Conference Paper

The Pareto Distribution of World's GDP

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Abstract

The problem of wealth distribution has gathered the attention of researchers for many years. In their work, the researchers are mainly engaged in the issue of distribution of wealth between individuals by analyzing empirical results at the country level, or specific lists that particular organization form like the Forbes list. Research are also increasingly directed toward the analysis of new models such as Boltzmann Gibbs or application of Gama function that describes this distribution. An interesting issue is the analysis of the distribution of wealth among the countries themselves. In these works, the value of GDP is used as the wealth that country has. In this article, the author dealt with the analysis of the distribution of GDP between countries at the global level. Analysis were performed using the Pareto distribution model of wealth distribution and GINI coefficient based on the data of the value of GDP for countries from IMF estimation. The analysis was conducted for the period from 1980 to the present, as well as analysis of data provided by IMF estimates for the value of GDP by 2022. The goal is to determine the degree of uneven distribution between the countries themselves in the world, analyzing the dynamics of change in the degree of unevenness and an analysis of the degree of unevenness in the future based on forecasts of the IMF on the values of countries GDP. The author also wanted to test if Pareto's 80/20 rule applies when it comes to the distribution of GDP at world level.

Keywords: GDP, distribution of wealth, IMF, Pareto distribution, GINI coefficient

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1. Introduction

The problem of the distribution of wealth has become very topical, which is a large number of researchers engaged. One of the first to deal with this problem was Vilfredo Pareto. Based on his research he found that the distribution of wealth between individuals can describe with power-law function that is now called Pareto distribution function of wealth and based on the value of the Pareto exponent is determined the degree of uneven distribution. Also based on his research he came to the conclusion

that 20% of the population owns 80% of the wealth of this population which is the subject verification of some of the works, such as Dunford et al. [5].

A large number of authors studies the distribution of wealth. They use various models and types of distributions, of which the most common is Pareto distribution. Pareto model has been successfully applied in the works. A major cause of economic inequality within modern market economies is the determination of wages by the market. Where competition is imperfect; information unevenly distributed; opportunities to acquire education and skills unequal market failure results. Since many such imperfect conditions exist in virtually every market, there is in fact little presumption that markets are in general efficient. This means that there is an enormous potential role for government to correct such market failures [12].

Economist Thomas Piketty argues that widening economic disparity is an inevitable phenomenon of free market capitalism when the rate of return of capital is greater than the rate of growth of the economy [10].

Atkinson [1] identified a number of contributing factors, including: globalization, technological change (information and communications technology), growth of financial services, changing pay norms, reduced role of trade unions and scaling back of the redistributive tax-and-transfer policy.

Over time, new models are formed that aim to better describe the distribution of wealth as polynomial model by Oltean & Kusmartsev [9]. Also models from statistical physics are used that can describe the process of money creation, exchange and distribution of wealth. It is a gas models without saving, saving and uneven savings. Based on the well-known laws of thermodynamics describe the economic processes. Some of the authors who have dealt with the development of these models are Yakovenko [15], Dragulescu [4] and Chakrabarti & Chatterjee [3].

We can talk about wealth at the country level also. Each country, that is, economy in the world, products manufactured through exchange and trade at the global level can lead to exchange of wealth between countries where some countries will become richer and some poorer. When we talk about measures the wealth of a country as a criterion may be taken the value of GDP that the country had made annually where it recorded all the production that the country has, and the effects of exchange at the international level. The question is whether GDP is really the best criterion of wealth? Certainly not, because the wealth of a country can be defined as a set of values that a country has in its territory, like natural resources, which can be financially measured, but other segments too like cultural, population, education structure, etc., but for research purposes GDP is the simplest and can easily reach it.

Skipper [13] and Dunford [5] dealt with problem of application of Pareto's model. They found that the Pareto model can be applied to analyze the distribution of GDP. Specifically, Dunford et al. applied Pareto model, where is found that 20% of the world's countries possess 91.62% of its wealth (GDP), which confirmed that a Pareto-rule does not apply to the distribution between countries and showed that Pareto-distribution model describes good distribution a wealth countries. Skipper R. applied Zipf distribution model which contains the Pareto exponent and showed that as in the previously mentioned papers dealing with the problem of distributing wealth between individuals, the Pareto model describes good the richest part of the monitored group.

The aim of this article is to analyze the distribution of wealth (GDP) at world level on the basis of data from the database of the IMF for the period 1980 to 2016 and for the period from 2017 to 2022 based on the forecast that the IMF had provided for all countries in the world. As a measure of inequality Gini coefficient will be used and Pareto's exponent on the basis of which will determine the movement of inequality in the distribution in the specified period. It will also be an analysis of whether Pareto's 80/20 rule can be applied, that is, that this rule does not apply as identified in the work of R. Dunford et al. and check whether 20 richest countries in the world holds 80% of the world's wealth, as one of the possible Pareto's 80/20 rule description.

2. Measuring the Distribution of Wealth and Pareto Principle

Distribution of wealth and its uniformity can be measured in several ways. The first method is GINI coefficient which is commonly used. GINI coefficient was developed by the Italian statistician Corrado Gini and published in his paper 'Variability and mutability'. Its value represents the percentage of the area between the line of perfect uniformity of distribution and the observed Lorenz curve in the area between the two extreme positions of the Lorenz curve. This indicator is now often used as a measure of inequality in the distribution. The value ranges between 0 and 1, and what the value is closer to zero means that the distribution is more uniform, and vice versa.

Vilfredo Pareto in 1879 found that the high levels of wealth (but also income) distribution is done according to the power-law distribution. Distribution parameters can be changed from one society to another, which are observed, but regardless of the social and political conditions Pareto found that the distribution of wealth respect the

general law of distribution, which is now known as the Pareto Law. Pareto distribution is given by the following probability density function:

$$P(W) = C \cdot W^{-(1+\alpha)}, \quad \text{for } W \geq W_o \tag{1}$$

where *W* is wealth, *P(W)* density function, W_o the lower limit of wealth and *C* constant. α is known as the Pareto exponent (Levy M., Solomon S., 1997, 90). Pareto exponent shows us the degree of unevenness in the distribution of wealth. If the Pareto exponent decreases, it means that the uneven distribution of wealth, that is, most of the total wealth goes into the hands of the individual, in this case, the group of countries. This model of distribution has an important use as an indicator of the degree of inequality in the company in the distribution of the fluctuations in the exchanges [8].

Value of Pareto exponent can be found by applying the Zipf's formula where Pareto exponent is reciprocal value of the exponent in the Zipf's formula [7].

A number of researchers shows that the model perfectly aligned with empirical data [6], but with certain corrections of the model itself [2]. In the last few years there is a lot papers that point out that Pareto model is not ideal for a description of the overall distribution of wealth, but to perfect describes only the lower part of distribution, that is, distribution between the richest members of society (about 3 to 5%), while in the poorer part exists the problem of divergence, which is described by Boltzmann Gibbs distribution [4].

Pareto distribution originally was developed to describe the distribution of wealth among individuals, since it seemed that most of the wealth of the community in the possession of a small part of the members of the same community. It is known Pareto principle 80/20, which states that 20% of the population controls 80% of the wealth of the community. When the value of the Pareto exponent equal to 1.16, this means that in the observed population there is a 80/20 principle [5].

In studies of many authors confirmed that the probability distribution and the cumulative probability of agent-based models can be described with Boltzmann Gibbs distribution from physics. A fundamental law of equilibrium in statistical physics is Boltzmann Gibbs law, which says that the probability P(ε) to find a physical system or subsystem in a state of energy ε determined by an exponential function:

$$P(\epsilon) = ce^{-\frac{\epsilon}{T}} \tag{2}$$

In formula (2) *c* is a constant of normalization, *T* is a temperature that is equal to the average energy per particle. A probability value may range up to 1. To describe the

equation function in the system must apply the law of conservation of energy, that is, that is the summation of the energy that each particle has the same total sum of energy of the system that is constant and that the probability of the particles having energy equal to the sum of energy of two particles is equal to the probability that the product particles have a particle from that particular energy.

Dragulescu and Yakovenko [4] used Boltzmann Gibbs distribution to describe the distribution of money between agents:

$$P(m) = ce^{-\frac{m}{T}} \tag{3}$$

where m is the amount of money that each agent has and T is 'temperature of money' that is equal to the average value of the money that each agent has [15]. In their paper Dragulescu and Yakovenko have shown that this model can be applied to describe the distribution of cash and due for example to the USA and UK [4]. Based on the performance of the distribution function is obtained that the normalization constant temperature is equal to the reciprocal value of average money that agents have.

3. Methodology

In this study will be used Zipf's function shown in formula (4)

$$w_n = A \cdot r^{-\beta} \tag{4}$$

where: r –rank that the country has on the list based on the value of their wealth (GDP), w_n – countries wealth (GDP), A – constant and β – exponent which is the reciprocal of the Pareto exponent α. Formula 4 will be applied to the period from 1980 to 2022 to determine the value of the Pareto exponent and thus determine the dynamics of change in imbalances in the distribution of GDP. In addition to this formula will be an analysis of the value of the Gini coefficient for the period 1980 to 2016 and for the period from 2017 to 2022 based on the forecast that the IMF had provided for all countries in the world. Based on the trends of these values will be analyzed the dynamics of changes in the distribution of world GDP, and what are the forecasts of the IMF on the basis of value in the period until 2022. It will be carried out comparing the value of the exponent of Pareto and Gini coefficient and thus determine whether there is a match the dynamics of these values or not.

Based on the values that the IMF the analysis of wealth distribution between countries in groups:

1. first group – 20% of the richest countries

2. second group – second 20% of the richest countries
3. third group – third 20% of the richest countries
4. fourth group – fourth 20% of the richest countries
5. fifth group – 20% of the poorest countries

On the basis of this distribution will be determined whether Pareto's 80/20 rule applies to the distribution of the world GDP, or is it a different relationship like Dunford et al. (2014) in their paper proposed, et. 90/20. Also we will the analysis the relationship between the wealth held by the group of the 20 richest countries in the observed period in order to determine whether the case of a distribution of world GDP Pareto 80/20 rule can be that 20 richest countries in the world possess 80% of world GDP.

Analyzes of value Gini coefficients were made in the program Gretl, and analysis of the value of the Pareto exponent was done in Origin Pro 9 program.

4. Results

The IMF released its data for the period from 1980 to 2022, where a valuation of the IMF as well as the forecasts of those values for the period until 2022 are given. The number of countries has increased over time. So in 1980 we have a total of 146 countries are handled by the IMF, to 2004, their number has grown to 191, and that number is retained in the analysis by 2022. The number of countries are changing with time, because in this period has led to the disintegration of the former socialist countries, as well as the formation of new states. It is also important to mention that the data published by the IMF means that for all values of GDP which have been published using the same currency, the US dollar, which makes it possible to perform such an analysis. In the analysis were not observed economic and customs unions such as the EU or the BRICS, only country individually and as a distribution among them was analyzed.

Based on the analysis from program Gretl and Origin Pro 9 Table 1 shows the values obtained for Gini coefficient and Pareto Exponent, while the Graph 1 shows graphical representation of value of the Gini coefficient in the observed period.

Table 1: Gini coefficient values, Pareto exponent and the coefficient of determination.

No.	Year	Gini	Pareto's model		
			Exponent	Error	R^2
1	1980	0.817629	0.96816	0.01354	0.97755
2	1981	0.817469	0.96260	0.01301	0.97920
3	1982	0.816362	0.97548	0.01236	0.98129
4	1983	0.817443	0.96291	0.01228	0.98145
5	1984	0.818649	0.94720	0.01245	0.98082
6	1985	0.820893	0.94504	0.01239	0.98089
7	1986	0.821141	0.94541	0.01266	0.98004
8	1987	0.822175	0.94714	0.01300	0.97886
9	1988	0.823603	0.95010	0.01301	0.97887
10	1989	0.824500	0.95078	0.01280	0.97953
11	1990	0.824749	0.95904	0.01197	0.98164
12	1991	0.825945	0.97331	0.01130	0.98358
13	1992	0.827854	1.00944	0.01235	0.97864
14	1993	0.828392	1.00489	0.01288	0.97650
15	1994	0.829592	0.99918	0.01323	0.97503
16	1995	0.829475	1.00248	0.01269	0.97661
17	1996	0.829837	1.00191	0.01225	0.97804
18	1997	0.831384	0.99902	0.01242	0.97705
19	1998	0.831255	0.98915	0.01259	0.97606
20	1999	0.831962	0.98352	0.01276	0.97539
21	2000	0.836928	0.98566	0.01196	0.97752
22	2001	0.836758	0.99188	0.01089	0.98124
23	2002	0.836707	0.99526	0.00986	0.98450
24	2003	0.835654	0.99907	0.00901	0.98706
25	2004	0.834949	1.00347	0.00823	0.98912
26	2005	0.834378	1.00767	0.00775	0.99036
27	2006	0.833426	1.01744	0.00825	0.98914
28	2007	0.832747	1.03092	0.01013	0.98381
29	2008	0.831600	1.04185	0.01245	0.97588
30	2009	0.832021	1.04676	0.01532	0.96406
31	2010	0.833036	1.05542	0.01762	0.95324
32	2011	0.835014	1.06188	0.02024	0.93944
33	2012	0.835193	1.06290	0.02223	0.92797
34	2013	0.835738	1.06596	0.02447	0.91423
35	2014	0.836861	1.05220	0.02287	0.92382
36	2015	0.837944	1.03814	0.02155	0.93136
37	2016	0.839078	1.02431	0.02000	0.94001

No.	Year	Gini	Pareto's model		
			Exponent	Error	R^2
38	2017	0.839882	1.01228	0.01878	0.94649
39	2018	0.840499	1.00268	0.01785	0.95127
40	2019	0.841002	0.99347	0.01692	0.95585
41	2020	0.841380	0.98485	0.01608	0.95985
42	2021	0.841772	0.97662	0.01537	0.96309
43	2022	0.842171	0.96859	0.01489	0.96521
Source: Data processed by the author.					

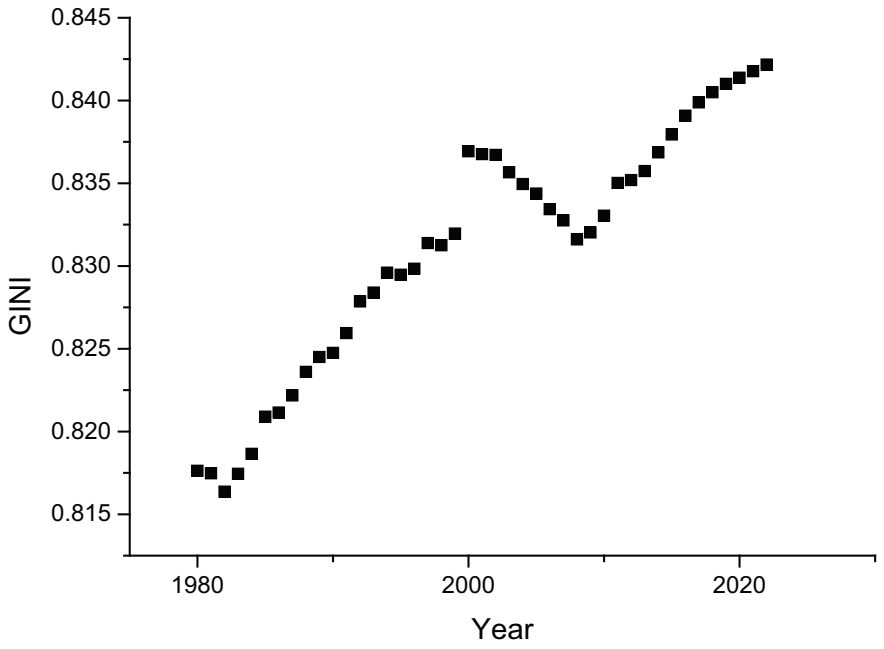

Figure 1: The value of the Gini coefficient in observed period. Source: Graph processed by the author.

Based on the obtained values from Graph 1 and Table 1 we can see that Gini coefficient over time has growing trend. In the first three years of the period, this value is falling, while after that until the year 2004 grew, when then until 2008 followed a short period of decline and then we see that this value is growing and that according to IMF forecasts the value of the Gini coefficient will continue to grow. Based on the theory that if we know the Gini coefficient is higher, that is, moves to 1 implies that an increase in inequality in the distribution of wealth. In this case means that there will be a concentration of wealth in a certain circle of countries, while the rest of the world have a smaller part of world's GDP. It is interesting to see that since 2008 the value of the Gini coefficient starts to grow, which coincides with the appearance of

the last crisis. We know that during the periods of crisis, there is the appearance of unequally distribution within the population, which has been shown in the example distribution worldwide GDP, because then the maximum group poorer countries, which are dependent on import were affected by the appearance of the actual crisis. We see also that according to IMF projections, although by 2022 it is expected that in all countries to reach GDP growth, this growth will certainly not be uniform everywhere, and most will benefit from the most developed countries, which will contribute to the further concentration of wealth in them.

Projections by the IMF involve *ceteris paribus*, that is, unchanged situation. Will the same projections be achieved and the value of the Gini coefficient be what is displayed will depend on how the world economy, and the political situation, because we have seen that there is a change in this field, that is, China's economy grows slowly and takes precedence over the American, countries of BRICS are becoming economically stronger and more dominant, but also leads to the change of the agreement, which have until recently in force, such as agreements on trade, where we see the United States take restrictive measures which wants to protect its economy and production, but also in the political field where the sanction extends toward Russia continues, however they can lead to an increase of the same.

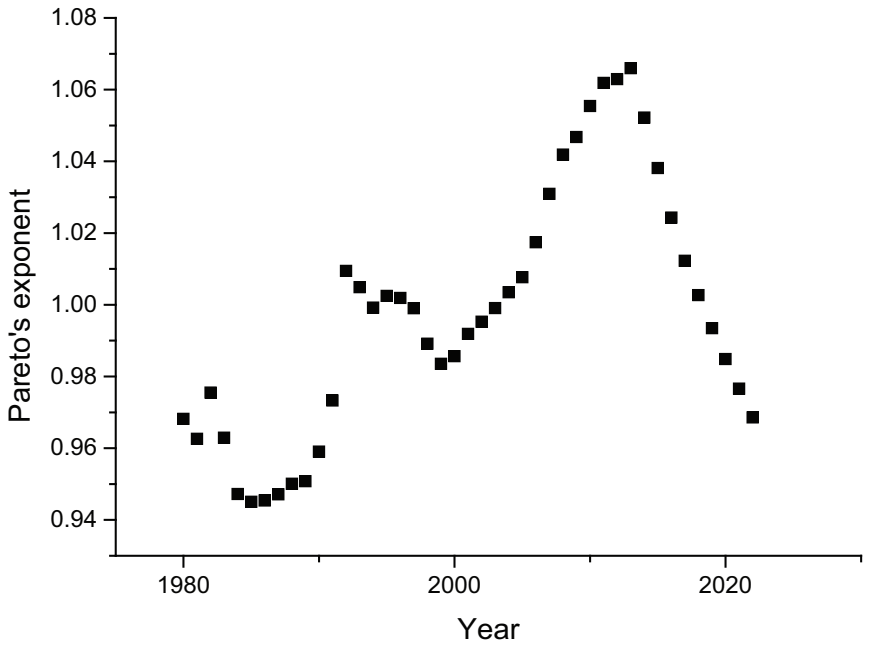

Figure 2: The value of the Pareto exponent in observed period. Source: Graph processed by the author.

Based on the value from Graph 2 and Table 1, we see that there is a difference in the dynamics Pareto exponent and Gini coefficient. The Pareto exponent also has a drop-down values in the first 4 years, which leads to growth until 1992 when moving a slight drop in value until 1999, after which coefficient rises and 2013. After 2013, the value of the Pareto exponent is decreasing and expected to continue to decline. For Pareto exponent is known that as the value of the exponent is growing that a more uniform distribution, while when the exponent decreases means that uneven. On the basis of the values we see that there are disagreements in relation to the value of the Gini coefficient and Pareto exponent for the reference period. Certainly, in both cases we see that for the last periods predict unequally distribution of wealth because the value of the Gini coefficient increases, while Pareto exponent decreases.

Based on these values for the Pareto exponent, we can also see that confirmed the conclusion that Pareto distribution model best describes the richest part of the population, in this case, the richest countries, while the values predicted by the model for other countries that are poorer substantively differ from the real values that we have. Pareto model well described empirical data, which was confirmed by high values of the coefficient of determination for this model, which can be seen in the fourth column of Table 1. The graphic shows an example of the Pareto distribution for 1982, 1992, 2012 and the year 2022.

Based on his research Pareto found a rule that 20% of the population owns 80% of the wealth. Based on the data from IMF and from Graph 3 we can see that the group of countries stands out by their high values of GDP ranking. We have tried to determine whether Pareto's rule 80/20 applies to the distribution of wealth of countries. Table 2 shows the values by groups of countries and share the wealth of the richest 20% countries (first group) of the total value of world's GDP.

Table 2: Distribution of world's GDP by groups of countries.

No.	First group (in millions $)	Second group (in millions $)	Third group (in millions $)	Fourth group (in millions $)	Fifth group (in millions $)	The share of first group
1980	1.12E+07	1.49E+06	354485	101240	15949	0.85015
1981	1.24E+07	1.66E+06	399581	114034	18012	0.84968
1982	1.32E+07	1.80E+06	419844	123399	19281	0.84864
1983	1.41E+07	1.90E+06	443696	130004	19854	0.84962
1984	1.53E+07	2.04E+06	478876	137963	21202	0.85086
1985	1.64E+07	2.15E+06	512140	152682	25229	0.85230
1986	1.73E+07	2.26E+06	536598	161536	26669	0.85292
1987	1.84E+07	2.45E+06	559605	155353	25343	0.85259
1988	2.00E+07	2.61E+06	586838	166529	27608	0.85513

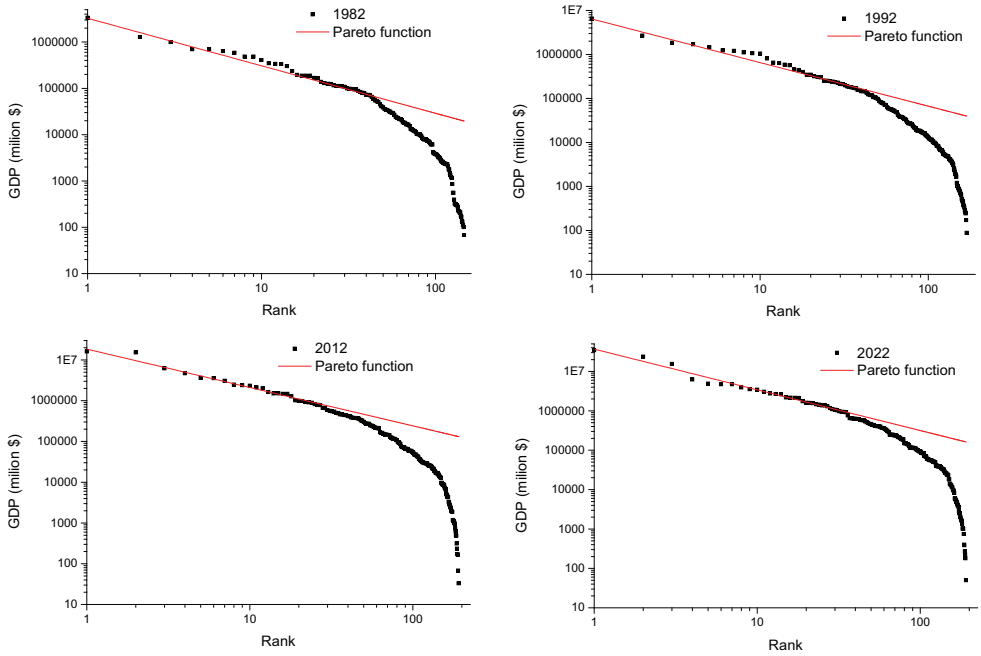

Figure 3: Pareto distribution of world's GDP for 1982, 1992, 2012 and 2022. Source: Graph processed by the author.

No.	First group (in millions $)	Second group (in millions $)	Third group (in millions $)	Fourth group (in millions $)	Fifth group (in millions $)	The share of first group
1989	2.16E+07	2.82E+06	609359	180960	30222	0.85577
1990	2.33E+07	3.04E+06	626321	199208	31909	0.85657
1991	2.49E+07	3.18E+06	670804	207293	34554	0.85889
1992	2.85E+07	3.26E+06	739151	249164	46230	0.86916
1993	2.97E+07	3.41E+06	806297	254175	47784	0.86803
1994	3.12E+07	3.66E+06	839567	262277	48954	0.86636
1995	3.31E+07	3.81E+06	866082	277360	52764	0.86867
1996	3.50E+07	4.01E+06	935985	292422	54739	0.86858
1997	3.72E+07	4.10E+06	951982	314854	55339	0.87266
1998	3.85E+07	4.27E+06	1.08E+06	333327	57999	0.87015
1999	4.04E+07	4.46E+06	1.13E+06	353584	61305	0.87066
2000	4.38E+07	4.45E+06	1.14E+06	348983	58895	0.87963
2001	4.58E+07	4.77E+06	1.20E+06	387812	61533	0.87709
2002	4.78E+07	5.01E+06	1.22E+06	418401	64744	0.87685
2003	5.07E+07	5.41E+06	1.30E+06	454052	67986	0.87504
2004	5.46E+07	6.00E+06	1.44E+06	479782	68354	0.87248
2005	5.90E+07	6.50E+06	1.59E+06	519579	73915	0.87177
2006	6.40E+07	7.12E+06	1.77E+06	561260	81801	0.87032

No.	First group (in millions $)	Second group (in millions $)	Third group (in millions $)	Fourth group (in millions $)	Fifth group (in millions $)	The share of first group
2007	6.92E+07	7.74E+06	1.95E+06	609350	87815	0.86947
2008	7.25E+07	8.19E+06	2.08E+06	647209	92229	0.86803
2009	7.27E+07	8.20E+06	2.11E+06	654601	93781	0.86799
2010	7.76E+07	8.63E+06	2.25E+06	695661	98046	0.86928
2011	8.25E+07	8.98E+06	2.29E+06	744508	104680	0.87199
2012	8.69E+07	9.39E+06	2.46E+06	778546	110143	0.87209
2013	9.13E+07	9.76E+06	2.60E+06	833908	112263	0.87278
2014	9.62E+07	1.02E+07	2.68E+06	886614	115104	0.87394
2015	1.00E+08	1.06E+07	2.74E+06	921193	118197	0.87479
2016	1.05E+08	1.09E+07	2.84E+06	947471	120881	0.87611
2017	1.11E+08	1.14E+07	3.03E+06	994948	126333	0.87695
2018	1.18E+08	1.20E+07	3.23E+06	1.05E+06	133396	0.87755
2019	1.25E+08	1.27E+07	3.43E+06	1.12E+06	141008	0.87807
2020	1.32E+08	1.33E+07	3.64E+06	1.19E+06	151076	0.87848
2021	1.40E+08	1.40E+07	3.86E+06	1.27E+06	160928	0.87891
2022	1.48E+08	1.47E+07	4.11E+06	1.35E+06	169305	0.87930

Source: Data processed by the author.

Based on the data we see from Table 2 share of 20% of the richest countries in the total world GDP ranging in values from 84.9% to 87.9%. Based on the data we see that the share fell in 1982 on minimum value and after that grew until 1992, where until 2000 the growth was with temporary reduction which reached a record value. After that value falling until 2009, and then again starts to grow until 2022 where is almost same like in 2000. When value started to rise in 2009 coincides with the beginning of the last world's crisis. The very dynamics of the values from Table 2 can be seen in Graph 4.

Based on the value we can see that they approach the amount of almost 90% of the total wealth. If the conditions do not change can be expected in the distant future that 20% of countries in the world possess 90% of world GDP, and therefore we can say that in today's conditions we can apply new Pareto Principle or 90/20, and for now 87/20 is more precise.

Maybe there's another way to get in connection with the distribution of world GDP explain Pareto principle 80/20. Perhaps it refers to the fact that 20 of the richest countries in the world possess 80% of world GDP. The following Table 3 shows the value of the share of world GDP, which is owned by 20 richest countries in the world.

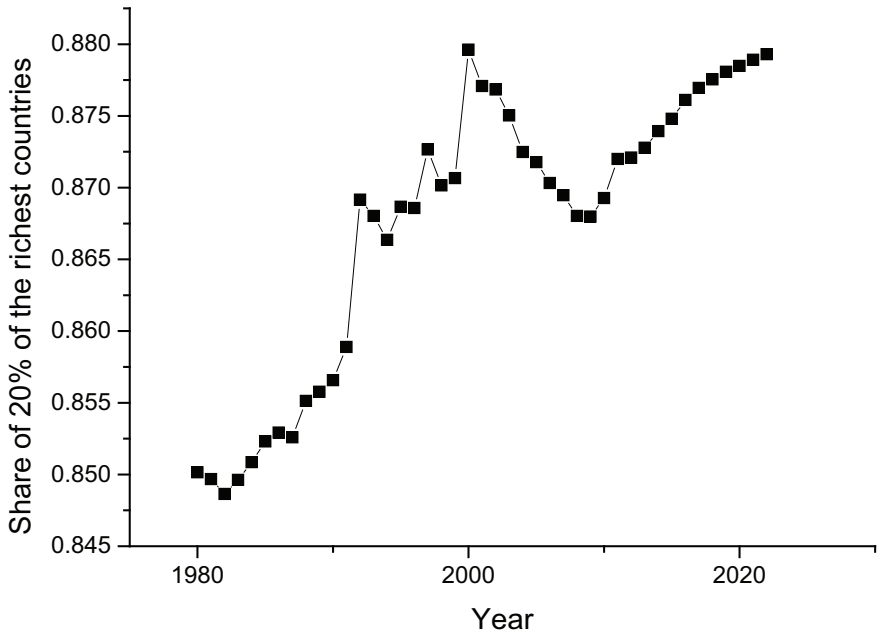

Figure 4: Share of 20% of the richest countries in the world's GDP in observed period. Source: Graph processed by the author.

Table 3: Share of 20 richest countries in the world's GDP.

No.	Value of GDP of 20 richest countries (in millions $)	Share
1980	1.02E+07	0.77926
1981	1.14E+07	0.77868
1982	1.21E+07	0.77599
1983	1.29E+07	0.77711
1984	1.40E+07	0.77783
1985	1.50E+07	0.77982
1986	1.58E+07	0.78038
1987	1.69E+07	0.77987
1988	1.83E+07	0.78210
1989	1.98E+07	0.78456
1990	2.12E+07	0.77917
1991	2.25E+07	0.77539
1992	2.51E+07	0.76640
1993	2.62E+07	0.76579
1994	2.76E+07	0.76515
1995	2.91E+07	0.76276
1996	3.07E+07	0.76219

No.	Value of GDP of 20 richest countries (in millions $)	Share
1997	3.24E+07	0.76062
1998	3.36E+07	0.75926
1999	3.53E+07	0.76089
2000	3.79E+07	0.76037
2001	3.97E+07	0.75892
2002	4.14E+07	0.75917
2003	4.38E+07	0.75709
2004	4.72E+07	0.75351
2005	5.09E+07	0.75237
2006	5.51E+07	0.75027
2007	5.96E+07	0.74881
2008	6.23E+07	0.74662
2009	6.26E+07	0.74718
2010	6.68E+07	0.74863
2011	7.11E+07	0.75155
2012	7.48E+07	0.75130
2013	7.86E+07	0.75186
2014	8.29E+07	0.75346
2015	8.67E+07	0.75433
2016	9.06E+07	0.75601
2017	9.60E+07	0.75711
2018	1.02E+08	0.75771
2019	1.08E+08	0.75814
2020	1.14E+08	0.75848
2021	1.21E+08	0.75882
2022	1.28E+08	0.75912
Source: Data processed by the author.		

Based on values we can see in Table 3 the share of the richest 20 countries is around 76% with the growing trend in the last 12 years that have been analyzed and if the situation does not change this value should be around 76%. Values from Table 3 for better interpretation are shown in Graph 5. Based on this analysis we can conclude that the Pareto 80/20 rule could apply if under number 20 we consider the number of countries that are seen and that they have about 80% of world GDP.

If we compare the dynamics of the value of the Graph 4 and 5, we see that they differ, to the period in 2004 when the two prints have a growing trend. This can be interpreted a number of countries to be taken into account in the analysis because of the observed period, resulting in the formation of new countries that emerged from

the first of all the former socialist countries. After 2004 the number reduced to 191 countries of the world, however, the dynamics began to overlap.

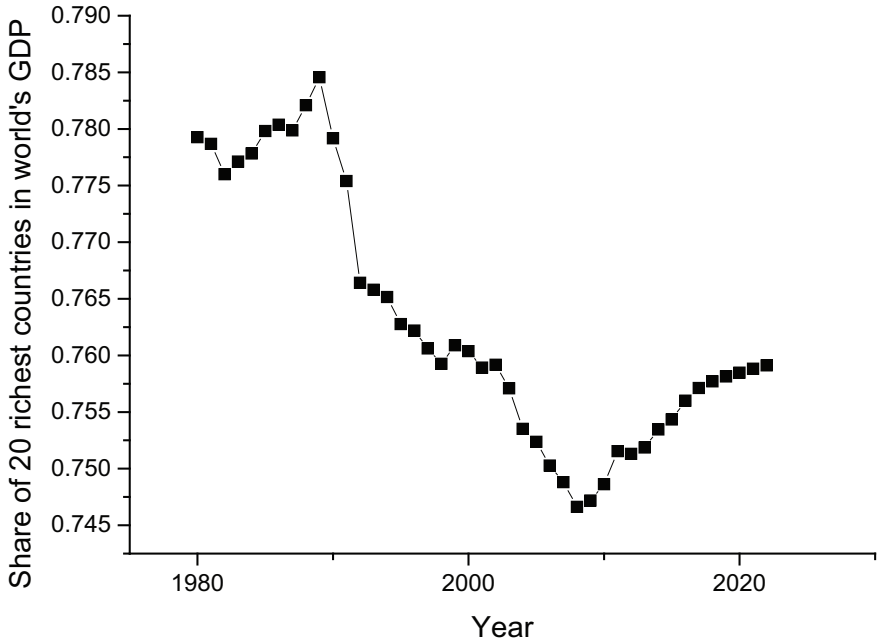

Figure 5: Share of the richest 20 countries in world's GDP. Source: Graph processed by the author.

5. Conclusion

In this article, we analyzed the application of Pareto distribution model on the distribution of GDP between countries. For analysis, we used data from the IMF for the period from 1980 until today, as well as information which the IMF predicts GDP values the world's countries on the principle of *ceteris paribus*. Based on the analysis we can conclude that Pareto model in the form of Zipf's formulas well describes the distribution of wealth between the world's countries, based on the values in graphs confirm that Pareto model best describes the distribution of the richest countries, as is done in a number of papers related to distribution of individual wealth.

When it comes to matching of values and the dynamics of the distribution of wealth between the Gini coefficient and Pareto exponent as a measure of inequality, on the basis of the analysis it was found that in observed period, there is not good fit between the values for these two parameters. In the period since 2013, the trend in both parameters tell us about expected growth of inequality in the distribution of wealth, that is, GDP at world level, which means that there will be a high concentration value.

In this article, we dealt with the issue of Pareto rule if it can apply to the case of distribution of GDP at world level. Although many other studies have shown that at the present time does not apply Pareto's 80/20 rule when it comes to individual distribution of wealth, the same can be concluded for the distribution of GDP. Specifically, based on the analysis in Table 2 can be seen that this ratio goes up to 90/20 or 87/20 in the reporting period as in research for distribution at the individual level established. So it can be said that the new Pareto rule is 90/20. If the analysis took part in the total value of the 20 richest countries in the world, then we can say that this rule can apply, that is, that 80% of world GDP has 20 richest countries in the world.

Future research in this area can be directed in several directions. We need to determine the reason why Pareto distribution can be applied in distribution of world GDP, true causes and to quantify in terms of uneven distribution. Also testing of other models such from Econophysics can be done and to determine theoretical reasons for their application.

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