

ANALYSIS OF INDONESIA'S AUTOMOTIVE COMPONENT EXPORT BY COUNTRY OF DESTINATION USING MULTIVARIATE ANALYSIS

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Abstract

The aim of this paper was to present an overview of Indonesia's automotive component export by the country of destination. The data were taken from the Statistics Indonesia (*Badan Pusat Statistik/BPS*) of 2014, particularly the code of HS8708. Descriptive statistics, cluster analysis and principal component analysis were used in the analysis. The results showed that histogram of total export value indicated that the curve was skewed to the right which means there were some extreme values on the right. The largest export value, subsequently, came from Thailand, Japan, and Malaysia. Based on dendrogram of the cluster analysis, there were five clusters of country of destination. Meanwhile the countries of destination include Thailand, Japan, Malaysia, Brazil, Mexico, and others. Biplot principal component analysis identified the diverse characteristics of export destination countries among clusters. Gear boxes, clutches, and chasis frames were mostly demanded by Thailand; most of road wheels and part of radiators were exported to Japan; numbers of fuel tanks were sent to Malaysia; drive axles were mostly exported to the cluster of China, United Kingdom, and Philippines; while high demand of radiator spare-parts were obtained from United States.

Keywords: automotive component export, cluster analysis, principal component analysis, biplot.

Presenting Author's biography



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1. Introduction

The rampant of automotive industry in Indonesia is accompanied by the potential growth of automotive component industry. The development of the automotive industry in Indonesia, however, cannot be separated from the support and ability of its automotive component industry. It is reported that there are 200 companies engaged in the automotive components industry, in which 55% of them

are joint venture with high-level technological dependence [1]. The ability of the automotive component industry in Indonesia can be seen through its export capability. Classification code commonly used in world trade is based on the HS code (Harmonized System).

Overall, Indonesia's automotive industry has been exporting automotive products ranging from motorcycles, cars and a wide range of components to many countries. In 2013, total export of automotive products (HS 87) reached the value of US \$ 4.6 billion. Of the total value of the automotive component belonging to the group HS 8708 in the form of components and accessories contributed 31.04% of the total exports [2].

Export data of HS 8708 is in the form of a matrix of quite complex data because it consists of a wide range export commodities as well as many destination countries. To extract information from the data, statistical techniques are required. Thus, the aim of this paper was to present an overview of Indonesia's automotive component export by country of destination using some descriptive statistical and multivariate analysis techniques. The objectives were to describe variation of total value of export among country of destination using histogram, to identify groups of country of destination using cluster analysis (CA), and to identify the clusters by graphing the clusters and commodities in a single display using biplot principal component analysis (PCA).

Both techniques were performed to explain the situation in the export of automotive components and furthermore can be used as a basis for decision and policy considerations associated with exports to the countries of destination. Research on the use of cluster analysis and PCA in the data analysis of export destinations has been carried out by Handoko and Sunaryo [3]. They used data of various export commodities such as palm oil and rubber.

2. Methods

This study consisted of several stages. The first is collecting export data from Statistics Indonesia (*Badan Pusat Statistik/BPS*). The data was based on Indonesia's Export Statistic in 2014 [4]. The next stage was to develop data matrix with rows which elaborated the destination countries and columns described the group HS with code 8708. There was a total of 116 countries and 96 commodities. Descriptive statistical analysis was used to analyze the total value of automotive component export to various destinations. Cluster analysis was used to determine the group of 116 countries based on their similarity. CA is one of multivariate technique that can produce a classification scheme of individual observations, depending on their relative similarity or nearness to an array of different variables. The basic idea is one of dividing a specific data profile into segments by creating maximum homogeneity within and maximum distance between groups of observations [5].

Principal component analysis and biplot then were used to explain the grouping. PCA is a technique for forming new variables which are linear composites of the original variables [5]. PCA is a reduction data technique because compress a large number of variable to small data. The maximum number of new variables that can formed is equal to the number of original variables, and new variables are uncorrelated among themselves [5].

3. Results and Discussion

Descriptive Statistics

The total value of exports of HS 8708 commodities (automotive parts) to the entire country of destination in 2014 had reached 1.62 billion USD (Fig. 1). Histogram of total export value indicated that curve was skewed to the right which means there were some extreme values on the right. They were total export value to Thailand, Japan, and Malaysia. This high value indicated the extraordinary trade relation with these three countries. Based on data from The International Organization of Motor Vehicle Manufacturers (OICA) in 2014, total production of vehicles in Japan

was in the 3rd rank in the world, Thailand in the 12th, Indonesia in the 15th, and Malaysia in 23rd [6]. The first was China and the second was USA. Based on those data, Thailand was the largest car production in ASEAN and of course requires a lot of components from both domestic and imported from neighboring countries including Indonesia. Malaysia with its national car project also requires components from Indonesia. While Japan and Indonesia has a long history dealing with the development of the automotive industry.

Variable

Total export value

N	116
Mean	13964991
StDev	48206682
Sum	1619938904
Minimum	5
Q1	9429
Median	127408
Q3	1669463
Maximum	354181151

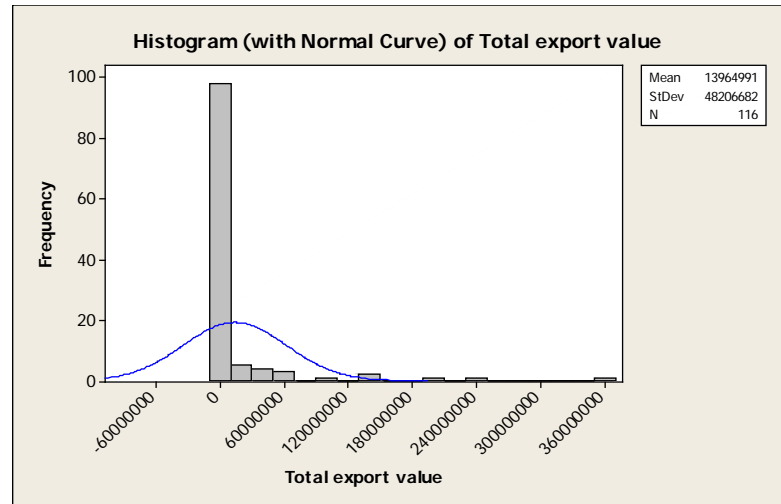


Fig. 1 Descriptive statistics and histogram of total export value

Tab. 1 Top fifteen largest HS 8708 export destination

No	Country of Destination	Export Value (US \$)
1	THAILAND	354,181,151
2	JAPAN	249,250,294
3	MALAYSIA	206,591,860
4	BRAZIL	130,674,238
5	MEXICO	130,636,366
6	PHILIPPINES	98,162,796
7	UNITED STATES	57,714,054
8	INDIA	52,770,301
9	VIET NAM	50,306,386
10	NETHERLANDS	39,018,847
11	TAIWAN	37,788,973
12	CHINA	37,490,378
13	GERMANY, FED. REP. OF	37,316,540
14	UNITED KINGDOM	22,036,017
15	PAKISTAN	13,831,630

Thailand is the country's largest export destination in 2014 with a total value of 354.18 million dollars followed by Japan and Malaysia and other countries as can be seen in Tab. 1. It showed that Thailand, Japan and Malaysia required high number of automotive components from

Indonesia to serve the needs of the automotive vehicle assembly or replacement of component (after sales service). Meanwhile, based on the type of commodity, it can be seen that the gear boxes is ranked first in terms of export value, followed by road wheels, clutches and other parts (Tab. 2).

Tab. 2 Top ten largest export HS 8708 commodity

No	HS Code	Commodity	Export Value (US\$)
1	8708402600	Gear boxes assembled for transport of persons	532,920,055
2	8708999000	Other parts, accessories for other vehicles of heading 8701-8705	112,645,140
3	8708701600	Road wheels of hub-caps for transport of person	112,468,889
4	8708703200	Road wheels of wheels not fitted with tyres for transport of person	105,965,317
5	8708299500	Other parts and accessories for transport of person	71,932,475
6	8708936000	Clutches and parts there of for vehicles transport of persons	67,938,381
7	8708997000	Other chasis frames or parts-	67,488,298
8	8708502600	Drive-axles with differential, assembled for transport of persons	64,334,685
9	8708919900	Part of radiators for vehicles of person, goods, special purpose	47,067,712
10	8708992100	Fuel tanks for vehicles transport persons or goods	46,085,572

Cluster Analysis

Grouping of country of destination was analyzed by cluster analysis. Dendrogram or classification tree is the standard output of hierarchical cluster and can be seen if Fig. 2. The number of clusters can be easily determined by specifying the cutting point horizontally. Based on dendrogram, there were 5 clusters consisting of: Cluster 1 (Thailand), Cluster 2 (Japan), Cluster 3 (Malaysia), Cluster 4 (Brazil and Mexico), and Cluster 5 (other countries of destination).

Principal Component Analysis

PCA then was used to explain the clusters. It showed that the first principal component and the second principal component can illustrate the diversity of data at 68.2 %. This figure shows that 68.2% of the diversity that occurs in the data can be explained through the first and second axis of the principal components. When the three major components were included, the percentage of the diversity that can be explained reached 90.6 % as shown in Fig. 3.

Biplot principal component analysis indicated that the export destination countries among clusters showed different characteristic (Fig. 4). Gear boxes, clutches and chasis frames were mostly exported to Thailand. Road wheels and part of radiators were mostly exported to Japan. Fuel tanks were mostly exported to Malaysia. Drive axles were mostly exported to cluster 5 especially to China, United Kingdom, Philippines. Part of radiators were mostly exported to United States.

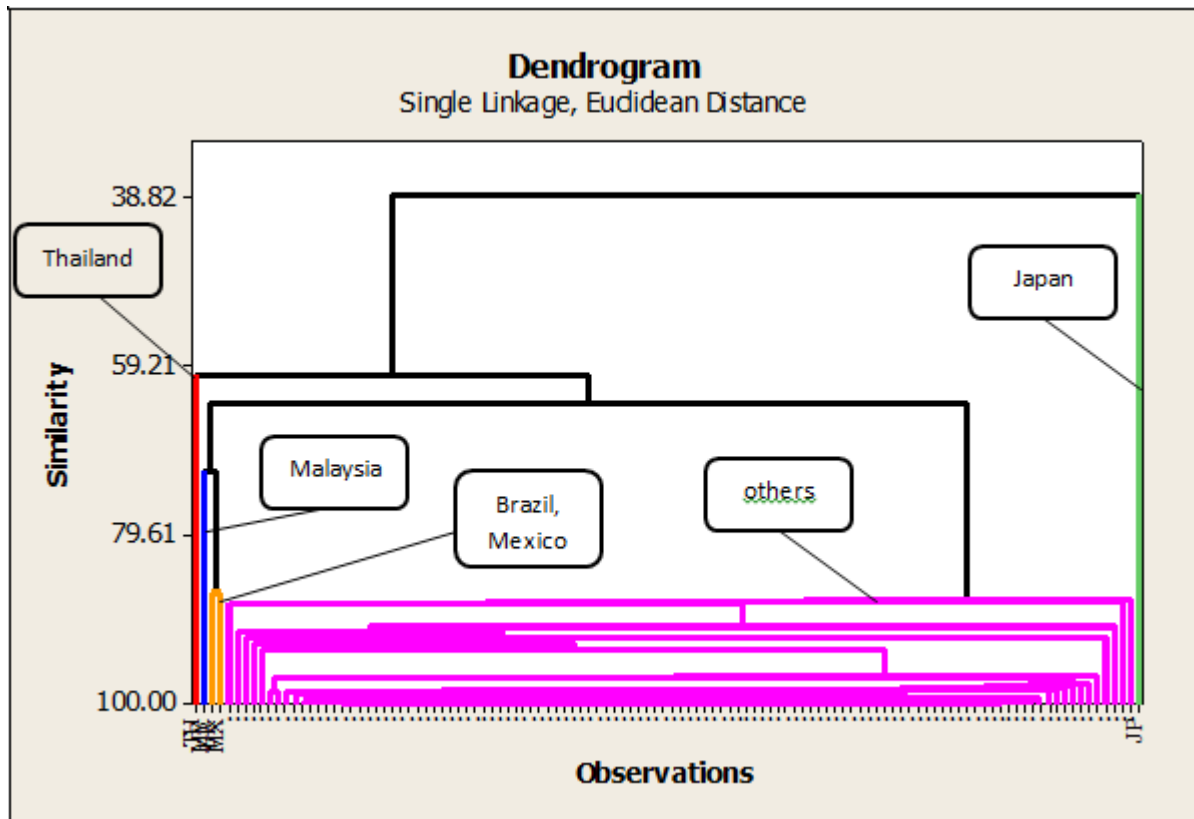


Fig. 2. Dendrogram of 116 country of destination

Principal Component Analysis: 8708299500, 8708402600, 8708502600, 8708701600, 8

Eigenanalysis of the Correlation Matrix

Eigenvalue	3.6493	3.1671	2.2438	0.9398	0.0000	0.0000	0.0000	-0.0000
Proportion	0.365	0.317	0.224	0.094	0.000	0.000	0.000	-0.000
Cumulative	0.365	0.682	0.906	1.000	1.000	1.000	1.000	1.000

Eigenvalue	-0.0000	-0.0000
Proportion	-0.000	-0.000
Cumulative	1.000	1.000

Variable	PC1	PC2
8708299500	0.387	-0.188
8708402600	0.059	0.487
8708502600	0.400	-0.183
8708701600	-0.169	-0.456
8708703200	-0.059	-0.512
8708919900	0.331	-0.413
8708936000	0.225	0.104
8708992100	-0.274	0.003
8708997000	0.453	0.189
8708999000	0.464	0.084

Fig. 3 Eigen value and principal component score from 5 clusters and 10 commodities data matrix

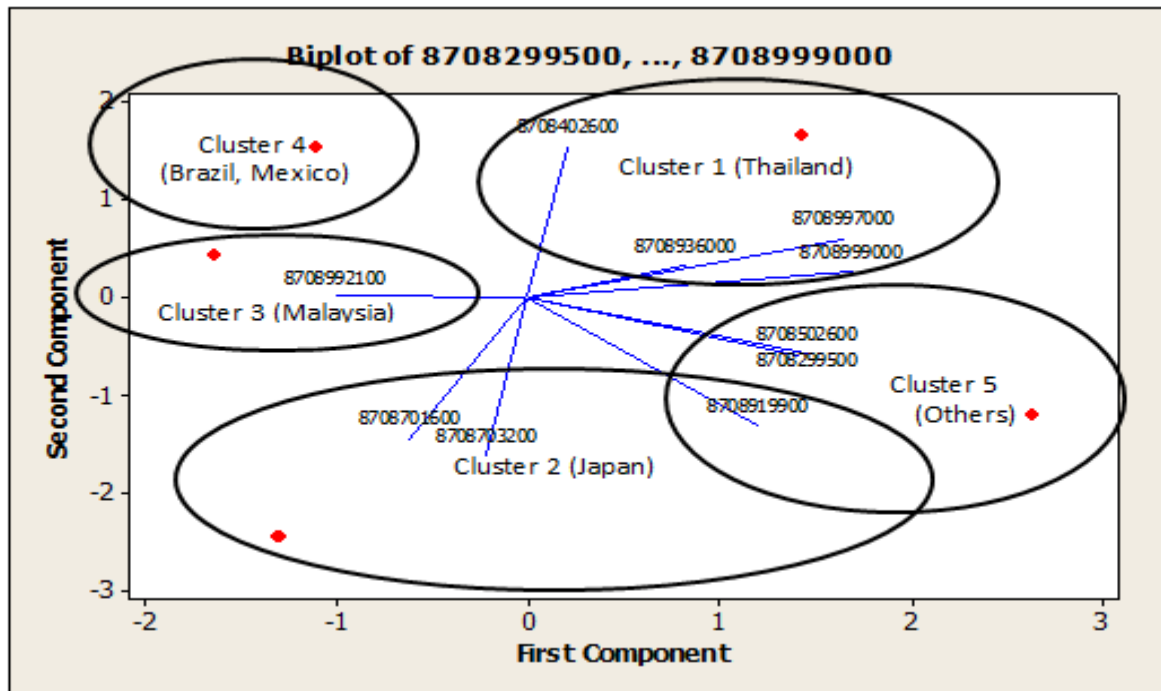


Fig. 4 Biplot of clusters and top ten export commodity (HS 8708)

4. Conclusion

1. The total value of exports of HS 8708 commodities (automotive parts) to all country of destinations in 2014 had reached 1.62 billion USD. Histogram of total export value indicated that curve was skewed to the right which means there were some extreme values on the right. They were total value of export to Thailand, Japan, and Malaysia. The high value indicated the special trade relations between Indonesia with these three countries particularly on automotive components
2. In 2014, Thailand was the largest export destination with the total value of 354.18 million USD, and was followed by Japan, Malaysia, and other countries.
3. The highest demand in export was gear boxes, followed by road wheels, clutches, and other parts.
4. Grouping of country of destination resulted five major clusters, namely, Cluster 1 Thailand, Cluster 2 Japan, Cluster 3 Malaysia, Cluster 4 Brazil and Mexico, and Cluster 5 other countries of destination.
5. Biplot principal component analysis indicated that the export destination countries among clusters showed different characteristic. Gear boxes, clutches and chasis frames were mostly exported to Thailand. Road wheels and part of radiators were mostly exported to Japan. Fuel tanks were mostly exported to Malaysia. Drive axles were mostly exported to the cluster of (China, United Kingdom, Philippines), while a high number of radiator spare-parts was sent to United States.

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References

- [1] T.S. Dewayana, D. Sugiarto, D. Hetharia. Peluang dan Tantangan Industri Komponen Otomotif Indonesia. *Proceeding Seminar Nasional Competitive Advantage II*. Universitas Pesantren Darul Ulum Jombang. 2011.

- [2] Ministry of Trade. *Perkembangan Komponen Otomotif di Indonesia*. Warta Ekspor. Ditjen PEN/MJL/005/7/2014. 2014.
- [3] J. Handoko, S. Sunaryo. Analisis Pengelompokkan Negara-Negara Importir Produk Indonesia Berdasarkan Faktor Barang Industri. *Jurnal Sains dan Seni POMITS*. Vol 3, No 2, 2337-3520. 2014.
- [4] Badan Pusat Statistik. *Statistik Ekspor Indonesia 2014*. 2014. <http://www.bps.go.id/>
- [5] S. Sharma. *Applied Multivariate Technique*. New York : John Wiley & Sons. 1996.
- [6] The International Organization of Motor Vehicle Manufacturers. 2014. Production Statistics 2014. <http://www.oica.net/category/production-statistics/2014-statistics/>