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How COVID-19 Quarantine(s) Can Generate Poverty?

Mario Arturo Ruiz Estrada

ABSTRACT

This research paper attempts to show visually how the COVID-19 quarantines can generate massive unemployment, constant expansion of inflation, reduction of the purchasing power parity, and poverty expansion from a multidimensional perspective. This visualization is only possible by creating a new multivariate graphical modeling called "The Multidimensional Poverty Kaleidoscope Graph." The multidimensional poverty kaleidoscope graph is not intended to use a forecasting model in any case. However, its application is not limited to the study of a particular group of countries. It is not constrained by issues about the region or countries interested in applying the multidimensional poverty kaleidoscope graph. There are four primary phases in the implementation of the multidimensional poverty kaleidoscope graph. The first phase is the design of the input-output table. The second phase is divided into two sections of analysis: the first section of analysis assumes that the COVID-19 quarantine time framework growth rate (Y = Independent variable) impacts directly on our four variables in analysis, such as the inflation growth rate (X_1); the unemployment growth rate (X_2); purchasing power parity growth rate (X_3); the government budget deficit (X_4). In the second section of the analysis, the last past four variables in analysis became our dependent variables and directly affected the poverty growth rate (Z). The third phase is the construction of the multidimensional poverty kaleidoscope graph. Finally, the multidimensional poverty kaleidoscope graph was applied to three countries, such as the U.S., Malaysia, and Guatemala.

KEY WORDS: Poverty, policy modeling, poverty indicators, economic development, graphs.

JEL Classification: I32.

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1. Introduction

This paper introduces a new multidimensional graphical analytical tool to evaluate the impact of pandemics (quarantines) on the poverty expansion from a multidimensional perspective. It is called "The Multidimensional Poverty Kaleidoscope Graph." It is based on the uses of the octahedron geometrical representation that is moving constantly in real time according to a constant input of data and running of a serial of growth rates. The multidimensional poverty kaleidoscope graph can show clearly the effects of any pandemics (such as

COVID-19) on the constant expansion of poverty in any country from a multidimensional perspective. The difference between the multidimensional poverty kaleidoscope graph and other graphical models such as Lorenz curve to analyze the poverty behaviour, such as the classic two-dimensional and three-dimensional graphical representations is that the multidimensional poverty kaleidoscope graph presents a general understanding of four variables in two different levels (Level-1: independent variable and Level-2: dependent variable) that can affect directly on the poverty behaviour anytime and anywhere, which includes the inflation growth rate (X_1 in Level-1: dependent variable and Level-2: independent variable), the unemployment growth rate (X_2 in Level-1: dependent variable and Level-2:

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independent variable), purchasing power parity growth rate (X_3 in Level-1: dependent variable and Level-2: independent variable), and the government budget deficit (X_4 in Level-1: dependent variable and Level-2: independent variable). At the same time, we have two variables in both levels such as in the Level-1 is the COVID-19 quarantine time framework growth rate (Y) and Level-2: the poverty growth rate (Z) simultaneously. The multidimensional poverty kaleidoscope graph is offering to policy-makers and researchers a new graphical tool for studying the impact of quarantines on the economic performance from a multidimensional perspective.

2. The Multidimensional Poverty Kaleidoscope Graph: Overview

This part of the research presents the assumptions used by the multidimensional poverty kaleidoscope graph. The multidimensional poverty kaleidoscope graph consists in the constant interaction of four variables in constant changes [for example, the calculation of the inflation growth rate (X_1 in Level-1: dependent variable and Level-2: independent variable), the unemployment growth rate (X_2 in Level-1: dependent variable and Level-2: independent variable), purchasing power parity growth rate (X_3 in Level-1: dependent variable and Level-2: independent variable) and the government budget deficit (X_4 in Level-1: dependent variable and Level-2: independent variable)] that can affect directly on two variables simultaneously [in Level-1 is the COVID-19 quarantine time framework growth rate (Y) and Level-2 is the poverty growth rate (Z)] in real time respectively. The multidimensional poverty kaleidoscope graph assumes that each country has its own macroeconomic problems from COVID-19. The multidimensional poverty kaleidoscope graph is based on three basic assumptions: (a) The COVID-19 levels control in any country cannot be stopped until a new vaccination and extension of quarantine controls; it can only be induced by vaccination, social distance, quarantine(s), and the faster health care system respond together. (b) The fast expansion of COVID-19 levels directly depend on how globalize any country is connected to the rest of the world (e.g. tourism, trade, foreign workers). (c) The COVID-19 spread ways

in different countries has its unique characteristics. Therefore, it might be difficult to try to implement a successful COVID-19 reduction program in another less successful COVID-19 spread reduction program respectively.

The multidimensional poverty kaleidoscope graph offers a new perspective of analysis and research of pandemics on the economy of any country. The traditional research is based on the Gini coefficient (Lorenz curve) and different graphical representations to analyze pandemics impact on any economy that only evaluate superficially but never the effects of pandemics from a multidimensional perspective; but with the multidimensional poverty kaleidoscope graph, it is possible to visualize the final impact of pandemics in any economy from a general perspective in the same graphical space and time.

3. Phases in the Multidimensional Poverty Kaleidoscope Graph

Phase I: Design of the Input-Output-Table

Basically, the input-output-table is a database that keeps six vectors that permits storage of a large amount of data annually. These six vectors are the inflation, unemployment, purchasing power parity, the government budget deficit, the COVID-19 quarantine day's duration, and the poverty. These six vectors can help us to do it calculations in the phase II subsequently.

Phase II: The Measurement of Six Growth Rates

The second phase of the calculation of the multidimensional poverty kaleidoscope graph involves the measurement of six growth rates using the database from each vector, these six growth rates are: the inflation growth rate (X_1 in Level-1: dependent variable and Level-2: independent variable), the unemployment growth rate (X_2 in Level-1: dependent variable and Level-2: independent variable), purchasing power parity growth rate (X_3 in Level-1: dependent variable and Level-2: independent variable) and the government budget deficit (X_4 in Level-1: dependent variable and Level-2: independent variable)-. Additionally, two more variables follow by in the Level-1 represented by the COVID-19 quarantine time framework growth rate (Y) and the Level-2 under the poverty growth rate (Z). These six variables are analyzed with their changes amounts between the previous year ($t-1$) and the given year ($t+1$) under the calculation of six growth rates

respectively. The calculation of each growth rate number of variables used in the multidimensional poverty kaleidoscope graph varies depending on the objectives of the researchers or policymakers and the orientation of the cases of research. Once the number of variables is determined, the next step is to collect the statistical and historical data that constitute the four variables and two dependent variables. All four variables in the input-output-table may not have a direct relationship between them - they can have different role depend on the level of analysis such as in Level-1 (dependent variables) or Level-2 (independent variables) and two variables can play the role of independent (Y) and dependent variable (Z). Each of the four X_i variables to be measured is viewed as an independent variable (i.e. endogenous variable). However, there is no connection and interdependency among these four X_i indices when they are joined in the graph. These four X_i variables are used to draw a graph that represents the evolution and stages of COVID-19 spread in any country from a multidimensional perspective. These four X_i variables are: the inflation growth rate (X_1 in Level-1: dependent variable and Level-2: independent variable) (see Expression 1), the unemployment growth rate (X_2 in Level-1: dependent variable and Level-2: independent variable) (see Expression 2), purchasing power parity growth rate (X_3 in Level-1: dependent variable and Level-2: independent variable) (see Expression 3), and the government budget deficit (X_4 in Level-1: dependent variable and Level-2: independent variable) (see Expression 4)- The first step is to define all variables and parameters. Once all the variables and parameters are defined, all the data based on the variables and parameters is listed in each vector. Finally, we can proceed to calculate our six growth rates followed by: The calculation of the inflation growth rate (X_1) is the difference between the Consumer Price Index (CPI) of a given year (CPI_{t+1}) and the CPI of previous year (CPI_{t-1}) divided by the CPI of previous year (CPI_{t-1}) (Equation 1).

$$X_1 = [(CPI)_{t+1} - (CPI)_{t-1}] / (CPI)_{t-1} \quad (1)$$

The calculation of the unemployment growth rate (X_2) is the difference between the unemployment volume of a given year (UE_{t+1}) and the unemployment volume of previous year (UE_{t-1}) divided by the unemployment volume of previous year (UE_{t-1})

(Equation 2).

$$X_2 = [(UE)_{t+1} - (UE)_{t-1}] / (U)_{t-1} \quad (2)$$

The calculation of the purchasing power parity growth rate (X_3) is the difference between the purchasing power parity amount of a given year (PPP_{t+1}) and the purchasing power parity amount of previous year (PPP_{t-1}) divided by the purchasing power parity amount previous year (PPP_{t-1}) (Equation 3).

$$X_3 = [(PPP)_{t+1} - (PPP)_{t-1}] / (PPP)_{t-1} \quad (3)$$

The calculation of the government budget deficit growth rate (X_4) is the difference between the government budget deficit amounts in USD millions of a given year (D_{t+1}) and the government budget deficit amounts in USD millions of previous year (D_{t-1}) divided by the government budget deficit amounts in USD millions previous year (D_{t-1}) (Equation 4).

$$X_4 = [(D)_{t+1} - (D)_{t-1}] / (D)_{t-1} \quad (4)$$

Moreover, there are two levels of analysis followed by the Level-1 under the COVID-19 Quarantine time framework growth rate (Y) and the Level-2 under the poverty growth rate (Z).

The calculation of the Level-1 by the COVID-19 quarantine time framework growth rate (Y) is the difference between the COVID-19 quarantine days amount of a given year (Q_{t+1}) and the COVID-19 quarantine days amount of previous year (Q_{t-1}) divided by the COVID-19 quarantine days amount of previous year (Q_{t-1}) (Equation 5).

$$Y = [(Q)_{t+1} - (Q)_{t-1}] / (Q)_{t-1} \quad (5)$$

Finally, the calculation of the Level-2 by the poverty growth rate (Z) is the difference between the amount of people in poverty of a given year (P_{t+1}) and the amount people in poverty of previous year (P_{t-1}) divided by the amount of people in poverty of previous year (P_{t-1}) (Equation 6).

$$Z = [(P)_{t+1} - (P)_{t-1}] / (P)_t \quad (6)$$

4. Plotting of the multidimensional poverty kaleidoscope graph

The multidimensional poverty kaleidoscope graph presents a general idea about the current COVID-19 situation and its impact on poverty in any country and anytime based on a new concept of graphic representation (see Figure 1). This new concept of graphic representation consists of six axes (Ruiz Estrada, 2017), each of which has positive values. In the case of this research, the COVID-19 quarantine time framework growth rate (Y) is going to have a large impact on the four growth rates at the level-1 of analysis [(X₁, X₂, X₃, X₄), (Y)]. At the same time, these four growth rates behaviour directly at the Level-2 of analysis [Z, (X₁, X₂, X₃, X₄)]. These four growth rates in analysis are the inflation growth rate (X₁ in Level-1: dependent variable and Level-2: independent variable) (see Expression 1), the unemployment growth rate (X₂ in Level-1: dependent variable and Level-2: independent variable) (see Expression 2), purchasing power parity growth rate (X₃ in Level-1: dependent variable and Level-2: independent variable) (see Expression 3), and the government budget deficit (X₄ in Level-1: dependent variable and Level-2: independent variable) (see Expression 4) (see Figure 1). They can be joined together to create a general area. This general area is called “the area of COVID-19 impact on poverty (PX_i).” The (PX_i) shows the dimension of negative impact of COVID-19 can affect the poverty expansion from a multidimensional perspective. For comparison purposes, the PX_i can be applied to different years for any country. The analysis of the PX_i is based on the comparison of two periods. In the case of this research paper, two periods [i.e., given period (t+1) and previous period (t-1)] are compared. The PX_i may present three possible scenarios, namely:

Scenario-1: Expansion PX_i^1 first period < PX_i^2 second period

Scenario-2: Stagnation PX_i^1 first period = PX_i^2 second period

Scenario-3: Contraction PX_i^1 first period > PX_i^2 second period

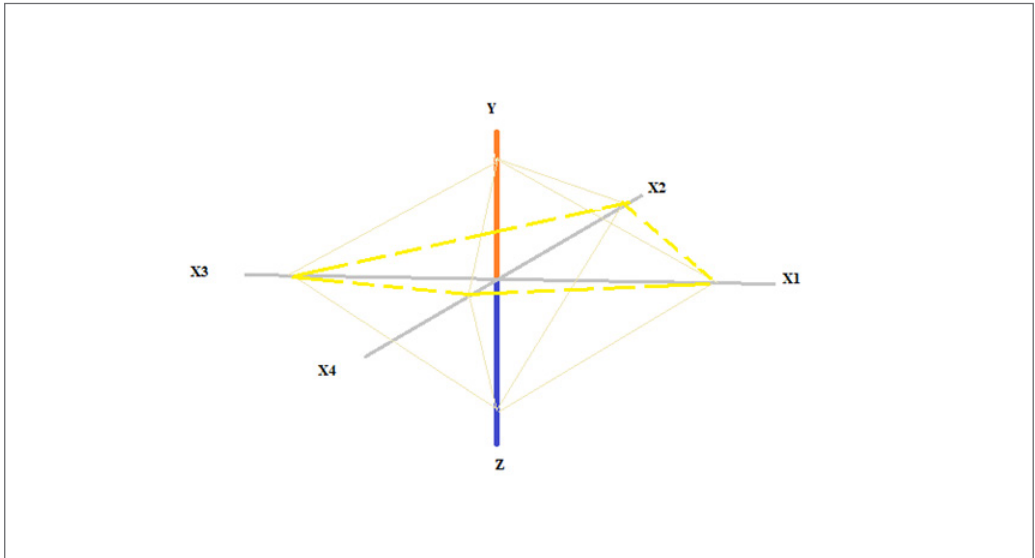
The fifth and sixth axes are represented by Level-1 of analysis by the COVID-19 quarantine time framework growth rate (Y) and the Level-2 of analysis by the poverty growth rate (Z). They are positioned in the center of the graph which is the meeting point of the other four axes.

5. Difference between the Multidimensional Poverty Kaleidoscope Graph and Lorenz Curve (Gini Coefficient)

All the above-mentioned analytical methodologies persist in measuring changes of welfare based on the evaluation of basic variables in the study of pandemics (quarantines) and poverty. This research paper, however, asserts that the study of pandemics (quarantines) and poverty should not merely focus on the traditional scheme of indicators; instead it should take into consideration a new alternative analytical toolbox based on a new serial of indicators and graphs to doing a deep analysis of countries from a multidimensional perspective. The contribution of the Lorenz curve and Gini coefficient in the past fifty years play important role in the study of pandemics and poverty of many countries. In fact, the Lorenz curve and Gini coefficient (Gini coefficient, was first launched in 1912 with the single goal of putting people back at the center of the income distribution in terms of a statistical debate and policy. Since then, various uses of the Lorenz curve and Gini coefficient have been developed. The Gini coefficient focus its attention on the frequency distribution of the income a highly topical theme in the current analysis of the poverty debate, providing path-breaking analysis and policy recommendations (Gini, 1912).

Fragile points can be found in the Lorenz curve and Gini coefficient. The Lorenz Curve and Gini coefficient are supported only by the relative mean absolute difference, at the same time, the average absolute difference. The Lorenz curve and Gini coefficient can give only some remarks in the study of the complicated puzzle of the pandemics’ (quarantines’) effects on the poverty study. The multidimensional poverty kaleidoscope graph offers a deep analysis based on six variables interacting together in the same graphical space and time.

The Lorenz curve and Gini coefficient can only help observe the effects of pandemics superficially, by looking at the past and present situation of the poverty of a country. The Lorenz curve and Gini coefficient focus on the specific point of pandemics – quarantines’ (cause) on poverty (effects) from two dimensional point of view. The multidimensional poverty kaleidoscope graph incorporates other factors, regarding the pandemics (quarantines) and their

Figure 1*The Multidimensional Poverty Kaleidoscope Graph*

effects on poverty, into analysis. Furthermore, the study of the Lorenz curve and Gini coefficient merely applies basic calculations to observe the gains and losses associated with the fast spread of COVID-19 and poverty of a country. Overall, the current study maintains that the Lorenz curve and Gini coefficient pose many limitations in the study of other pandemics' factors which need to be included in the poverty evaluation of different countries. On this account, this paper further maintains that the study of COVID-19 effects requires simultaneous inclusion of large number of variables and a multidimensional graphical approach respectively.

6. Application of the multidimensional poverty kaleidoscope graph: U.S., Malaysia, and Guatemala

In our research, we compare two different graphical models of analysis of the effects of pandemics on the poverty analysis of any country. There is the Lorenz curve (Gini coefficient) (see Figure 2) and the multidimensional poverty kaleidoscope graph (see Figure 3). The reason we chose the Lorenz curve (Gini co-

efficient) in our analysis is because this research will compare results and effectiveness of the multidimensional poverty kaleidoscope graph. In both models we selected five countries for results' comparison (e.g., United States, Malaysia, and Guatemala).

For the purpose of the current research, the multidimensional poverty kaleidoscope graph was applied to 3 different countries between January 2020 and April 2020 (see Figure 3). These two periods of time were chosen because the general objective of the multidimensional poverty kaleidoscope graph is to observe the four variables that can generate poverty interacting together the inflation growth rate (X_1 in Level-1: dependent variable and Level-2: independent variable) (see Expression 1), the unemployment growth rate (X_2 in Level-1: dependent variable and Level-2: independent variable) (see Expression 2), purchasing power parity growth rate (X_3 in Level-1: dependent variable and Level-2: independent variable) (see Expression 3), and the government budget deficit (X_4 in Level-1: dependent variable and Level-2: independent variable) (see Figure 1). At the same time, we have two levels of analysis: the level-1 of

analysis is the COVID-19 quarantine time framework growth rate (Y) and the level-2 of analysis is the poverty growth rate (Z).

To apply the multidimensional poverty kaleidoscope graph on three countries, we assume that all variables in the multidimensional poverty kaleidoscope graph applied the Omnia Mobilis assumption (Ruiz Estrada, 2011) and the Dynamic Imbalance State assumption (Ruiz Estrada & Yap, 2013), perhaps both assumptions can generate an effect of relaxation of all variables, but both assumptions have something in common, they examine poverty from a multidimensional perspective.

The preliminary results of our simulations regarding the impact of COVID-19 on the U.S. economy show that ($X_1=0.17, X_2=0.11, X_3=0.22, X_4=0.27$) and ($Y = 0.30$ -full quarantine-, $Z = 0.33$). It is possible to observe how a quarantine, in only three months can generate so much damage in such a short period. Therefore, if the U.S. implement a long quarantine for one year can show the next results in its economy : $X_1=0.40, X_2 = 0.55, X_3=0.05, X_4=0.65, Y = 0.99$ -full quarantine for one

year-, $Z = 0.75$. Then the American economy can experience a deep depression with results more catastrophic than the Great Depression. Even countries such as Malaysia, whose levels of ($X_1=0.11, X_2=0.30, X_3=0.12, X_4=0.37$) and ($Y = 0.30$ -full quarantine for three months-, $Z = 0.40$). If the Malaysian government implements a quarantine of one full year, then we have the next results followed by $X_1=0.70, X_2 = 0.65, X_3=0.02, X_4=0.75, Y = 0.99$ -full quarantine for one year-, $Z = 0.85$. Finally, in the case of Guatemala: $X_1=0.23, X_2 = 0.65, X_3=0.05, X_4=0.41$) and $Y = 0.30$ -full quarantine for three months-, $Z = 0.40$. Hence, a full year quarantine can show for Guatemala the next results: $X_1=0.85, X_2 = 0.88, X_3=0.01, X_4=0.85, Y = 0.99$ -full quarantine for one year-, $Z = 0.95$ (see Figure 3).

7. Concluding Remarks

Firstly, this research presents a new analytical tool to study the impact of pandemics (quarantines) on the expansion of poverty of any country from a multidimensional perspective. The preliminary results from the multidimensional poverty kaleidoscope graph can

Figure 2

GINI Index

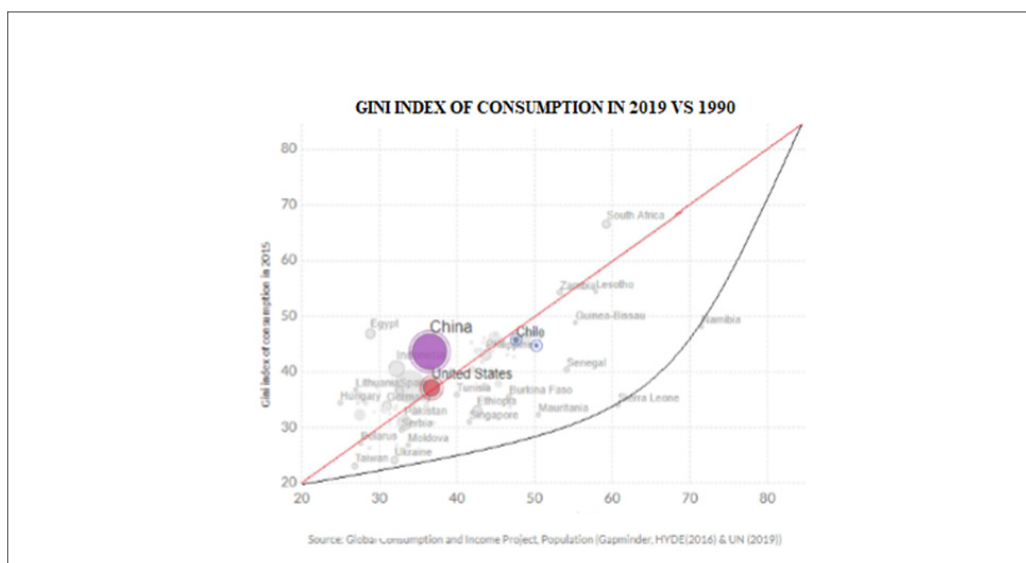
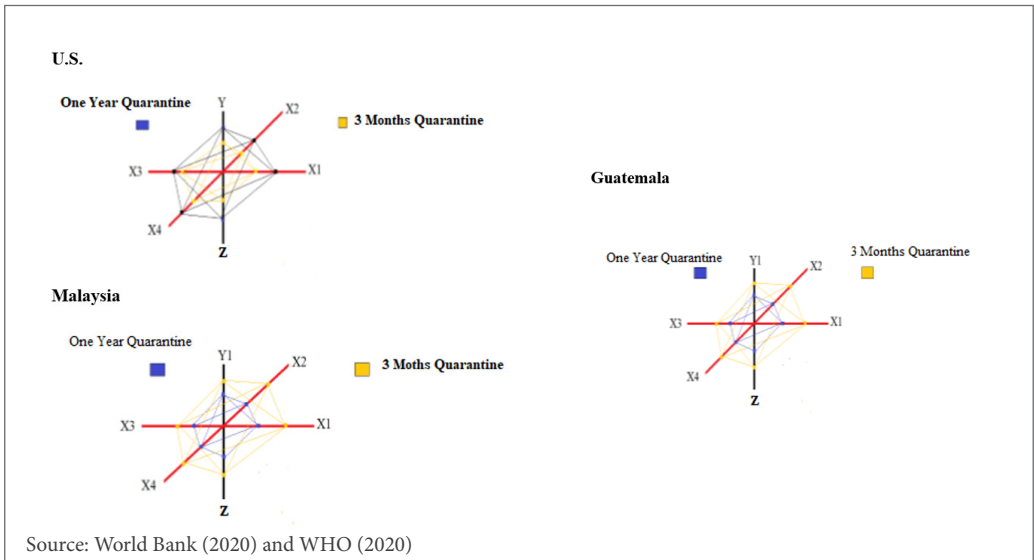


Figure 2

Application of the Multidimensional Poverty Kaleidoscope Graph: U.S., Malaysia, and Guatemala



show how much COVID-19 damage four macroeconomic variables. At the same time, the damage of these four macroeconomic variables can directly impact the poverty expansion globally. The multidimensional poverty kaleidoscope graph can be a powerful and effectiveness graphical analytical toolbox in the study of the effects of pandemics (quarantines) on the poverty of any country. We assume that the Lorenz curve (Gini coefficient) can be considered a complementary analytical tool.

This research paper concludes that a large extension of a quarantine can generate considerable damage on (X_1 , X_2 , X_3 , X_4 , Z) in any country. At the same time, the damage of all these variables (X_1 , X_2 , X_3 , X_4 , Z) can affect considerably the poverty expansion exponentially. Independently, this country keeps developed, developing, or least developed status the COVID-19 quarantines effects are invaluable and catastrophic.

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