Showcasing the Inequality behind the Economic Productivity

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Abstract: It has been a while since we have started understanding the effects of our economic activity. But are we really doing anything about it? In this paper, we aim at introducing and presenting a new indicator meant to tell the story of economic productivity beyond its economic implications. The construction of the new indicator starts by computing national economic productivity as a sum of labor and capital productivity. The national economic productivity is introduced in a multiplicative equation with reversed GINI coefficient, the human development index and a ratio of biocapacity and ecological footprint of consumption. The reversed GINI coefficient corrects the value of the national economic productivity by accounting for the inequality of the distribution of income. The human development index captivates the quality of life beyond the distribution of income with areas like education and health. The ratio between the biocapacity and the ecological footprint of consumption showcases whether the country can ensure its sustainability by accounting its capacity to produce all that it needs to sustain the life of the citizens and to store and/or to eliminate the production residues. The results are quite surprising, painting a completely different picture from what we know from the economic reports.

Keywords: *productivity, measurement, indicator, callisthenic productivity.*

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1. Literature Review

We live in a world in which productive means good, more is better, consumption is proof of wellbeing, however, there is another side of this apparent productivity and in some cases it doesn't retrieve the results it promises to deliver. There seems to be a culture of productivity and competitiveness where there should be a culture of effectiveness and cooperation.

Labor productivity and economic growth are 'key factors in any economy. It is related to the fact that labor productivity depends on the availability and quality of labor resources and applied technologies. As a result, labor productivity heavily influences the production process and production costs. And production costs affect the competitiveness of nations in the global market' (Emsina, 2014).

We put a lot of effort in measuring competitiveness and different shades of productivity using indicators such as real GDP growth rate, GCI (Global Competitiveness Index), GDP per capita and others. Fagerberg & Srholec (2007) looked at the dynamic between GDP per capita in PPPs and real GDP growth rate, unit labor costs and real GDP growth rate etc. in order to better understand competitiveness in a given period of time. However, we put much more less effort in measuring the long term negative impact this constant chase of productivity and competitiveness has.

Even if productivity does not necessarily represent a country's wellbeing, it's capacity to generate competitiveness, the standards of living, etc. - it has been the most widely accepted measure for at least the past 20 years (Lall et al., 2002). Ever since the industrial revolution, productivity and competitiveness have been in focus when analyzing countries, regions, nations and industries. Not all the authors vow for this never ending pursuit. Lall (2001) raised a question whether national productivity is a real priority or rather a "dangerous obsession". Rhetoric question or not, it brings forth a less charming perspective.

In recent years, several researchers, academics and policy makers have challenged more and more vocally the so called productivity and competitiveness indexes. They have either proposed 'optional improvements' as Xia et al. (2012) or highlighted the need for 'upgraded methodologies and replacement indicators' as Podobnik et al. (2012). Xia et al. (2012) postulated that 'WEF should refine GCI methodology including national culture as an additional factor so that GCI can become a much better predictor of economic growth'. Podobnik et al. (2012) examined how 'the level of competitiveness affects the dynamics of a country's wealth

during a recession and the authors developed a new measure, which is called a relative competitiveness, to evaluate an economy's competitiveness relative to its GDP'.

2. Introduction

Economic productivity is an indicator that measures how efficient an unit is in turning inputs into outputs, be it a company, a hospital or an university, a city or a country. Productivity depends on factors beyond the inputs and the outputs themselves, some of them with direct implications, others with indirect implications; some of them can be measured, while others can't. Measuring productivity is a process with ambivalent implications: on one hand, it shows how effective an economy is and on the other hand, it showcases which actions have to be taken in order to increase the ratio of output to input.

Callisthenic productivity is also an efficiency indicator, but instead of focusing solely on the effectiveness of the economic processes, it focuses on the effectiveness of the economic processes in creating a proper climate globally, encompassing the following components: environment, social fairness, freedom, nondiscrimination, welfare, inclusion, education, health, political representation and sustainability.

Considering the social dimension in measuring economic productivity is a difficult process due to several reasons. First of all, we have fuzzy concepts: fairness does not mean the same thing for each individual - the needs, expectations and desires of each individual differ, depending fundamentally on the context in which they are being analyzed. Secondly, we are faced with the difficulty of aggregating individual, disparate perspectives in order to create a global perspective, we have to consider all relevant social dimensions such as freedom, justice, welfare, health, education, environment etc. and the interactions between them. Thirdly, ever since the end of World War II the main priority of most countries was the economic reconstruction (social reconstruction being perceived as a consequence of the economic one). This is one of the reasons why for so many years we have recorded solely economic performance; as a consequence, today we struggle to analyze the causes that have generated the present scale of social inequity, precisely because of lack of data.

3. The economic dimension

In our research, the economic dimension is captured by two indicators, gross domestic product (GDP), and gross national income

(GNI). Gross domestic product is a macroeconomic indicator reflecting the sum of the market value of all goods and services destined for final consumption produced in all branches of the economy within a country within one year. Gross national income is equal to Gross Domestic Product from which we deduct the primary income paid by resident units to non-resident units and increased by primary incomes received from the rest of the world by resident units. It is necessary to use both indicators as the first captures the size of the economy, while the second one captures the national benefits of the country's economy. For a poor, developing country, it may not be very relevant that it has increased its GDP; if we want to know whether its citizens are better off, then measuring the national income is more relevant to this issue than GDP (Stiglitz et al., 2008, p. 24). For developed countries the two variables have almost identical values; however, for developing countries, where a large part of the economic result is due to the capitalization of foreign capital or, more correctly, to the exploitation of national resources by non-resident capital holders, there may be huge differences between GDP and GNI.

Using these two indicators gives us a good idea about the state of the economy and there is nothing wrong with that. The problem is that we started using GDP and GNI in a variety of contexts, giving them way more meaning than they actually have. We are using them to capture the development degree of countries or their strategical position, their openness and their sustainability, their power.

The main problem needed to consider when dealing with indicators representing large populations is that the situation of the individuals that make up the populations lacks clarity. Aggregated indicators do not always reflect the true nature of the framework they are trying to describe; sometimes it is better for indicators to be treated separately. In order to bring in some clarity, we will analyze also the distribution of the population. 'A conceptually simple way to capture the distributive aspects is to measure the median income (the income through which half of the individuals are on top and the other half, below). If inequality increases, the difference between the average and the median can increase, situation in which the average seizes to provide a correct picture of the economic well-being of the regular member of the society' (Stiglitz et al., pp. 32-33). In order to control for these variations in analyzing the economic climate in a country, researchers have developed a number of indicators that capture in detail the distributive aspects that distort the prospect of the average income.

4. The social dimension

The most popular indicator that captures the inequality of income distribution is the one proposed by Gini. The Gini Coefficient is a measure of statistical dispersion used primarily to represent disproportions in the distribution of income or wealth of a country's population. The Gini coefficient can take values from 0 (which means full equality: each individual holds the same amount of income) to 1 (or 100, which means full inequality: one person holds all the income and the others have nothing). Globally, Gini's values vary between 0.232 (23.2%) in Sweden and 0.707 (70.7%) in Namibia, but there are still countries that have not been evaluated. If income were to be shared proportionately with population strata - 10 percent of the pyramid would receive 10 percent of national income, 20 percent of the population would receive 20 percent of the income, and so on – case in which the Gini coefficient would be zero. Inequality would be non-existent. On the other hand, if all income would go to the person at the very top of the social pyramid, the Gini coefficient would have the value 1 equivalent, in a sense, to "perfect inequality" (Stiglitz, 2013, p. 71). Gini has the great merit of deepening the level of analysis, going from national to social strata.

Access to quality education and health care are fundamental rights of the individual. "The problem in quantification of education and health services is that the relationship between inputs and outputs is not a direct one: the costs refer to the resources that enter the institution providing education or health services, whereas the results (e.g. the overall health of the population or student competencies) are influenced by many factors. For example, people's lifestyle will affect health outcomes in the same way that parenting time with the child will affect impact of education. Most statistical offices only sum up the costs of providing these services. If we are to interpret this aspect from the perspective of standards of living, it is to suppose that these costs are allocated optimally' (Stiglitz et al., 2008, p. 98).

The most accessible way to quantify access to education and health services is to analyze the percentage of GDP allocated to each area, along with the number and distribution of educational and hospital units. However, the existence of a strongly branched network of educational establishments and hospitals does not necessarily mean that the population has access to them. In this respect, it is possible to analyze the proportion of the population with health insurance, e.g. the average level of schooling of the population, these two measures being more relevant to surprise access. The proportion of the population without health insurance can be an indicator of economic uncertainty in relation to health, and the percentage

of illiteracy within the population can surprise economic uncertainty in relation to the low quality of labor, both of which are indicators relevant to the quality of human capital. Some of the most relevant indicators for assessing the effects of education on the quality of life are measurements of the skills that people can exploit in their professional life, but this is almost impossible to measure.

For this paper, we opted for including the perspective of access to education and health services through the Human Development Index (HDI), a composite indicator measuring the average achievements in three fundamental dimensions of human development: a long and healthy life, knowledge and a decent standard of living. The long and healthy life is captured by the Life Expectancy Index (LEI), knowledge is captured by the Education Index (EI, obtained by aggregating the average number of years of tuition and the anticipated school year indicator) and the decent standard of living is captured by the Income Index (II) (United Nations Development Program¹).

Adjusting economic performance through HDI includes the perspective of education, health, standards of living, in fact, the quality of life and the level of development of a society. As we know quantifying the social equity is far from being an easy endeavor, but it is essential in quantifying the quality of life. Measuring only the economic outlook bears a trap in itself, namely that it only tells us where we come from without telling us where we are heading.

5. The environmental dimension

The environmental dimension of the productivity is equally complex, or even more complex than the economic one, underlining the importance of maintaining a qualitative environment that offers optimal living conditions. Some of these aspects can be quantified and their measurement can serve as a starting point in setting the goals to ensure sustainable development. One of the indicators that quantify the stress of the environment is the ecological footprint. A country's 'ecological footprint' (for demand) is the total area needed to produce the food, fiber and timber it consumes, to absorb the waste it produces, and to provide space for infrastructure. For supply we use the biocapacity of a country, which is the capacity of biosphere production and its ability to provide a flow of biological resources and services to human kind. Since the mid-1980s, the world footprint became greater than the planet's capacity. In 2003 the world footprint exceeded the bio-capacity of the Earth by approximately 25% (Sen

¹ <https://www.undp.org/>

et al., 2008). In 2007 it had already reached 33%. The latest data we have is at the level of 2014 and the situation is at its worst so far. Singapore has an ecological deficit of 9890%, Bermuda's ecological deficit is 4810%, and the deficit of Reunion is 2820%, while Barbados has a deficit of 2070%². What we have noticed from the data is that the small countries tend to have bigger deficits, especially if they are situated near the Equator, which makes perfect sense if we consider the fact that the temperatures here are extremely high, the climate is very dry and the forest area is very narrow, reducing the country's capacity to absorb its own production of CO₂.

In 2007 there were 1,8 hectares per person available for producing the necessary goods and for storing the waste produced. Now, just 10 years later, there are only 1.7 left. Europeans use 5 hectares per person and North Americans 15, which is far more than the real biocapacity of the two geographic areas, given the average population density. In Singapore and Bermuda, there are just 0.1 hectares available. Globally, there are more than 60 countries with a biocapacity less than 1 hectare/person. From the 10 countries that have the richest biocapacity, only one is European and that is Finland, with a biocapacity of 12.9. The richest biocapacity globally belongs to the French Guiana, with an average 102.9 hectares/person.

According to data from the Global Footprint Network³, in 2007, the global footprint of world consumption was 2.84 ha per capita while its total biocapacity was 1.7 ha per capita, thus having an ecological deficiency of 1.14, an increase of 0.2 in just a decade. This means that mankind consumes 67% more than it can afford. Surprisingly or not, this deficit is mainly driven by high-income countries, according to the World Bank classification⁴. Globally, high income countries have ecological footprints considerably larger than their biocapacity. There is a strong correlation between the density of population and the deficit of biocapacity and also a reversed correlation between the temperature and the biocapacity.

The land area of the world is 148.9 million sq. km, that is 14890 million ha. China alone has an ecological footprint of 5200 million ha. The US have an ecological footprint of 2670 million ha. The two make use of more than half of the biocapacity of the planet.

The country's environmental footprint can be used as an indicator for the inequality in the exploitation of natural resources and the interdependencies between geographic areas. Global imbalances are

² <https://data.footprintnetwork.org/#/>

³ <http://www.footprintnetwork.org/>

⁴ <http://www.worldbank.org/>

generated predominantly by CO₂ emissions, expressed in the forest hectares required for storage. However, population expansion has put pressure on the forest area due to the need for arable land for food and built up land. Thus, deforestation has reduced mankind's ability to convert carbon dioxide, aggravating the degradation of environmental quality. Moreover, the world population grew in size considerably and so did the carbon emissions. If in 1961, we needed an average of 70 ha per person to absorb the carbon emissions, now we need about 210. This multiplied by the growth of the population means a huge impact upon the environment and upon the Earth's capacity to sustain life as we know it.

One of the great achievements of the environmental footprint indicator is the ability to express environmental pressure in an easily understandable unit (Stiglitz et al., p. 75), which can be measured both globally and at the level state and even individually.

Beyond the environmental footprint, the environmental dimension of social equity can be captured by indicators such as green GDP, environmental performance index (EPI), carbon footprint (CO₂), atmospheric CO₂ emissions, etc., but all these surprise indicators just the state of the environment at a time, without saying anything about the sustainability of human actions or the ability of the environment to continue supporting the processes of economic and social development.

In order to capture the sustainability dimension, we can use the Environmental Sustainability Indicator (ESI) or the ecological reserve or deficiency concept. The environmental sustainability indicator measures overall progress towards environmental sustainability. The indicator provides a composite profile of environmental issues management at national level. ESI uses a value scale of the form: 23.9-30.0, 30.1-40.0, 40.1-50.0, 50.1-60.0, 60.1-70.0, 70.1-100, dividing the countries into these categories, where 0 represents a theoretical minimum (worst) and 100 a theoretical maximum (the best). Even if ESI can very well capture the prospect of sustainability, for this analysis we will opt for the use of ecological reserve and ecological concepts, because they capture more than the sustainability of a country, also showing the degree of dependence on the global resource stock, the extent to which it removes the country from a sustainable path, the source of unsustainability (low biocapacity, high consumption or both).

As members of the Global Footprint Network consortium show, countries sometimes exploit a biocapacity that exceeds their own, either for production or for waste disposal. The concept of biocapacity has been defined as the ability of ecosystems to produce useful biological materials

and to absorb man-made waste by using extractive technologies and managerial processes. Useful biological materials are defined as those required by the human economy. Which means that what is considered useful can change from one year to another. Biocapacity is measured in global hectares, an indicator obtained by multiplying the country's surface (measured in hectares), adjusted by coefficients that capture its production and absorption capacity, coefficients that actually capture the potential to support human activities. Since different types of land have different capacities, the surface in global hectares of two areas with the same size may be different; for example, one hectare of arable land will measure less in global hectares than one hectare of pasture, since the capacity of the first is clearly superior to the latter. Bioproductivity may vary from year to year, which may cause global hectare to be resized.

The deficiency or ecological reserve is obtained by subtracting from a country's biocapacity the ecological footprint of its consumption. The environmental footprint of consumption is the area designed to support the consumption of a particular population. The consumption footprint (measured in global hectares) also includes the area required to produce the consumed materials and the area required to absorb carbon emissions. The country's consumption footprint is calculated as the sum of the primary production footprint and the footprint of imports minus the footprint of exports. Both total biocapacity and total consumption footprint can be divided by population, resulting in the number of global hectares per capita being an easy to understand and to compare index used in equations. Thus, when the environmental footprint of consumption exceeds a country's biocapacity, then that country will have an ecologic deficit; when biocapacity is higher than the ecological footprint of consumption, that country will have ecological reserves.

If a country has an ecological deficit, it means either it imports biocapacity through trade, or it feeds on the global ecological heritage through harmful emissions that it is unable to assimilate through the forest area at its disposal, or both. If the deficit of some countries can be counterbalanced by the reserve of others, the global deficit remains deficient, with no other planet available to provide us with non-renewable resources or able to take on the harmful emissions. 'Climate change due to increased greenhouse gas concentrations in the atmosphere is a global problem that cannot be assessed in relation to national borders' (Stiglitz et al., 2008, p. 18). The consequences of climate change are very unevenly distributed; a country can suffer from the pollution of a neighboring country even more than its own pollution and the fact that those generating 'air or

water pollution (including greenhouse gas emissions) do not pay the social costs of their deeds is a major distortion of the economy' (Stiglitz, 2013, p. 35) and, we might add, of the society. None of these distortions are found in the variables that measure economic performance.

6. The callisthenic productivity

Starting from the areas of convergence of the economy and social fairness, we will try to design a model of quantification of national economic productivity that incorporates the social dimension.

To analyze economic productivity in the context of social equity, we have developed a model that measures productivity, embracing both the prospect of sustainability and social equity. Starting from the calculation of the national economic productivity, expressed as a sum of labor productivity and capital productivity, both at national level, the notion of national economic callisthenic productivity was born, expressed by the following equation:

$$\varepsilon = \left(\frac{\text{GNI}}{\text{EMPC}} + \frac{\text{GNI}}{\text{GCF}} \right) * \frac{1}{\text{GINI}} * \text{HDI} * \frac{\beta}{\text{EFC}}$$

or

$$\varepsilon = (\text{WL} + \text{WK}) * \frac{1}{\text{GINI}} * \text{HDI} * \frac{\beta}{\text{EFC}}$$

WL - Labor productivity

GINI - The GINI coefficient

ε -National Economic Calisthenic Productivity

GCF - Gross Capital Formation

WK - Capital Productivity

HDI - Human Development Index

GNI - Gross National Income

β - Biocapacity

EMPC - Employee Compensation

EFC - Ecological Footprint of Consumption

The national economic callisthenic productivity represents the economic productivity that countries can achieve within their means, without abusing resources in developing countries and without abusing the stock of resources of future generations. Nowadays, when borders have become just symbols of legitimacy it is rather obsolete to speak about own means – given that workers can move, capital can move, revenues can move. However, the current levels of economic productivity are not sustainable in

the long run because they will result in a decrease in the quality of life – however surprising this is. We will end up having several rich countries with a low quality of life, needed to invest much more than they have gained in reconstructing what they have ruined.

The equation of national economic callisthenic productivity is obtained as a sum of labor and capital productivity (as ratio of GNI to EMPC plus ration of GNI to GCF) adjusted by the Gini coefficient, the Human Development Index and the ratio of a country's biocapacity to its ecological footprint of consumption. GNI is defined by Eurostat⁵ as ‘the totality of primary income they receive organizations resident: compensation of employees, taxes on production and imports less subsidies, proceeds on property (receivable less payable), gross operating surplus and mixed income crude. It is equal to GDP (Gross Domestic Product) + primary income to be recovered from the rest of the world - primary income to be paid to the rest of the world’.

For calculating labor productivity we divided GNI to the Compensation of Employees (EMPC). The World Bank defines compensation of employees as ‘all payments in cash or in kind (such as food and lodging) incurred by employees in exchange for services rendered with salary contributions for health, pensions, unemployment - social security, that benefit the employees’.

For calculating capital productivity we divided GNI to the Gross Capital Formation. The latter is defined by the World Bank as representing the expenditures for completing the ‘fixed assets of the economy, plus net changes in inventories. Fixed assets include land improvements (fences, ditches, drains etc.); plant, machinery and equipment acquisition; construction of roads, railways and the like, including schools, offices, hospitals, private dwellings, respectively commercial or industrial buildings. Inventories are goods owned by companies to deal with temporary or unexpected fluctuations in production or sales’, along with those in processing; plus net purchases of goods.

We opted for the use of GNI instead of GDP because, as a consequence of globalization, sometimes significant differences may occur between resident income and domestic production (Jivan, 2014). Some of the income earned by residents is sent abroad, other residents receive remittances, the state can benefit from financial support or assistance from other states; also the profits made by companies with foreign capital on the territory of

⁵ http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

another country, can be sent to the country of origin of the capital - all of these factors contributing to creating a gap between GDP and GNI.

The second term of the equation is the inverse of the GINI coefficient. We chose to divide into GINI because conventionally it takes values between 0-1, its values being the better as it is closer to 0. Although GINI is the denominator, it is not problematic for our equation because the situations of absolute equality or inequality are possible only theoretically, in practice GINI takes values from 0.232 (in Sweden) to 0.707 (in Namibia). Dividing GINI benefits states with lesser inequality and disadvantages states with greater inequality. Given that inequality is in all states, all will be penalized by dividing it into GINI, but differently in intensity.

The third term is the Human Development Index, which builds a bridge between GINI, the coefficient that measures distribution of inequality and the last term of the equation that captures the degree of sustainability of economic processes and productivity. The Human Development Index captures the state of development of a state in terms of the quality of life of its citizens. It encompasses three essential dimensions: life expectancy, access to education and a decent standard of living measured by income. HDI is introduced into the multiplication equation because its values are the better, the higher they are. And HDI also varies conventionally from 0 to 1. Given that all countries have significant milestones to ensure that their own citizens have the optimal development, each of them is penalized in terms of productivity, but those with a higher degree of development will be less penalized.

The last part of the equation captures the degree of responsibility of a country's productivity. Productivity is achieved by exploiting a certain biocapacity. As the Global Footprint Network has demonstrated, sometimes states exploit a biocapacity that exceeds their own, either for production or for the disposal of waste.

To analyze what productivity each country would achieve if it were limited to its own biocapacity, we calculated the ratio between the biocapacity and the actual consumption of each state, then we have introduced it into the equation as a ratio. This ratio may generate three situations: i. The first in which biocapacity and ecological footprint of consumption are equal, in which productivity remains unchanged; ii. the second where the environmental footprint of consumption is greater than biocapacity, resulting in a subunit value, where productivity is reduced proportionally; and iii. the third situation where biocapacity is greater than the ecological footprint of consumption, resulting in a supra-unit value, where productivity is positively adjusted.

7. Conclusions

In this paper we have introduced a new indicator for measuring national economic productivity by taking into account the effects of the social dimension and the environmental dimension. The two dimensions capture how healthy and how sustainable the economic productivity is in the long run.

For a country that exploits 10 times more than the resources it has at its disposal it is reasonable to assume that this is not a sustainable productivity, especially given the fact that most of the countries exceed their own biocapacity. We have gone beyond borrowing from the neighboring countries, we have gone beyond borrowing from the future generations. We are not yet sure where are we borrowing from, but it would be advisable for us to realize it soon.

The social dimension showcases whether the economic productivity results into a better quality of life for the majority of the population. By using the Gini coefficient we were able to grasp whether the economic productivity results into a concentration of the revenues at the top or whether it means the majority of the population is better off. The human development index shows how clever the governments are in making use of the results of the private sector so that they benefit the people. Most developed countries have welfare systems put in place that allow the citizens to benefit from medical care and education free of charge. This means that the labor force in those countries will have a better quality which in time will benefit the employers as well. The biggest exception here are the US, which have a very productive economy but a very poor welfare system.

The national economic callisthenic productivity tries to capture whether the level of productivity achieved right now by countries will be sustainable over time. Applying a series of corrections to the productivity indicators used at the moment highlights the need for responsibility. Countries should not expect the private sector to take on this responsibility, but rather should create the framework to support the private sector in their quest.

The biocapacity of our planet is at risk and so it is the future if we do not take appropriate measures. Having larger GDPs doesn't necessarily mean that the quality of life is better. Most of us can't deny that the last half century has meant bringing forth new development, advancement of technology, great innovation – all of which have improved significantly the quality of life. However, there are still countries in which people are deprived by their fundamental rights though we have the capacity to change that. Capacity doesn't mean willingness as increase in productivity doesn't mean improvement in the quality of life.

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