The Complexity of Global Economic Disparity and Integration of Countries

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Abstract— Over the years, record shows that while the economy grows, the gap between the rich and poor widened. The issue on economic disparity is even elevated as one of the eight millennium development goals of United Nations because the organization had seen its adverse effects. This paper explored the emergent economic behaviour of countries in global economic disparities. The main method of research utilized in this study is Complex Adaptive Analysis. While being primarily descriptive-analytical, the CAS approach enables the researcher to investigate self-organizing behaviors that emerge out of local agent interactions. Data sets used in this study were GDP and GINI from open database of World Bank and global finance. The study found out two emergent behaviors, first, the richness or poorness of a country has no bearing on income disparity. This feature implied that national productivity is not concerned with stabilizing wealth distribution. Another feature revealed in this study was on the variations of GINI index in OECD countries or rich nations. The variation reveals that the wealth is more properly distributed in richer nations than the developing countries. Therefore, as Gross National Product increases, countries will open access to more economic opportunities thereby decreasing income disparity. A nation with high Gross Domestic Product have lower gaps between rich and poor therefore economic opportunities are better and income distribution are likely to be even.

Keywords— Complex Adaptive System, economic disparity, emerging behaviour, synergy.

I. INTRODUCTION

Over the years, the economy is never in equilibrium. The prices continually fluctuate, quantities of goods and services produced varies and wages has to continually increase to cope up with the changes in all economic factors. Beinhocker (2006) saw economy as a complex adaptive system. As a complex adaptive system, most of production, trade and consumptions do not reach optimal amount and prices of goods and services are never the same. The movement of economic variables such as revenue, production and wages are non-linear. World economy, though complex, increases over the years. Worldbank data showed an increasing Gross National Product (GNP), an indication that the world's economy is growing. However, while the economy grows, the gap between the rich and poor is still wide.

According to Keeley (2015) income of the richest 10% of the OECD countries is higher by 9.5% than that of the 10% poorest. This gap is also higher in developing counties. This disparity resulted to inequality in the opportunities to access quality education, healthcare and employment. The issue on economic disparity is even elevated as one of the eight millennium development goals of united nations because the

organization had seen its adverse effects. Eventually, this disparity will slow economic growth and reduce social mobility. This paper explores the emergent economic behaviour of countries.

II. CONCEPTUAL FRAMEWORK

This paper hypothesized that income levels do not necessarily influence income disparity. By using income levels as a context of the nations, countries display a complex adaptive behaviour in terms of their income disparities. Nations observe the income disparities in other nations belonging to different income levels. By rational choice theory, nations will adapt the practices of nations with higher income levels and low disparities.

Beinhocker (2006) explained the complexity of the economy and how it qualifies as a complex adaptive system. His findings were thoroughly discussed by Gintis (2006), who introduced five big concepts of complexity). These are dynamics, agents, network, emergence and evolution. The economic impact cannot be explained by the direct relationship with only one player but an interaction among all players like supply, production, labor among others. These dynamism in the interaction resulted to both non-linear and non-equilibrium effect. The complex adaptive system of the economy can also be explained using the concept of agents. The nation's economy as agents has limited information and high cost of information processing. Further, each country participates in a complex network formed by treaties and international organizations in all parts of the continents and over the years, there were emergent behaviours observed through macro and micro economic interactions. Lastly, with the aim of economic advancement, the phase of economy evolved with the use of technology.

Figure 1 shows the schematic diagram of the study. Using countries as agents, they interact with one another in terms of GINI and GDP. This interaction resulted to clustering of countries according to economic performance and disparity. Ideally, countries that have the same internal attributes e,g, GDP and Income Disparity, are expected to cluster together. However, the dynamic responses of these countries in real-time may actually be different. This type of dynamic interaction leading to a different sort of emergent behaviour is what this paper wished to discover. Such a display of dynamic interaction is particularly evident in nations which are members of trade blocks such as the European Union.
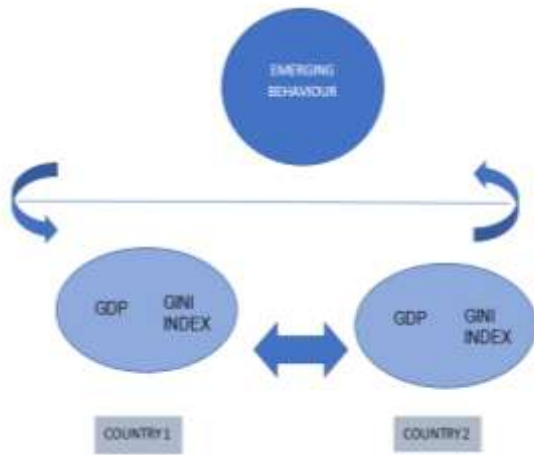
Figure 1 Schematic diagram of the study

In the early stages of formation, member EU nations had high hopes of collaborative prosperity. Later, we find that leading countries like the United Kingdom and others are more keen in disentangling themselves from the Union because their membership to EU became more of a liability than an asset. Until more recently, ten (10) countries in Asia have pursued a similar alliance through the ASEAN and we expect to observe a different kind of dynamism that will take place in this context.

III. METHODOLOGY

The main method of research that is utilized in this study is Complex Adaptive Analysis. Complex adaptive analysis allows for the exploration of non-linear interaction among the agents of the system. While being primarily descriptive-analytical, the CAS approach enables the researcher to investigate self-organizing behaviors that emerge out of local agent interactions. Data sets used in this study were GDP and GINI from open database of World Bank and global finance. These data were processed and analyzed to come up with the emergent behavior of countries with differentiated wealth and income disparities.

Factor analysis is used to determine the features described by the variables. It is a statistical process used to observed the values express as function in correlated variables. It is also used to test the significance of a specific factor loading (Decoster, 1998). The features derived in factor analysis were used as inputs to calculate the synergies. Positive synergies imply feature similarities based from the principle of cooperation. In calculating the synergy, a program or application from Northwestern Mindanao State College of Science and Technology (NMSCST) was utilized. Histogram is shown to summarize the synergy generated. Histogram is a graphical representation showing in the vertical axis the count or frequency while horizontal access represents data ranges. A scatterplot was also generated to look at emerging patterns. Emergent pattern/feature is formed when the countries interact with each other in term of GDP and GINI. These features were then analysed and discussed.

IV. RESULTS AND DISCUSSION

Table 1 presents the result of the factor analysis performed on the variables.

TABLE 1. Factor Analysis Result

Unrotated Factor Loadings and Communalities			
Variable	Factor1	Factor2	Communality
GDP 2017	0.731	-0.682	1.000
GINI 2017	0.731	0.682	1.000
Variance	1.0691	.9303	2.0000
%Var	.535	.465	1.000
Factor Score Coefficients			
Variable	Factor1		Factor2
GDP 2017	0.684		-0.733
GINI 2017	-0.684		0.732

The feature in the factor I is named as income and wealth distribution having both positive loading in GDP and GINI while factor 2 is income disparities feature which loaded negative for GDP and positive for GINI Index. Of the two features derived, feature 1 on income and wealth distribution was discussed due to higher result in variance (53%). Although factor 2 was not analysed in this paper, the factor analysis was only used to create cluster that is essential in finding emergent behaviour, thus this method is not considered critical in this portion.

Knowing that factor 1 above has positive loadings, table 2 shows the generated synergy through an application software.

Table 2 presents the top 10 countries with lowest and highest computed synergy and countries with highest synergy. It can be seen from the table 2 that the first 10 countries with lowest synergy were Organization for Economic Cooperation and Development (OECD) member countries. These countries are wealthy countries with higher GDP and GINI ranges from 24.4 to 26.6. On the other hand, most developing countries have more synergies. This implies that developing countries connect more to the world with the aim of increasing trade and overall productivity however, it can also be seen that these countries have very high economic disparity ranging from 47 to 57.7. In contrast more developed countries are already very cautious in establishing connections to other countries securing more positive synergy.

The histogram presented in figure 2 illustrates the emergent behaviour of agent countries in terms of economic disparity. For better analysis, since GDP of countries are presented in large numerical values, the researcher took the logarithmic values to deduce the large number into smaller factor without losing information.

Based from the presented graph, countries can be clustered in 2. Cluster 1 had GDP logarithmic values ranging from 26.4 to 30. Majority of the countries under this cluster are developed and OECD countries, those who are economically advantaged than the rest of the world. Whereas in cluster 2 logarithmic valued ranged from 21.6 to 25.5. Countries on this clusters are more developing and highly indebted. From this clusters, a scatterplot were generated and results are presented in next figure.

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TABLE 2. Computed Synergy

Country Name	2017 GDP	GINI 2018	SYNERGY
Czech Republic	2.15726E+11	25.6	1
Denmark	3.24872E+11	25.3	1
Finland	2.51885E+11	25.6	1
Iceland	23909289979	24.4	1
Norway	3.98832E+11	24.9	1
Slovak Republic	95769031980	26.1	1
Slovenia	48769655479	25.9	1
Sweden	5.3804E+11	25.7	1
Ukraine	1.12154E+11	26.3	1
Belgium	4.92681E+11	25.9	2
Netherlands	8.262E+11	26.6	2
Chile	2.77076E+11	45.9	77
Indonesia	1.01554E+12	45.7	77
Mexico	1.14992E+12	45.9	77
Panama	61838175800	46.1	77
Egypt, Arab Rep.	2.35369E+11	47	79
India	2.59749E+12	47.9	82
Philippines	3.13595E+11	47.9	82
Colombia	3.09191E+11	48.9	83
Lesotho	2639386291	49.3	83
Sri Lanka	87174682200	51.4	83
Zambia	25808666422	49.5	83
China	1.22377E+13	51	85
South Africa	3.49419E+11	57.7	94

Fig. 2. Histogram of GDP of countries

Table 3 presents the list of countries in cluster 1 and table 4 presents the list of countries in cluster 2.

TABLE 3. List of countries in cluster 1

United States	Russian Federation	Sweden	Denmark
China	Korea, Rep.	Poland	Malaysia
Japan	Australia	Belgium	Philippines
Germany	Spain	Thailand	Colombia
United Kingdom	Mexico	Iran, Islamic Rep.	Pakistan
India	Indonesia	Norway	Chile
France	Turkey	Nigeria	Finland
Brazil	Netherlands	Israel	Bangladesh
Italy	Switzerland	South Africa	Egypt, Arab Rep.
Canada	Argentina	Ireland	Vietnam
Portugal	Czech Republic	Romania	Peru

TABLE 4. List of countries in cluster 2

Greece	Bulgaria	Bolivia	Zimbabwe
Algeria	Uruguay	Cameroon	Lao PDR
Kazakhstan	Croatia	Latvia	Senegal
Hungary	Tanzania	Paraguay	Mali
Ukraine	Slovenia	Estonia	Georgia
Slovak Republic	Ghana	Uganda	Nicaragua
Sri Lanka	Lithuania	Zambia	Albania
Luxembourg	Azerbaijan	El Salvador	Mozambique
Panama	Tunisia	Nepal	Armenia
Costa Rica	Jordan	Iceland	Madagascar
Mongolia	Rwanda	Tajikistan	Sierra Leone
Macedonia, FYR	Moldova	Malawi	Burundi
Chad	Kyrgyz Republic	Mauritania	Lesotho

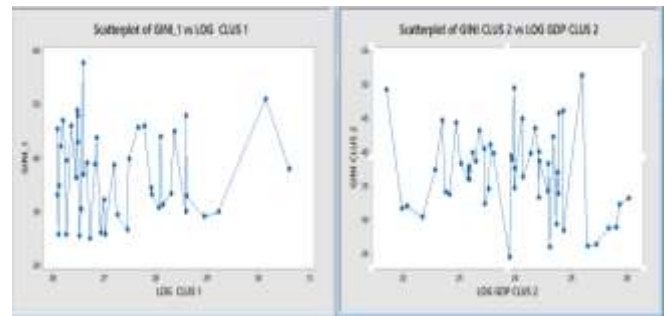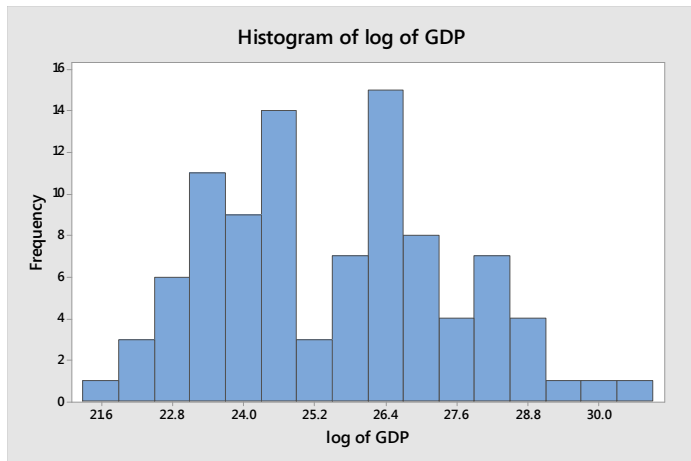Figure 3 presents the scatterplot of the countries found in cluster 1 and 2.

Fig. 3. Scatterplot of logarithmic values of GDP and GINI

The graphical presentation of cluster 1 is seen in the right side of the figure. The logarithmic values of the GDP in the horizontal access were smaller that matched the smaller values of GINI coefficient as shown in the vertical axis. Countries in this cluster have economic advantage which included 53% of OECD member countries. The lowest GINI index score was 24.9 while the highest was 48.9. Generally, it can be construed that these economically progressive countries have controlled inequality which further be inferred that as the GDP increases in countries in this cluster, the wealth and income distribution move within the ideal boundary of less than 50 GINI Score.

The scatterplot seen at the right side of figure 4 presents the cluster of countries having GDP logarithmic values lower than 26 and varied scores in GINI index. Most of these countries are seen to be economically disadvantaged and have higher GINI Index scores ranging from 26.1 to 51.4. The graph presented a pattern that these less economically advantaged countries cannot control the economic disparity. It can further be interpreted that when they aspire for economic progress, the disparity may widen.

Income Disparity in the Philippines

Table 5 presents the income disparity and GDP in the Philippines from 1985-2018.

Close examination of table 5 reveals that Philippine economy is continually increasing over the years for the past 30 years. The highest increase in GDP is recorded on 2012, an account for more than 55% increase from 2009. In 2012, Philippines was labelled as the emerging tiger in Asia. This significant changed in economy was greatly due to the government commitment to sound fiscal policy and forward-

looking monetary policy framework. This framework helped strengthen commitment to non-inflationary economic growth (Tetangco, 2013). However, the there was a decline in economic growth in 1998 because of the Asian financial crisis.

TABLE 5. Philippine GINI and GDP

Year	GINI index score	GDP (in billion Dollars)
1985	41	30.73
1988	40.8	37.85
1991	43.8	45.41
1994	42.9	52.9
1997	46	82.34
2000	42.8	81.02
2003	41.5	83.9
2006	42.2	121.3
2009	41.8	161.3
2012	42.2	250.1
2015	40.1	292.8
2018	47.9	313.6

The widest recorded income gap in the Philippines happened in 2015-2018 from GINI index of 40.1 to 47.9, an index score gap by 7.8 points. Philippine income inequality is increasing along with China, India, Indonesia and Russia (Caraballo, 2017). Moreover, the greatest improvement in GINI index was in 2012-2015 where index was down by 2.1 points. This decrease may be due to the significant decrease in poverty incidence from 25.2% in 2012 to 21.6%. In 2019, the Philippines hoped for an improvement in the gap between the rich and the poor along with the increased in Gross National Product.

Emergent Feature

1. As GDP increases GINI has no drift or both. It means that GINI index neither goes up or down. It can be inferred that whether a country is rich or poor, it has no bearing on income disparity. This feature implied that national productivity is not concern with stabilizing wealth distribution. For instance, high GDP maybe due to 10% of the population while the other 90% is not economically participating.

2. The variations of GINI index in OECD countries or rich nations are less than the variations in developing countries.

This feature indicates that wealth is more properly distributed in richer nations. This further implies that there is greater economic participation of the people in cluster 1 because access to economic opportunities are better in cluster 1 than in cluster 2, giving wider job opportunities and higher salaries.

V. CONCLUSION

In conclusion, as Gross National Product increases, countries will open access to more economic opportunities thereby decreasing income disparity. A nation with high Gross Domestic Product have lower gaps between rich and poor therefore economic opportunities are better and income distribution are likely to be even. Generally, governments of the developing countries are not so sensitive about the income gap of the people therefore economic policies needs to be revisited.

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