

# Local Change Analysis of Correlation of Education Level to GDP in Indonesia

Alfan Presekal<sup>1)</sup>, Riri Fitri Sari<sup>1)</sup>, Yukari Shirota<sup>2)</sup>

## Abstract

*This paper presents our work on analyzing data of provincial economic differences in Indonesia based on GDP and education. The data were mainly obtained from the website of Indonesia Central Bureau of Statistic (Badan Pusat Statistik/BPS). We performed local change analysis toward education level and GDP of all provinces in Indonesia from 2010 to 2015. We classify the provinces into high GDP per capita and low GDP per capita based on the average GDP per capita. From the analysis we gained the highest correlation value of 0.84 of Junior High School at average education level provinces with low GDP.*

## 1. Introduction

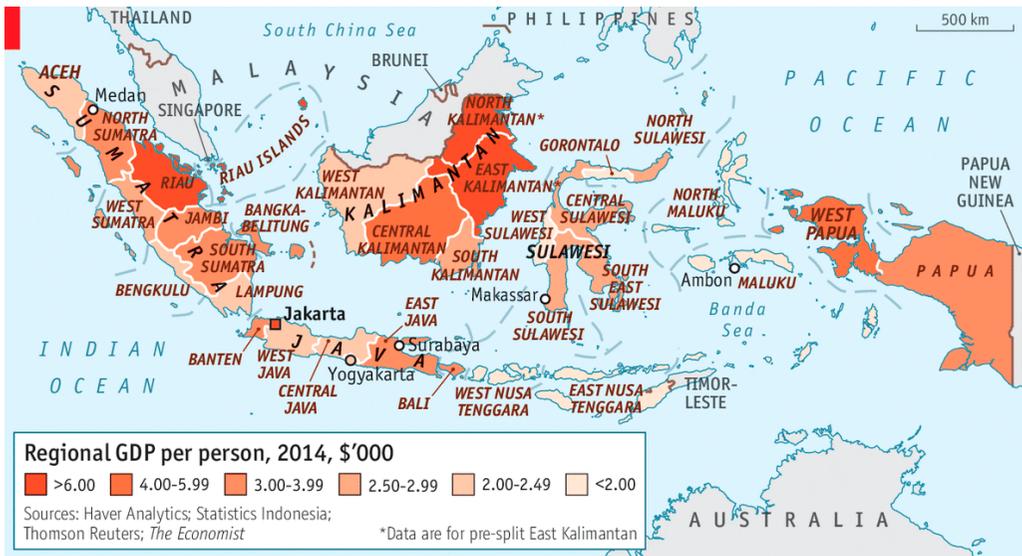
Indonesia is the largest economy in South East Asia with tremendous economy potency. In 2012 Indonesia has already become the 16<sup>th</sup>-largest Economy in the world. It has potential to become the seventh biggest economy worldwide by 2030 [1]. Afterward, according to the projection of the Price Waterhouse Cooper Indonesia will become the 4th largest world economy by 2050 [2]. Hence, Indonesia is a very important spot from business point of view. However, because there are various geographical and cultural diversities, it is difficult to accurately spot economic characteristic for every province in Indonesia. Figure 1 shows the geographical diversities of Indonesia as an archipelago and the distribution of GDP diversities for every province in Indonesia.

In this paper, we focused on the analysis of provincial data of Indonesia on aspects of Gross Domestic Product (GDP) and education level. The analysis has been conducted using statistical shape analysis. This work uses the morphometric as method of the statistical shape analysis for information clustering. This method was developed by the University of Leeds in 1998 which is commonly known as the geometric statistic [4-6]. Using this method, we analyzed the transformation in the shape of an object which is called as deformation. The challenge in transforming data sets which have different size, orientation, and shape to become a coordinated system is complex problem. This transformation using a coordinate system is called as register mark or landmark. By this method, we can quantify the shape of an object by removing the information of location, rotation, and scale. In our previous works, this

---

1) Computer Engineering, Department of Electrical Engineering, Universitas Indonesia

2) Department of Management, Faculty of Economics, Gakushuin University



Economist.com

Figure 1: Province GDP per Person 2014 [3]

method has already been applied to other economic parameters [7-8]. In addition, application of the method has been explained in the form of teaching materials [9].

To perform the analysis, we used data mainly from Indonesia Central Statistics Bureau (Badan Pusat Statistik/BPS). BPS is a non-department government agency which instituted by the Law Number 16 Year 1997. There are various data provided by BPS. Mainly the data was provided based on Indonesia census program which have been held every 10 years. The latest census in Indonesia was conducted in 2010. Among many data available, this work focused on the data of GDP and data related with education.

Hanushek et.al. proposed a standard method to estimate the impact of education to the economic growth which is performed by comparing cross-country growth regression from the average annual growth in Gross Domestic Product (GDP) per capita with schooling. Based on several literatures, there is a significant positive association between schooling and GDP growth [10]. Figure 2 shows the comparison between conditional year of schooling (x axis) and conditional growth (y axis) from many countries worldwide. 0 value or vertical blue line which separate conditional years of schooling represents the average years of schooling worldwide. On the right side of blue line represent country which has duration of schooling longer than average duration of schooling worldwide. Mean the left side of the vertical blue line represents the duration of schooling that is less than the average duration of schooling worldwide. 0 (zero) value or horizontal blue line which separate the conditional growth represent the average GDP growth worldwide. The points above the line represent countries which have higher GDP growth than average. In contrast the points below the line represent countries which have lower GDP growth. With regression analysis the average correlation shown as the red line. The report shows that there is a correlation between average duration of schooling and growth of GDP by 0.58. Based on this

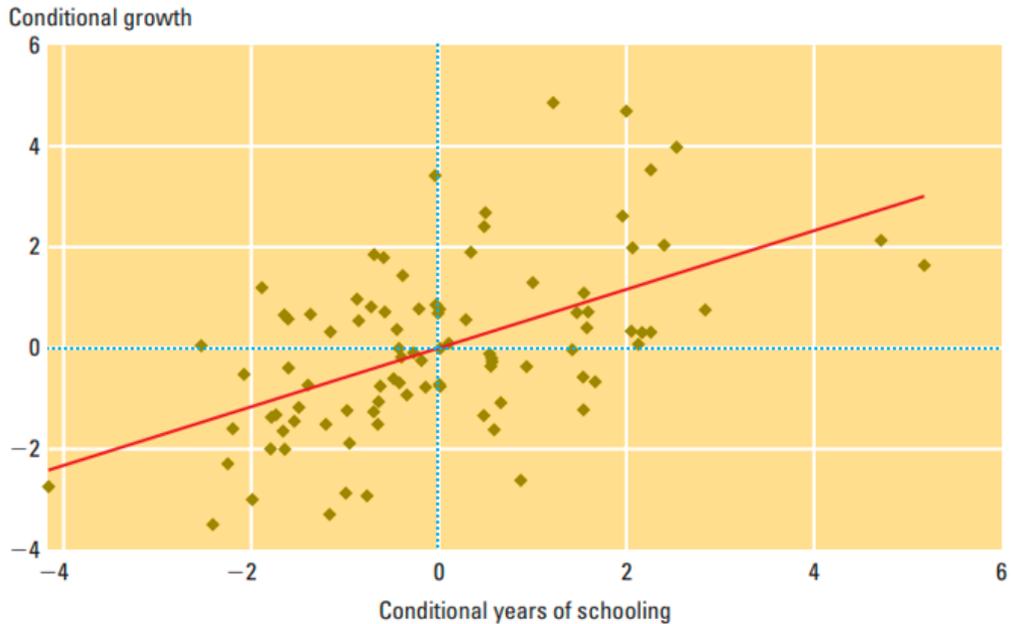


Figure 2: Association between GDP Growth and Duration of Schooling [10]

data we have the hypothesis that the education and the GDP for every province in Indonesia have positive correlations.

This paper consists of five sections. This first section, the Introduction explains the overview of this research. Section 2, we briefly explain the education in Indonesia, as education become our main parameter in this paper. Section 3 we explain the GDP, followed by section 4 which explains methodology how we obtained the data. Section 5 explore the analytical part and the correlation between Education and GDP. Finally, in Section 6 we conclude this paper.

## 2. Education in Indonesia

Education in Indonesia mainly become the responsibility of the Ministry of Education and Culture (Kementerian Pendidikan dan Kebudayaan) and Ministry of Religious Affairs (Kementerian Agama). Since October 2014, for higher education level (university) it no longer became responsibility of those two ministries. The elected president Joko Widodo relocated Directorate-General of Higher Education from the Ministry of Education to Ministry for Research and Technology. The directorate and ministry merged into the Ministry for Research, Technology and Higher Education (Kementerian Riset dan Pendidikan Tinggi). After this change The Ministry of Education and Culture only responsible for primary, junior secondary, and senior secondary education.

In Indonesia, education system is classified into four levels. They are primary high school (grades 1-6), junior high school (grades 7-9), senior high school (grades 10-12), and higher education (university level). Among them, the first two levels belong to the basic education system based on regulation in

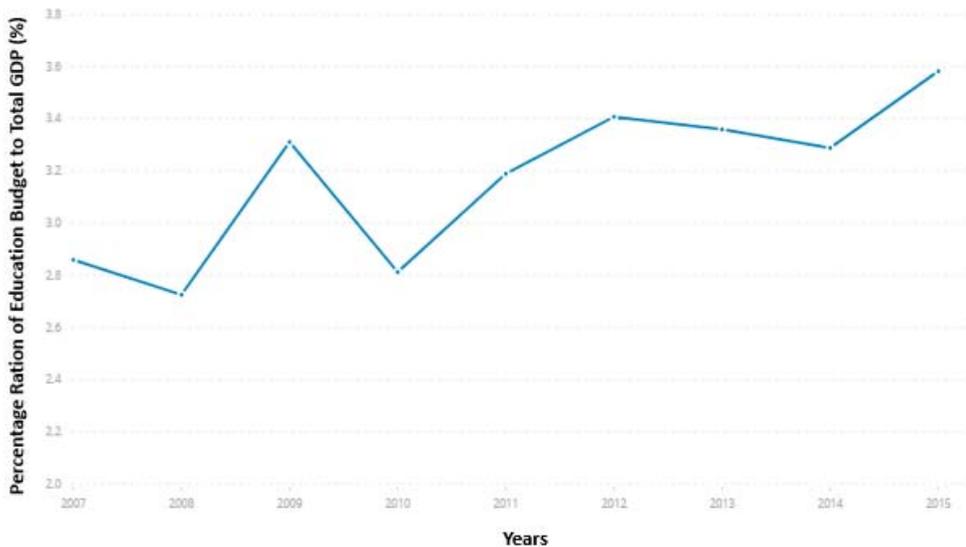


Figure 3: Percentage of Annual Education Budget to GDP in Indonesia [12]

Indonesia. According to the Indonesia Law No. 20 Year 2003, basic education is obligatory for every Indonesia citizen.

Education as a part of the right of every Indonesian is regulated by the 1945 Constitution of the Republic of Indonesia Article Number 31. Since the 4<sup>th</sup> amendment every year the government of Indonesia devoted 20% of the government expenditure to education. The allocation 20% of central and local government expenditure for education has been started from the year 2009. Based on the data from the Ministry of Finance of Indonesia from 2009 to 2016, the expenditure on education has been doubled from IDR 225.2 trillion to IDR 419.2 trillion. The total expenditure of Indonesia local governments on education also increased from IDR 100.9 trillion in 2010 to IDR 188.3 trillion in 2015. On average, 33% of local governments budget is allocated for basic education [11]. As shows in the Figure 3, the percentage of education budget to GDP in Indonesia have been increasing from the year 2007 to 2015.

### 3. Gross Domestic Product Percentage of Provinces

In this section we explain the GDP as an aspect of economic growth especially for every province in Indonesia. GDP is the sum of value added that have been produced by all unit of production in certain region. It also can be explained as the total value of final goods and services produced by the whole unit of economic. There are three approaches to calculate the GDP as follows:

- Production Approach: this approach measured the GDP based on the amount of value added produced by the production unit in particular time and location.
- Income Approach: this approach measured the GDP based on the amount of compensation received by factors of production which contribute in production process in particular time and location.
- Expenditure Approach: this approach measured the GDP based on the final demand components



Figure 4 shows total GDP for every province in Indonesia in 2017 and Figure 5 shows GDP per capita from every province in 2017. From the figure we can observed that the GDP every province in Indonesia is relatively diverse. The highest total GDP and GDP per capita is gained by DKI Jakarta. Provinces which located in Java island also tend to have high GDP. The low GDP provinces are mostly located in eastern part of Indonesia. With this diversity in GDP, we compare GDP head to head with the education Indonesia and find the correlation between two information.

#### 4. Methodology

To perform the analysis first, we classified the data of GDP for every province by two categories, high GDP and low GDP provinces. The high GDP province is a province which has the GDP per capita higher than the national average in Indonesia. While, low GDP province is a province which has GDP per capita lower than the national average in Indonesia. We got data of GDP per capita 2010 -2016 for Every Provinces from BPS Website (source: <https://www.bps.go.id/dynamictable/2015/10/07/957/-seri-2010-produk-domestik-regional-bruto-per-kapita-atas-dasar-harga-berlaku-menurut-provinsi-2010-2016-ribu-rupiah-.html>). After classified the provinces based on the GDP and evaluate the differences between higher GDP provinces and low GDP provinces with concern on the correlation between education levels and GDP. The education level data for every province was obtained from BPS which classify participation rate of education based on student age 7-12, 13-15, 16-18, and 19-24 (source: <https://www.bps.go.id/linkTableDinamis/view/id/1054>). Based on schooling system in Indonesia, we can infer that student with age 7-12 is primary/elementary school, student 13-15 is junior high school, student 16-18 is senior high school, and 19-24 is university.

Participation rate data provided by BPS only available in form of percentage for every province. We would like to get quantity of population which participate in certain education level. To get this data we multiply percentage of participation rate by number of population on Equation 1.

Equation 1:

$$Q = R \times P$$

- Q : Number of Population with Specific Education Level
- R : Participation Rate (in percent) for Specific Education Level
- P : Total Number of Population

We use this formula because specific data quantity of people with certain level of education is not available. The latest best data only available based on Indonesia census 2010 (source: <https://data.go.id/dataset/jumlah-penduduk-berdasarkan-tingkat-pendidikan-dan-jenis-kelamin-per-kabupaten>). We cannot obtain the following year data after 2010 because in Indonesia national census only held every 10 years. It means the next data may available in 2020. Not only data about education participation rate, data of population also cannot be updated annually. The accurate population data based on real count was taken in 2010. In order to get following years population from every provinces we use data from BPS (source: <https://www.bps.go.id/statictable/2009/02/20/1268/laju-pertumbuhan-penduduk-menurut-provinsi.html>). With province growth rate data and total population in 2010 we can estimate annual population from

population using Equation 2.

Equation 2

$$P_t = P_o e^{rt}$$

Pt : Projected total population in the following year  
 Po : Initial known total population  
 e : Exponent value 2.718282  
 r : Population growth rate  
 t : Time interval

With the available data and after mentioned method above we can obtain the information about GDP and education from 2010 to 2015. With those datasets we perform statistical analysis.

### 5. Result and Analysis

In this part we would like to show the result and analysis. We show the difference between high GDP province and others, by concerning the correlation between the education level and GDP. The classification of high GDP and low GDP province were conducted using average GDP from all provinces in Indonesia. As shows in the Figure 6, province which located above blue line is classified as high GDP province. On the other hand, below the line classified as low GDP province. For example, DKI Jakarta classified as high GDP group, while Papua belong into the low GDP group.

To perform the analysis from the perspective of education, we use data of school participation as the

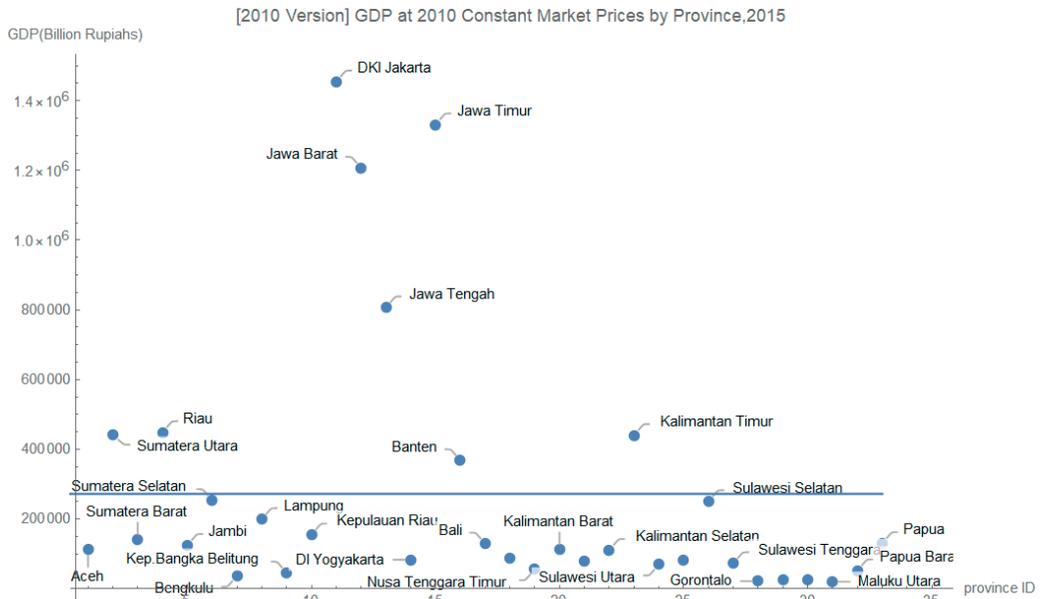


Figure 6: Gross Regional Domestic Product at 2010 Constant Market Prices by Province (Billion Rupiahs)

parameter of education. As show in the Figure 6, there are for school levels for analysis; they are (1) elementary schools, (2) junior high schools, (3) senior high schools, and (4) universities. Figure 7 shows the number of people for every level of education per province. Every province has four values which are ordered from top are (1) elementary schools, (2) junior high schools, (3) senior high schools, and (4) universities. We combine the four-value set into straight line there. Blue dot represents number of elementary school graduate, orange dot represents number of junior high school graduate, green dot represents number of senior high school graduate, and red dot represent the number of university graduate. We show the data as a cumulative because we can infer that people with higher level means already finish previous level of education. For example, people with university degree must be have been finished elementary, junior, and senior high school. To get the latest education level for every province, we can subtract the data by the higher education level. For example, to know number of population which has latest education level is senior high school we can subtract the cumulative data from senior high school with data of university graduate.

Figure 8 shows exclusive number of people with specific level of education by province in 2015. There we connect each high school value by line and plot points on the senior high school values. The peak of the senior high school lines is on the Jawa Barat (province ID number 12). The second peak is on Jawa Timur (province ID number 15). Among Jawa Barat data, the largest one is senior high school (1) and the second is the junior high school (2) and the fourth one is elementary school (4). Almost every province has the same order as that of Jawa Barat. However, in some provinces such as Aceh, Sumatera Utara, Jambi, Riau, Nusa, Tenggara Timur and Kalimantan Timur, the order is senior high school (1), university (2), junior high school (3) and elementary school (4).

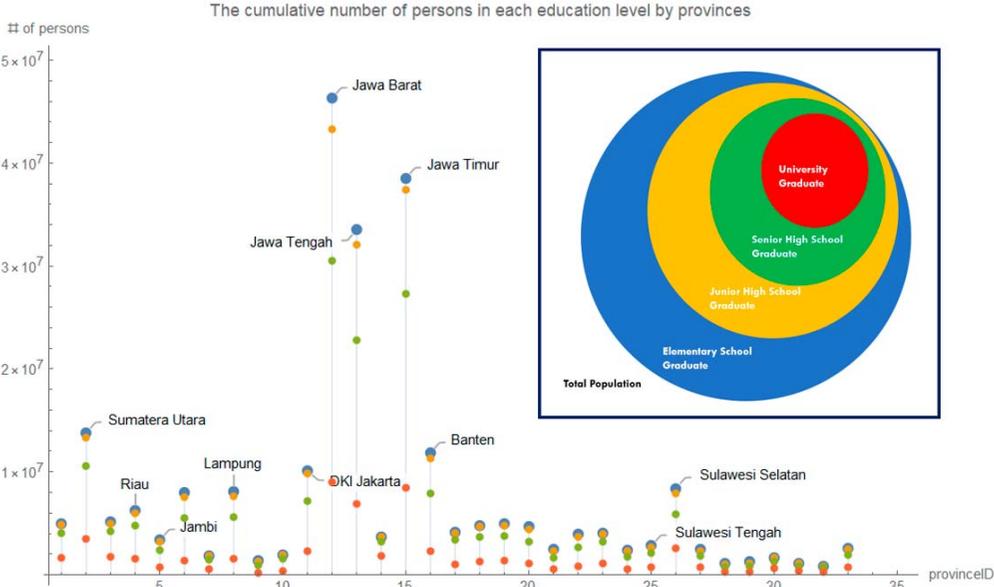


Figure 7: Cumulative number of people in each education level by provinces (2015)

インドネシア州における教育レベルと GDP の関連の分析 (白田)

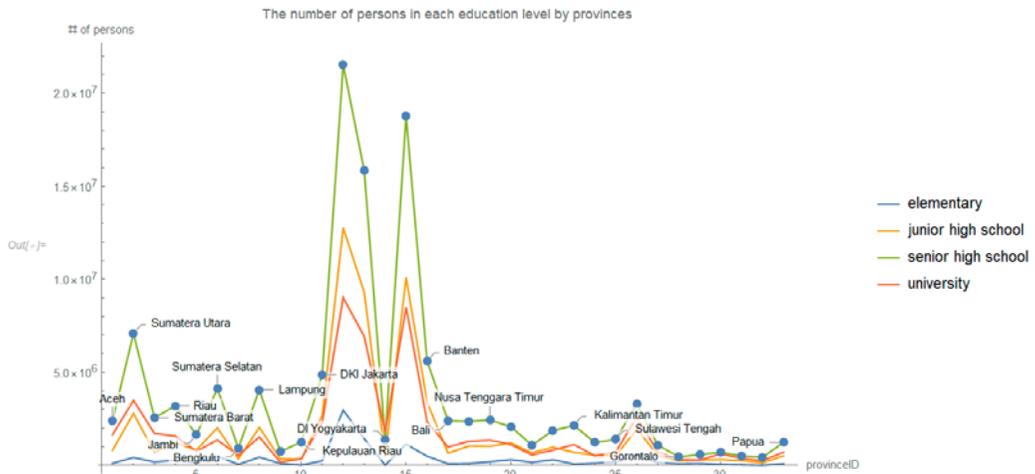


Figure 8: The exclusive number of each education level persons by provinces in 2015

Table 1: Comparison of Higher GDP Group and others

	Correlation between # of university people and GDP	Correlation between # of senior high school people and GDP	Correlation between # of junior high school people and GDP	Correlation between # of elementary school people and GDP	Correlation between total population and GDP
HigherGDPProvinceGroup	0.594	0.587	0.593	0.459	0.587
LowerGDPProvinceGroup	0.671	0.854	0.830	0.770	0.857
Whole Provinces	0.813	0.819	0.808	0.683	0.813
The number of people is exclusive among the four level groups.					

We would like to find the relationship between the GDP and the education level. Then we calculated the number of people correlation coefficients on the table 1. The number of school educated people are the exclusive numbers; the school type shown there is their final school. As shown in Figure 8, the number of elementary school persons is the smallest in each province. Therefore, in the whole provinces which is an addition of the two groups, the correlation of the elementary school (0.68) is lower than others (0.81-0.82). The correlation on the whole provinces GDP and total population of each province which has no classification on GDP and school types was 0.81 (in the right side corner of the bottom line). The total population of a province includes the non-educated people.

Based on the higher GDP provinces group results. The correlation is almost the same (0.59) on university, senior high school, and junior high school. The correlation of 0.59 is much greater than that of elementary people (0.46). The correlation with the total population was also 0.59. For the lower GDP province groups. The correlation between the senior high school persons and GDP is the greatest (0.85) and secondly the correlation between the junior high school persons and GDP is great (0.83). These are the top two in the lower GDP group. The correlation with the total population was also 0.86 which is similar to these values of 0.85 and 0.83. The other school type correlations say that the correlation with

the elementary school one (0.77) is higher than that of university one (0.67).

In Figure 9 to 12, the number of the educated people per level versus GDP by provinces. The large three-dimensional marks represent that the province is a member of the high GDP group. The number of the member is eight. The plot is a log-log plot to identify the lower GDP group members. In any school type,

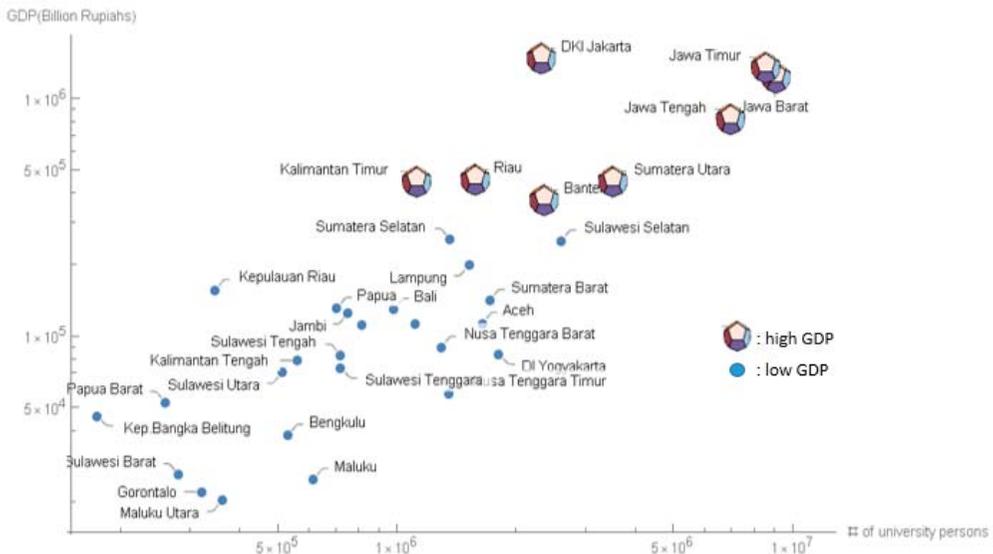


Figure 9. The number of university graduate versus GDP by provinces in 2015 (in Log-Log plot)

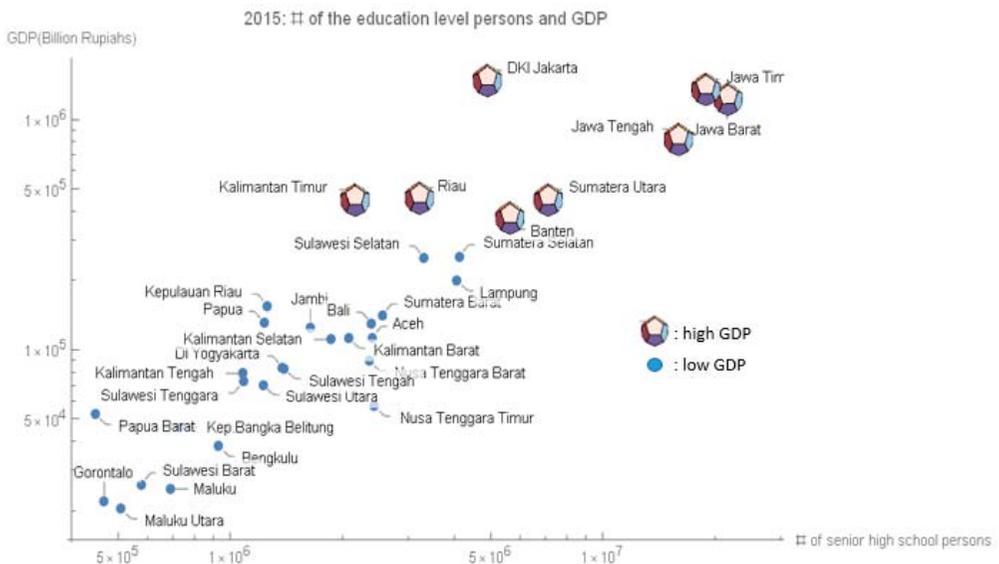


Figure 10. The number of senior high school graduate versus GDP by provinces in 2015 (in Log-Log plot)

インドネシア州における教育レベルと GDP の関連の分析 (白田)

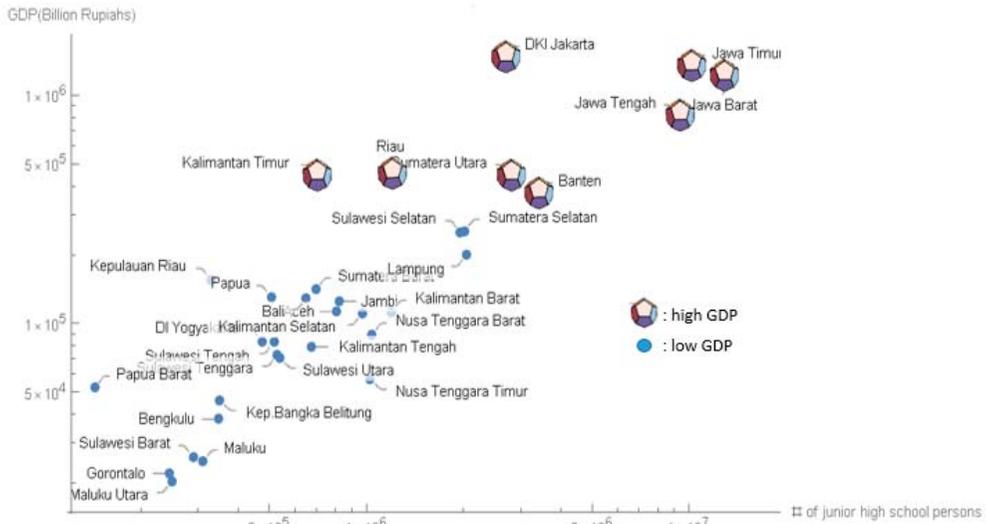


Figure 11: The number of junior high school graduate versus GDP by provinces in 2015 (in Log-Log plot)

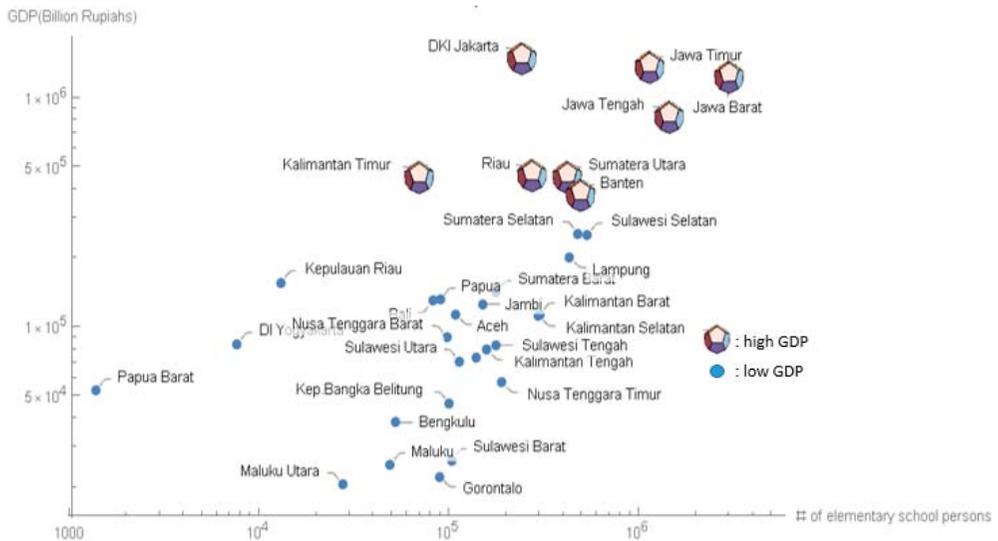


Figure 12: The number of elementary school graduate versus GDP by provinces in 2015 (Log-Log plot)

the order of the number of persons is almost same. The exception is Sumatra Utara of which order moves  $5 \rightarrow 4 \rightarrow 7 \rightarrow 5$ . The correlations of the higher GDP group were almost 0.59. The reason may be that the order of the number of persons is almost the same.

We found the following things from the correlation coefficient analysis:

- (1) The correlation of the higher GDP group is lower than that of the lower GDP group.
- (2) In the higher GDP group, the correlation of university graduate is almost same as that of senior/junior high school ones.
- (3) In the lower GD group, the correlation of senior/junior high school are the greatest (0.82 and 0.81) and the next one is one of elementary school one (0.77). The smallest one is one of university (0.67).

## Education Level and GDP by Provinces

In this part, we analyze the movement of the education level and the per capita GDP of provinces between 2010 and 2015. As the parameter of the education, we use the percentage of junior high school graduated persons. The reason why we selected the junior high school figure is the correlation coefficient between the number of people with latest degree on junior high school to GDP is the largest in the lower

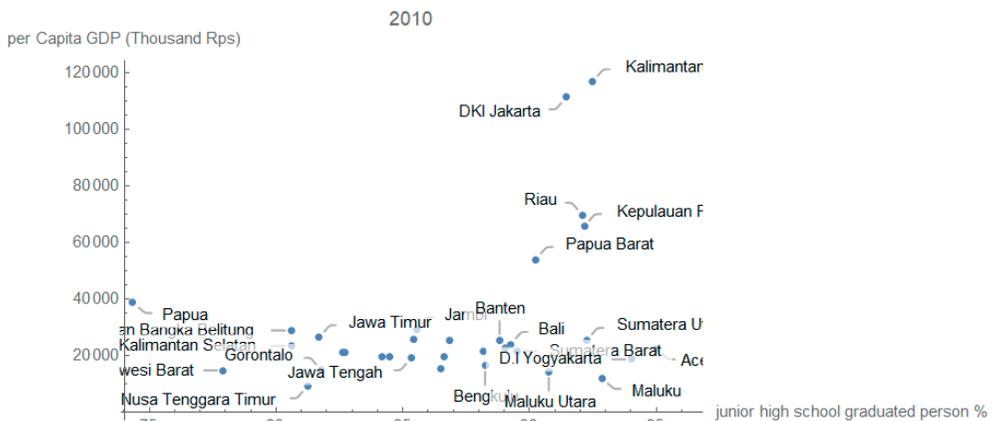


Figure 13: Percentage of junior high school graduate and per capita GDP by Provinces in 2010

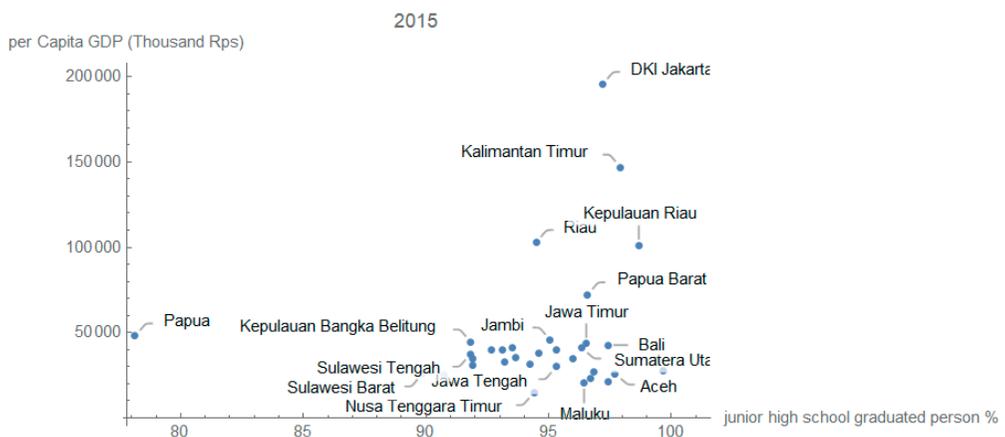


Figure 14: Percentage of junior high school graduate and per capita GDP by Provinces in 2015

GDP province group. Figure 13 and 14 shows the junior high school percentage and per capita GDP by provinces in 2010 and 2015. In 2010, Kalimantan Timur was the top province in per capita GDP. Subsequently in 2015, DKI Jakarta became the top per capita GDP province.

For the shape analysis, we have made the pre-shapes of the data in Figure 15. Figure 15 shows the pre-shape change on the deformation from 2010 to 2015. The pre-shape shows a relative change among provinces. In the pre-shape, the axis has no dimension. The Kalimantan Timur change shows the decline of both indices; compared to the other provinces growth rate, the growth rate is smaller. To clarify the local movement, we shall conduct the statistical shape analysis. The results are shown in Figure 13 and 14.

The addition of the two transformations on the original shape makes the 2015 pre-shape. To see the difference of the scaling, Figure 17 shows the original pre-shape and one after the Affine transformation. There the same color represents the same province. The Affine transformation shrinks the whole provinces which means homogenization. Kalimantan Timur and DKI Jakarta relatively decrease in the

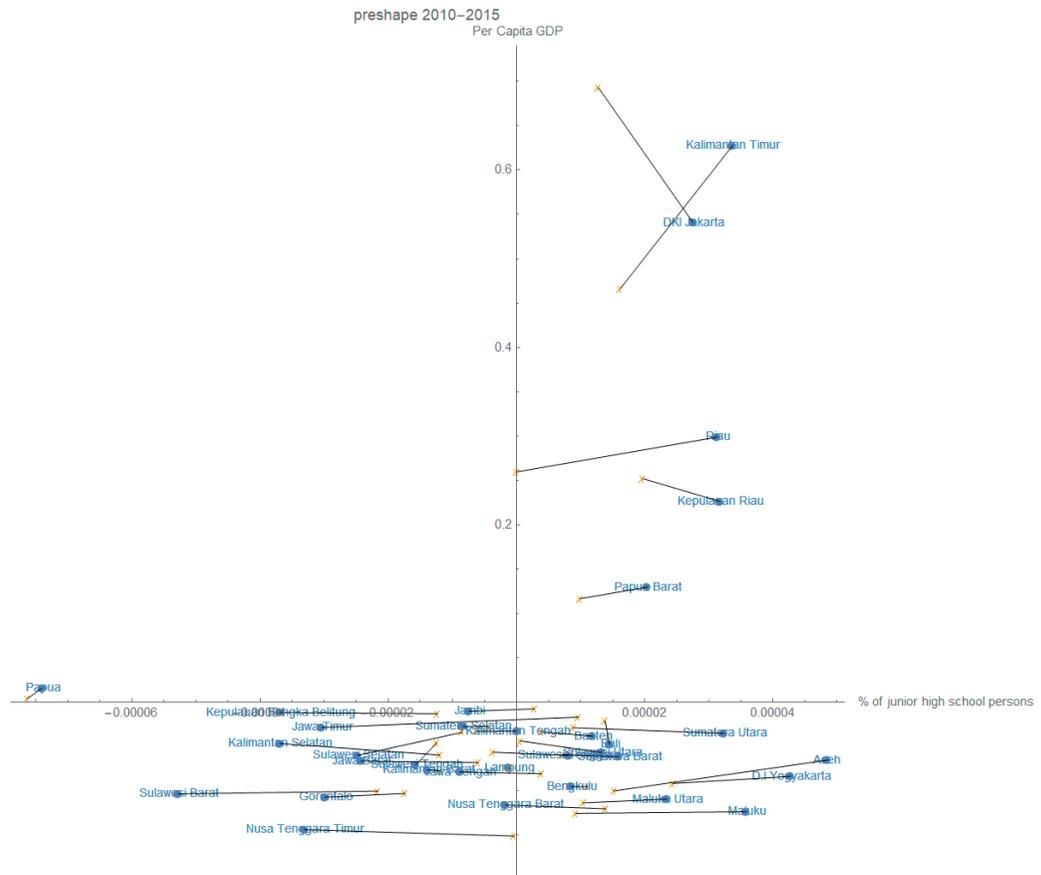


Figure 15: Pre-shape change of junior high school percentage and per capita GDP by provinces from 2010 (circle marks) to 2015 (cross marks)

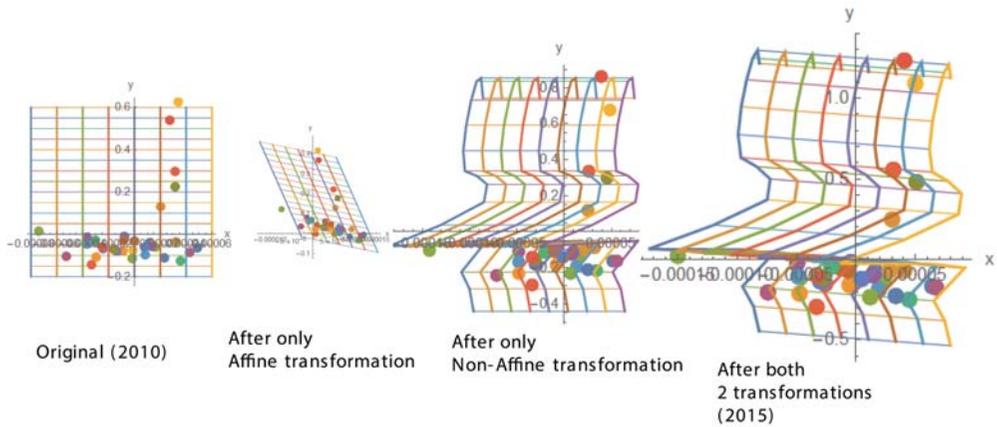


Figure 16: The original pre-shape (2010) is decomposed to the Affine and non-Affine transformations.

superiority. Let us see the bending status of the transformation grids in one after only non-Affine transformation (See the third figure). The lower group grows to the right direction and the top five provinces decreased the positions. Therefore, the large bent appears just below the x-axis. Among the top group, Kalimantan Riau shows the growth compared to Riau and Papua Barat. On the top position DKI Jakarta shows the drastic growth and pulls the transformation grids (See the hairpin curve bending on the top).

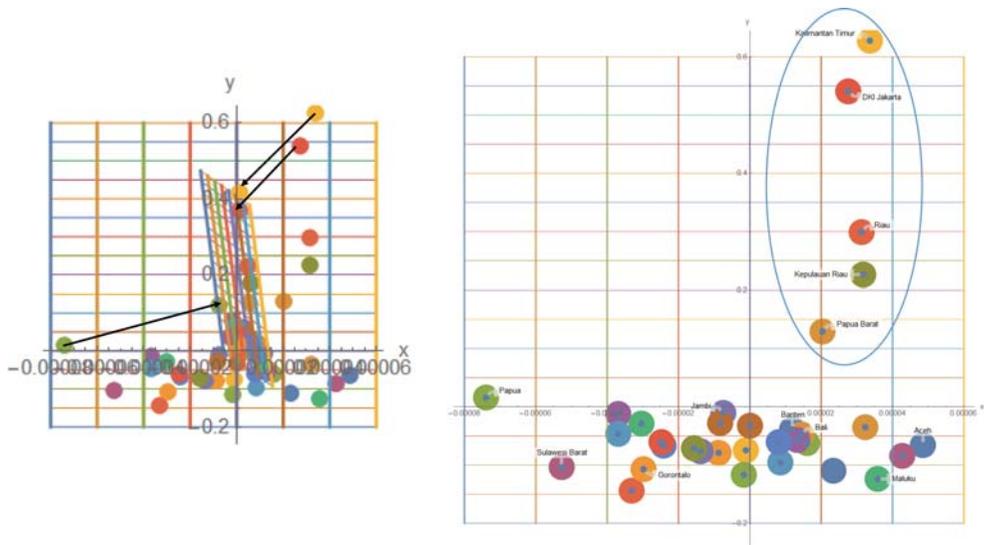


Figure 17. The original pre-shape and the shape after only Affine-transformation (the left figure) and the original pre-shape with province names (the right figure). The three arrows show the changes in Kalimantan Timur, DKI Jakarta, and Papua.

The left figure in Figure 19 illustrates the partial warp #1 change on the original pre-shape. In the right figure, we extract the net partial warp #1 movement. The change vector of each province makes the straight line as shown there. In the straight line, the largest negative values are ones of Kalimantan Timur and DKI Jakarta. On the other hand, the positive growth ones are Maluku, Aceh, D.I Yogyakarta, and Maluku Utara. The bending status in the partial warp #1 can express most of the non-Affine transformation.

Then we shall analyze the non-Affine transformation. The non-Affine transformation can be decomposed to 30 partial warp eigenvectors. Figure 18 shows the eigenvalue amplitude of the original pre-shape (2010). The value of the first eigenvalue is very large compared to others. Then we can say that the first partial warp is the dominant one. Let us see the partial warp #1 in Figure 19.

## 6. Conclusion

This paper has presented an analysis based on the statistical shape analysis of provincial differences in Indonesia which is based on the economic indicators, i.e. GDP percentage, population percentage, and electricity by province. The result shows that the education level correlated to a high GDP performance. In terms of education level by provinces and the GDP percentage, the deformation from 2010 and 2015 shows no significant changes on most of provinces. This result may indicate that the emerging economy is happening in most of provinces in Indonesia. Moreover, among many level of education. Number of junior high school graduate in every provinces has most significant correlation with GDP.

## Acknowledgement

This research was partly supported by funds from the Gakushuin University Research Institute for Economics and Management as the research project in 2018.

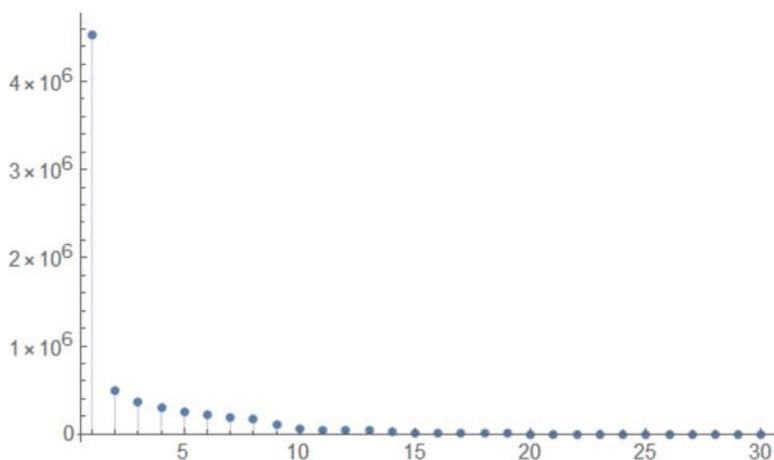


Figure 18. Eigenvalue amplitude of the original (2010) pre-shape2015

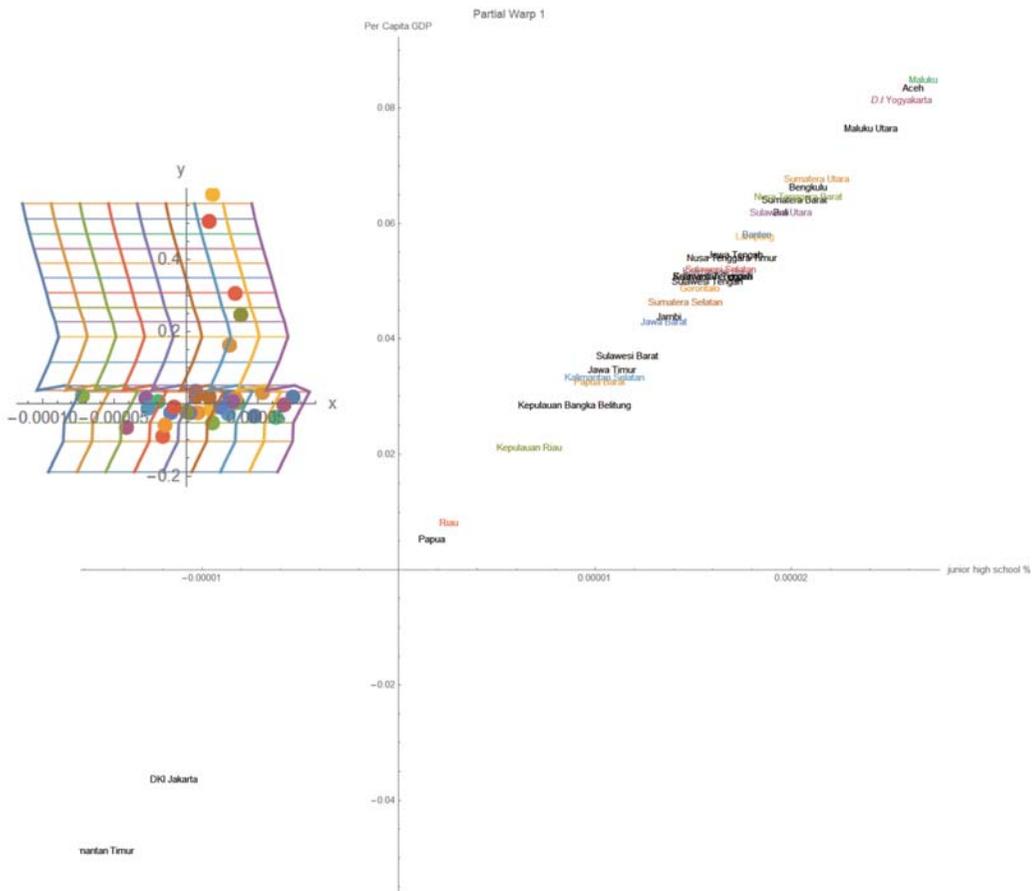


Figure 19. Partial warp #1

## References

- [1] Oberman, Raoul, et al. "The archipelago economy: Unleashing Indonesia's potential." McKinsey Global Institute. 2012
- [2] Hawthornth, John, and Danny Chan. "The World in 2050: Will the shift in global economic power continue." PwC's Economics and Policy (E&P) team in the UK. 2015.
- [3] The Economist. Tiger, tiger, almost bright. A guide to Indonesia's politics and economics in graphics. <https://www.economist.com/graphic-detail/2016/03/04/tiger-tiger-almost-bright>
- [4] I. L. Dryden and K. V. Mardia, Statistical shape analysis. J. Wiley Chichester, 1998.
- [5] K. Mardia, F. Bookstein, and J. Kent, "Alcohol, babies and the death penalty: Saving lives by analysing the shape of the brain," Significance, vol. 10, no. 3, pp. 12-16, 2013.
- [6] I. L. Dryden and J. T. Kent, Geometry Driven Statistics. Wiley Online Library, 2015.
- [7] S. Yukari, H. Takako, and S. Riri Fitri, "Visualization of time series statistical data by shape analysis (GDP ratio changes among Asia countries)," Journal of Physics: Conference Series, vol. 971, no. 1, p.

012013, 2018.

- [8] Y. Shirota, R. F. Sari, T. Widiyani, and T. Hashimoto, "Visually Do Statistical Shape Analysis! as TUTORAL," in Data Science and Advanced Analytics (DSAA) Tokyo, Japan, 2017: IEEE
- [9] T. Widiyani, Y. Shirota, and R. F. Sari, "A morphometries analysis method for craniofacial differences of ancient humans," in 2017 2nd International Conference on Automation, Cognitive Science, Optics, Micro Electro-Mechanical System, and Information Technology (ICACOMIT), 2017, pp. 22-27.
- [10] Hanushek, Eric A., and Ludger Wößmann. The role of education quality for economic growth. The World Bank, 2007.
- [11] Jasmina, Thia. "Public Spending and Learning Outcomes of Basic Education at the District Level in Indonesia." Economics and Finance in Indonesia 62.3. pp.180-190. 2016
- [12] World Bank Open Data. Indonesia Percentage of Education Budget to GDP. <https://data.worldbank.org/>