shared 26.40% of the importing values from ASEAN, Malaysia, 24.92%, and Indonesia, 15.65%.

# 3. Patterns identification and forecasting

This section is used to identify the patterns of exporting and importing values between Taiwan and the whole world (eight continents). If the patterns can be identified, then can use that model to do short-term forecasting.



# 3.1 Pattern identification of total exporting values from Taiwan to the world

Figure 29: Total exporting values from Taiwan to the world from January 1988 to April 2019 The time series of the total exporting values from Taiwan to the eight continents was shown above. It had a trend of growing up except that there was a big drop at the end of the year 2008, in which the financial crisis occurred [6].

Scrutinizing the above figure, one found there had a period of approximately12 months. The following table also showed that from 1988 to 2018 (31 years), the minimum exporting values occurred most frequently in February (23 times), and six times happened in January. In other words, there was 93.5% of minimum exporting values from Taiwan to the world occurred in either January or February, that is, with a period approximately 12 months. If the trading pattern of the total exporting values can be identified, use it to perform a short-range forecast.

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Table 14: The minimum total exporting values occurred in a year (1988 ~2018)

Minimum total exporting values occurred the month	Jan	Feb	Sep	Dec
Counting times	6	23	1	1

The autocorrelation function (ACF) and partial autocorrelation function (PACF) can be used to identify the possible pattern of the ARIMA (autoregressive integrative moving average) model [11,12].



Figure 30: Autocorrelation function (ACF) of the total exporting values from Taiwan to the world



Figure 31: Partial autocorrelation function (PACF) of the total exporting values from Taiwan to the world

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With the ACF and PACF from the above figures, by comparing with the standard patterns given by Hanke and Wichern [11], one found that  $ARIMA(3,1,1)(1,1,1)_{12}$  might be a good model.

## **3.1.1** Error analysis of the real and forecasting values of the total exportation

If the proposed ARIMA(3,1,1)(1,1,1)<sub>12</sub> model was suitable for the export trade forecasting of Taiwan, then the error for each month should be in an acceptable range. By using the monthly exporting values (January 1998 to December 2017, 360 months) with ARIMA(3,1,1)(1,1,1)<sub>12</sub> model to forecast the next 12 months values, the data in the following table can be obtained.



Figure 32: The ACF of the residuals of  $ARIMA(3,1,1)(1,1,1)_{12}$  model for the total exporting values from Taiwan to the world

From the above ACF figure, one found that the autocorrelation coefficients of the residuals of the ARIMA $(3,1,1)(1,1,1)_{12}$  model were within two standard errors of the mean (between two red lines). It meant the residuals were free from autocorrelation, and it approves that ARIMA $(3,1,1)(1,1,1)_{12}$  model was a suitable one for exporting forecasting [11,12].

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	Real value	Forecast value	Error in value	
Year/Month	(Million USD)	(Million USD)	(Million USD)	Error in ratio (%)
2018M01	27363.93	27856.22	492.29	1.80
2018M02	22355.02	25242.08	2887.06	12.91
2018M03	29985.19	30235.15	249.96	0.83
2018M04	26717.03	29154.61	2437.57	9.12
2018M05	29105.13	30446.89	1341.77	4.61
2018M06	28241.22	29555.35	1314.13	4.65
2018M07	28354.96	30168.32	1813.36	6.40
2018M08	28277.18	30573.04	2295.87	8.12
2018M09	29620.14	29894.89	274.75	0.93
2018M10	29545.09	31173.39	1628.30	5.51
2018M11	27781.57	30274.06	2492.50	8.97
2018M12	28562.16	30251.97	1689.81	5.92
Average	27992.38	29568.83	1576.45	5.81

Table 15: Error analysis of  $ARIMA(3,1,1)(1,1,1)_{12}$  model

The average error was only 5.81% of the year 2018, and it was an acceptable value.

Table 16: Forecasting 2019 total exporting values in million USD by the  $ARIMA(3,1,1)(1,1,1)_{12}$  model

Year	January	February	March	April	May	June	July	August	September	October	November	December
2019	27140	26799	27099	27569	27284	28099	27366	27510	26291	22519	28204	26538

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# **3.2** Pattern identification of total importing values from the world to Taiwan

Figure 33: Total importing values from the world to Taiwan from January 1988 to April 2019

The time series of the importing values from the world to Taiwan had a trend of increasing. Similar to the total exporting curve, the importing value had a drop after August 2008 due to financial crisis [6], and reached the bottom in January 2009, then bouncing back gradually.

Scrutinizing the time series, it had a period of approximately 12 months. From the table below, from 1988 to 2018 (31 years) the importation with minimum values occurred six times in January and 21 times in February. If one could find a suitable mathematical model to simulate importing values of Taiwan, then could use it for a short-term forecast.

Table 17: The minimum total	importing values occurred in	a year (1988 ~2018, 31 years)

Minimum total importing values occurred month	Jan	Feb	Aug	Sep	Dec
Counting times	6	21	1	2	1

The autocorrelation function (ACF) and partial autocorrelation function (PACF) were used to identify a suitable model for the importing pattern. They were:

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Figure 34: The autocorrelation function (ACF) of Taiwan's total importing values from January 1988 to April 2019





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By trial and error with the help of the standard pattern in Hanke and Wichern [11], the  $ARIMA(3,1,1)(1,1,1)_{12}$  might be a suitable mathematical model.



Figure 36: The ACF of the residuals of  $ARIMA(3,1,1)(1,1,1)_{12}$  model for the total importing values from the world to Taiwan

From the above ACF figure, one found that the autocorrelation coefficients of the residuals of the ARIMA $(3,1,1)(1,1,1)_{12}$  model were within two standard errors of the mean (between two red lines). It meant the residuals were free from autocorrelation, and ARIMA $(3,1,1)(1,1,1)_{12}$  model was a suitable one for importing forecasting [11,12].

#### **3.2.1** Error analysis and forecasting importing values from the world to Taiwan

By using the monthly importing values (January 1998 to December 2017, 360 months) with  $ARIMA(3,1,1)(1,1,1)_{12}$  model to forecast the next 12 months values, the data in the following table can be obtained.

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	Real value	Forecast value	Error in value	
Year/Month	(Million USD)	(Million USD)	(Million USD)	Error in ratio (%)
2018M01	24708.65	22706.48	2002.16	8.10
2018M02	19270.13	20352.1	1081.97	5.61
2018M03	23973.42	24702.68	729.26	3.04
2018M04	22563.33	23668.6	1105.27	4.90
2018M05	24685.24	24202.9	482.34	1.95
2018M06	23001.86	24196.37	1194.52	5.19
2018M07	26047.18	24686.83	1360.35	5.22
2018M08	23665.28	24292.27	626.99	2.65
2018M09	25253.25	23583.52	1669.72	6.61
2018M10	26157.29	24294.45	1862.84	7.12
2018M11	23114.08	23988.88	874.81	3.78
2018M12	23893.20	23795.12	98.08	0.41
Average	23861.07	23705.85	1090.69	4.55

Table 18: Error analysis of  $ARIMA(3,1,1)(1,1,1)_{12}$  model for total importing values

The average error was only 4.55% of the year 2018, and it was an acceptable value.

Using ARIMA(3,1,1)(1,1,1)<sub>12</sub> model to forecast the 12 months of 2019, the values in the following table can be obtained.

Table 19: Forecasting 2019 total importing values in million USD by the ARIMA(3,1,1)(1,1,1)<sub>12</sub> model

Year	January	February	March	April	May	June	July	August	September	October	November	December
2019	22359	23972	23719.7	23260	23198	23504	23209	23167	23296	19526	24411	23262

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#### 4. Conclusions

- (1)The average total trading values (including exporting and importing) of the past 40 months (January 1988 to April 2019) of Taiwan with the world (eight continents) was 47559.97 million USD per month. Exporting value share 54.5% of it, 25891.96 million USD per month, and the importing values were accounted for the rest 45.5%, 21668.21 million USD per month.
- (2)During January 1988 to April 2019 (376 months), only 14 months were trade deficit (14/376=3.72%), i.e. the exporting values less than the importing values. Basically, Taiwan was a trade surplus country.
- (3)Asia was the most important exporting continent for Taiwan. The average exporting values per month from Taiwan to Asia was 18582.30 million USD (71.67%) per month, followed by North America, 3300.97 million USD (12.77%) per month. Europe was the third largest exporting continent with 2422.12 million USD (9.38%) per month.
- (4)China was the most important country in Asia for Taiwan's exports. The average exporting values from Taiwan to China per month reach 10508.15 million USD, which shared 56.37% exporting values from Taiwan to Asia. The second most important exporting partner was ASEAN, with trading values 4621.71 million USD (24.98%). Japan grabbed the third, 1772.04 million USD (9.58%).
- (5) Singapore was the most important exporting country for Taiwan in ASEAN. The monthly exporting values from Taiwan to Singapore was 1409.70 million USD (30.58%), followed by Viet Nam, 859.03 million USD (18.59%), and Malaysia, 759.77 million USD (17.15%).
- (6)Same as exporting, Asia contributed the most important importing values for Taiwan. The average importing values from Asia to Taiwan was 12806.77 million USD (59.13%) per month, followed by North America, 2775.92 million USD (12.83%) per month. Europe grabbed the third, with values 2648.93 million USD (12.24%) per month.
- (7)China played the most important importing role in Taiwan's trade in Asia. The average importing values from China to Taiwan was 4256.05 million USD (33.14%) per month. Japan and ASEAN shared the second and third place with average importing values 3521.47 million USD (27.73%), and 2591.37 million USD (20.20%) per month, respectively.
- (8)In ASEAN (10 nations), Singapore was the leading sheep of importing values to Taiwan, 681.83 million USD (26.40%) per month. Malaysia took second place with importing values 651.56 million USD (24.92%) per month, and Indonesia the third, 404.89 million USD (15.65%) per month.
- (9)Total exporting and importing values of Taiwan had a cyclical pattern with an approximately period of 12 months. ARIMA(3,1,1)(1,1,1)<sub>12</sub> model could be used to simulate the total exporting and importing behaviour of the trading values. The average error analysis for the exporting values could be accurate to 5.81%, and for the importing values, 4.55%.
- (10) The forecasting values of total exports and imports from January to December 2019 were calculated by the ARIMA (3,1,1) (1,1,1)<sub>12</sub> model and were shown in relative tables.

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