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# Relating Sustainable Development Goals in a Conceptual Integrated Model of Growth and Welfare

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**Abstract.** The United Nations Sustainable Development Goals (SDG) is one of the most relevant efforts aiming at the promotion of sustainable development around the world. Many indicators serve as a guide to evaluate the actual level of development and to identify the issues that need more attention. What is not clear yet is the association between the goals and their indicators. This can limit the information on effective political tools to reduce inequalities at the national and local levels. Based on that, the paper aims to explore the connections between SDGs. Its approach involves i) the proposal of a conceptual integrated model of sustainable development rooted in the literature and connectable with the SDGs; ii) based on World Bank (2019) data on sustainable indicators over two decades, the test of a two-stage econometric model, one to explain product per capita and a second one to explain lack of happiness, assessed by the suicide rate. From the results, it is possible to identify the factors that influence the level of wealth and happiness while integrating Sustainable Development Goals.

**JEL classification:** I3, Q01, C23

**Key words:** Sustainable Development Goals, Sustainable Growth Model, Happiness, SDG indicators

## 1 Introduction

The UN's Sustainable Development Goals (SDGs) (United Nations 2019) are the most significant global effort so far to advance global sustainable development. Achieving these goals should involve and influence sustainability (Kennedy et al. 2015). This comprises the revitalization of local economies, paying more attention to the rural areas, developing an ecological low-carbon economy (Liu et al. 2016), and safeguarding space for food production, ecosystem services, and biodiversity conservation (Thorne et al. 2017).

These are urgent issues in our times (Lafortezza, Sanesi 2019), smart quarters coexist with poor neighborhoods and slums, revealing unbearable social persisting inequities, accumulating environmental degradations, and perpetuating economic inefficiencies. The challenge is to react and think about valuable actions able to promote sustainability by learning from the successes and failures of policies and consultancies reported in the literature and revealed by the evidence (Shaker 2015, Xu et al. 2016, Shen et al. 2017).

Sustainable development involves "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987). The challenge is to implement actions that are simultaneously ecologically viable, economically workable, socially desirable (Campbell, Heck 1999), and persisting over time (Adinyira et al. 2007).

From a spatial perspective, sustainable development should allow the "local population to attain and keep an acceptable, and not decreasing, level of welfare without endangering the opportunities of the inhabitants of adjacent areas" (Castro Bonaño 2003). In sum, a sustainable place can re-invent itself, to improve the lives of its inhabitants, promoting regeneration and respect for the environment, social cohesion, education for peace, and cultural integration (Ciudad del Saber 2012).

What matters and seems to make sense is to integrate sustainable development goals at different special levels knowing that people and places manage and optimize productive and creative capital (Fujita 1989). Many authors looked at the development of places with computable general equilibrium models (Kelley, Williamson 1984, Becker et al. 1986, Brueckner 1990). Others explored the concept of transitional dual economies (Lewis 1954), where rural areas provide the human and financial capital for urban growth (Fay, Opal 2000) in a typical core-periphery phenomenon (Krugman 1991). Henderson (2005) argues that development does not explain the dynamics of places, nor can these dynamics be the stimulus for development as it is possible to verify in many poor countries where urbanization did not lead to economic growth and development; the factors are resource usage (Henderson 1986), public transferences (Ades, Glaeser 1995) and institutions (Davis, Henderson 2003).

This paper aims to collect and systematize data on Sustainable Development Goals at the country level that can support the creation of frames of reference to integrate and interpret what appears to be detached disciplinary indicators. The assumption is that such indicators can only improve decision-making and promote sustainable development if integrated into knowledgeable mechanisms that can be useful to understand reality and suitable to identify and calibrate policy tools for different places.

What is the right tools level for each one of the sustainable development goals knowing that they interact with each other within specific contexts of space and time? The hypothesis is that there can be some instrumental association between SDGs to inform effective policy tools aimed to promote sustainable development.

To address that question and test this hypothesis, section 2 reviews the literature on UN Sustainability. Section 3 proposes a methodology to undertake an integrated analysis of the indicators of the UN Sustainability Goals. Section 4 provides a preliminary data analysis on World Bank Data (World Bank 2019) to perceive worldwide sustainability country profiles. Section 5 estimates a two stages econometric model that relates indicators of sustainable goals to growth and welfare and discusses the results and Section 6 concludes and proposes some future work for sustainable development knowledge and policy.

## 2 Literature Review in UN Sustainability Goals

Sensitive indicators of sustainability serve often to compare places (Quiroga Rayen 2001, Gallopín 2006). For instance, indicators that represent attributes of the urban system, public security, environment, culture, education, economy, funding, governance, migration, public participation, poverty, and the current development level. Resources such as the "Compendium of Sustainable Development Indicators Initiatives" and the "Community Indicators Consortium" currently allow places to access some comparable well-being data. The problem is that, on the one hand, global sustainability goals may not complement each other for each context and many trade-offs and interactions may arise between them. For instance, affordable and clean energy (Goal 7) goes with climate action (Goal 13), but the end of hunger (Goal 2) and sustainable landscapes (Goal 15) might be in contradiction with extensive land use for bio-energy (Goal 7) (Mika, Farkas 2017). For each space and time context, the priorities of the population differ according to their contextual needs which are different from the global priorities (Fuentes 2013).

The issue is whether sustainable development goals result from the global context, as often announced by international media, mirrored by the academic literature, stimulated by international institutions that support disciplinary-driven research; or if the concern is about sustainability in proximity contexts (Torre, Rallet 2005), without losing the framework of the spatially interconnected systems where place-based policies make sense (Neumark, Simpson 2015).

The assumption is that from the perspective of spatial and organizational proximity minimal wise investments in sustainability can reach marginal but cumulative benefits for regional sustainable development with demonstrative benefits for other places. At the local level, it is possible to attend to local geographic characteristics, committed economic capacity, responsible governance, managerial ability, adjusted policy tools, and face-to-face public participation; the dimensions for the deployment of sustainable investments (Shea et al. 2018). Given the significance of the SDGs for guiding development, rigorous accounting is essential for making them consistent with the goals of sustainable development (Wackernagel et al. 2017).

It is clear the need for some quantitative account of the SDGs for them to be a good guide for the development of regions and nations. However, as stated by Costanza et al. (2016), with 17 goals, 169 targets, and over 300 indicators proposed, the SDGs provide diluted guidance at best. Because of this, some attempts have been made to summarize the indexes and evaluate the correlation between the 17 SDGs. For instance, Costanza et al. (2016) proposed a Sustainable Wellbeing Index (SWI) and then linked it with SDGs; Anderson et al. (2022) created an SDG system model to observe the change in the influence of all targets on the official objective of the 2030 Agenda; Ament et al. (2020) and Pradhan et al. (2017) tried to identify the positive and negative correlations between the SDG indicators.

The contribution of this paper is the proposal and the test of a Circle of Development composed of seven vectors of development involving the 17 SDGs (Figure 1).

Territorial Capital is associated with making cities and human settlements inclusive, safe, resilient, and sustainable (G11), taking urgent action to combat climate change and its impacts (G13), conserving and sustainably using the oceans and seas for sustainable development (G14), protect, restore and promote sustainable use of terrestrial ecosystems, halt and reverse land degradation, and halt biodiversity loss (G15).

Productivity relates to ensuring access to affordable, reliable, sustainable, and modern energy for all (G7), promoting full and productive employment and decent work for all, and sustained, inclusive, and sustainable economic growth (G8); and ensuring sustainable consumption and production patterns (G12).

Income has to do with the end of poverty in all its forms everywhere (G1). Consumption, private and public links to end hunger and achieve food security everywhere (G3), ensure inclusive and fair quality education (G4), with achieving gender equality besides empowering all women and girls (G5), and in providing sustainable management of water and sanitation for all (G6). Financing involves strengthening the means of implementation and revitalizing the Global Partnership for Sustainable Development (G17) and, because of redistribution factors, reducing inequality within and among countries (G10). Investment contains building resilient infrastructure, promoting inclusive and sustainable industrialization and fostering innovation (G9); promoting peaceful and inclusive societies for sustainable development, providing access to justice for all, and building effective, accountable, and inclusive institutions at all levels (G16). Well-being relates to ensuring healthy lives and promoting well-being for all at all ages (G3). The issue is if there are some relations between all these disciplinary goals, as it is pointed out in the question marks of Figure 1.

Although all goals are expressed as political actions, the question to address is: what political actions are more efficient to promote sustainable development, assuming means are scarce and that the different goals relate to each other and have different requirements in space and time?

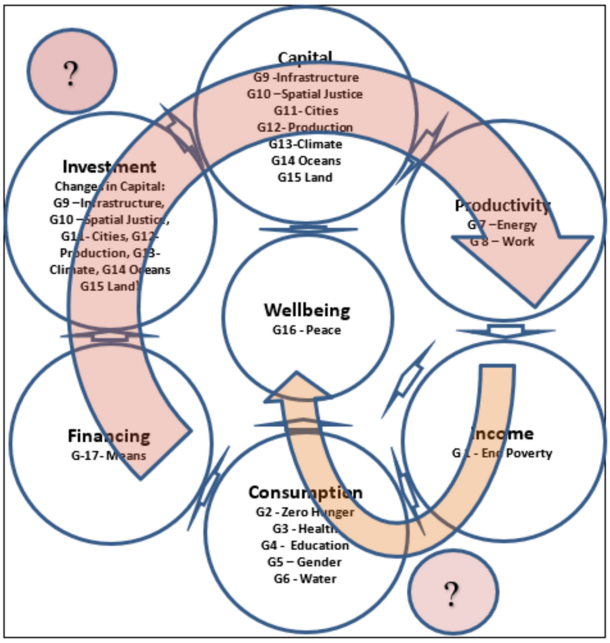



Figure 1: UN Sustainable Goals within the Circle of Development

## 3 Methodology

The paper aims to test if the Conceptual Model of UN Sustainable Goals within the Circle of Development presented in Figure 1 makes sense using indicators by country from the World Bank.

The scheme of Figure 1 guides a consistent aggregation of the 17 Goals materialized in two relatively robust regressions. The first one tries to explain income as a function of financing, investment, capital, and productivity. The dependent variable is Income per Capita (G1) and it is a function of the indicators for the goals G7, G8, G9, G10, G11, G12, G12 for low-income countries, G13, G14, and G17, and the urbanization rate. Equation (1) represents the model to be estimated.

$$\begin{aligned} \ln \mathrm{G1}_{it} \quad = \quad & \gamma_i \mathrm{urbanization} + \beta_1 \mathrm{G7}_{it} + \beta_2 \mathrm{G8}_{it} + \beta_3 \mathrm{G9}_{it} + \beta_4 \mathrm{G10}_{it} + \beta_5 \mathrm{G11}_{it} \\ & + \beta_6 \mathrm{G12}_{it} + \beta_7 \mathrm{G12\_low\_income}_{it} + \beta_8 \mathrm{G13}_{it} + \beta_9 \mathrm{G14}_{it} + \beta_{10} \mathrm{G15}_{it} \\ & + \beta_{11} \mathrm{G16}_{it} + \beta_{12} \mathrm{G17}_{it} + T + c_i + \epsilon_{it} \end{aligned} \tag{1}$$

The subscript $i$ refers to country and $t$ to year; $T$ is the time-fixed effect; $c_i$ is the country fixed effect and $\varepsilon_{it}$ is the error term. To account for the multicollinearity in explanatory variables Principal Component Analysis (PCA) was used in variables with a higher degree of correlation (G7, G9, G10, and G11). The $\gamma_i$ and the $\beta$ are the coefficients to be estimated.

The second regression explains welfare as a function of income and consumption of private and public goods. It has Well-being (G16) assessed by the rate of suicide per 100,000 persons as the dependent variable and the social goals present in the Consumption Box of Figure 1 (G3, G4, G5, and G6) and the Income Box (lnG1, estimated in Equation 1) as explanatory variables. Equation (2) represents the proposed model. The $\delta$ are coefficients to be estimated.

$$\begin{aligned} \mathrm{G16}_{it} \quad = \quad & \delta_1 \ln \mathrm{G1}_{it} + \delta_2 \mathrm{G2}_{it} + \delta_3 \mathrm{G3}_{it} + \delta_4 \mathrm{G3}_{\mathrm{NAE}_{it}} + \delta_5 \mathrm{G4}_{it} + \delta_6 \mathrm{G5}_{it} \\ & + \delta_7 \mathrm{G6}_{it} + c_i + \epsilon_{it} \end{aligned} \tag{2}$$

Table 1 presents the list of indicators selected for each SDG. In the next section, there is a brief discussion about the evolution of each one. The equations were estimated using

Table 1: Selected indicators for each SDG

| SDG | Indicator |
|---|---|
| G1 | GNP per capita (constant 2010 US$) |
| G2 | Mortality rate, under-5 (per 1,000 live births) |
| G3 | Incidence of tuberculosis (per 100,000 people) |
| G4 | Compulsory education, duration (years) |
| G5 | Adolescent fertility rate (births per 1,000 women ages 15-19) |
| G6 | People using at least basic drinking water services (% of the population) |
| G7 | Renewable energy consumption (% of total final energy consumption) |
| G8 | Unemployment, total (% of the total labor force) (modeled ILO estimate) |
| G9 | Individuals using the Internet (% of the population) |
| G10 | Exports of goods and services (% of GDP) |
| G11 | People using at least basic sanitation services (% of population) |
| G12 | Total natural resources rents (% of GDP) |
| G13 | PM2.5 air pollution, population exposed to levels exceeding WHO guideline value (% of total) |
| G14 | Agriculture, forestry, and fishing, value added per worker (constant 2010 US$) |
| G15 | Forest area (% of land area) |
| G16 | Suicide mortality rate (per 100,000 population) |
| G17 | Personal remittances received (% of GDP) |

data from World Bank (2019). The database contains information from 135 countries for the years 2000, 2005, 2010, and 2015. The equations were estimated using the fixed effects (within estimators) in STATA software.

## 4 Data on worldwide sustainability

The World Bank produced a specific database with indicators for the UN's SDGs (World Bank 2019). Based on this data (Figure 2) and selecting one available and adequate indicator per SDG, it is possible to estimate Equations (1) and (2) for the world and complement the analysis with the UN report of 2019.

SDG 1 is to end poverty in all its forms everywhere. The UN Report of 2019 says that the decline of extreme poverty continues, but projections of the proportion of people living below $1.90 a day show that in 2030 there will be still 6% of people in those conditions. This is associated with biased income creation and distribution not only between countries but, increasingly, within countries where rural detachment and urban exclusion persist. Sub-Saharan Africa deserves special attention on this issue (Wackernagel et al. 2017).

SDG 2 relates to the end of hunger, the achievement of food security, the improvement of nutrition, and the promotion of sustainable agriculture. The evolution of the mortality rate for those under 5 years old per 1,000 live births, available for many countries in the World Bank database, shows a clear improvement in the reduction of hunger around the world, mainly after 2010. Nevertheless, the number of people suffering from hunger has increased since 2014, associated with conflicts, environmental shocks, and economic slowdowns. Sub-Saharan Africa, Central and Southern Asia, and Oceania deserve special attention on this issue, not only related to hunger but also malnutrition.

Healthy lives and well-being for all ages is the aim of SDG 3. There have been major improvements in the world and even more in lower-developed regions in Sub-Saharan Africa and Central and Southern Asia. Notwithstanding this, in 2017, nearly 300,000 women died from complications relating to pregnancy and childbirth, and over 90 percent of them lived in low- and middle-income countries. The incidence of tuberculosis also decreased from 2000 to 2015, but that path is not steady in developing countries where, for some periods, there is an increase in the incidence. Regarding malaria, there were still, in 2017, about 219 million cases and 435,000 deaths from this disease, 90% in Sub-Saharan Africa.

UN Goal 4 aims to ensure inclusive and quality education and to promote lifelong learning opportunities for all. There is some improvement in the number of years of compulsory education but the percentage of children and adolescents not achieving the minimum proficiency in mathematics (56%) and reading (58%) is very low worldwide,

as of 2015, and particularly alarming for Sub-Saharan Africa (84%, 85%), Central and Southern Asia (76%, 81%), and Northern Africa and Western Asia (57%, 57%).

To achieve gender equality and empower all women and girls is UN SDG 5. The indicator "Adolescent fertility rate (births per 1,000 women ages 15-19)" shows an interesting evolution for all the regions of the world, except Northern Africa and Western.. Nevertheless, the indicator is still higher in the least-developed regions of Central and Southern Asia and in Sub-Saharan Africa, where the proportion of women subjected to physical and sexual violence is above 20% of married women.

Goal 6 aims to ensure the availability and sustainability of water and sanitation for all. The indicator "People using at least basic drinking water services (% of the population)" in Figure 2 shows an evolution for most world regions except for Eastern Europe, where the water supply is deteriorating from 2000 to 2015. Furthermore, there are countries with high levels of water stress, mainly in Northern Africa, Western, Central and Southern Asia.

The world is improving towards ensuring access to affordable, reliable, sustainable, and modern energy (Goal 7) with only Sub-Saharan Africa still far behind in 2017. Nevertheless, the use of non-clean and unsafe cooking fuels is still common in many regions of the world in Central, Southern, Eastern and South-eastern Asia, Latin America and the Caribbean, Southern Africa, and Sub-Saharan Africa. The good news is, coming from Europe where clean and safe renewable energies are getting more share.

Goal 8 refers to the promotion of sustainable and inclusive economic growth based on full and productive employment and decent work for all. Although growth and employment are increasing in Asia, Europe, and North America, that is not the case in Sub-Saharan Africa, Latin America, and the Caribbean, which seemed trapped in a vicious circle of underdevelopment. Unemployment is decreasing all over (Figure 2) but it is very changeable in Europe and North America, where economic crises seem to have strong social and economic impacts. Notwithstanding this, the proportion of non-occupied young people is much higher for women, namely in Central and Southern Asia, Northern and Western Africa, Sub-Saharan Africa, and Eastern and South-eastern Asia.

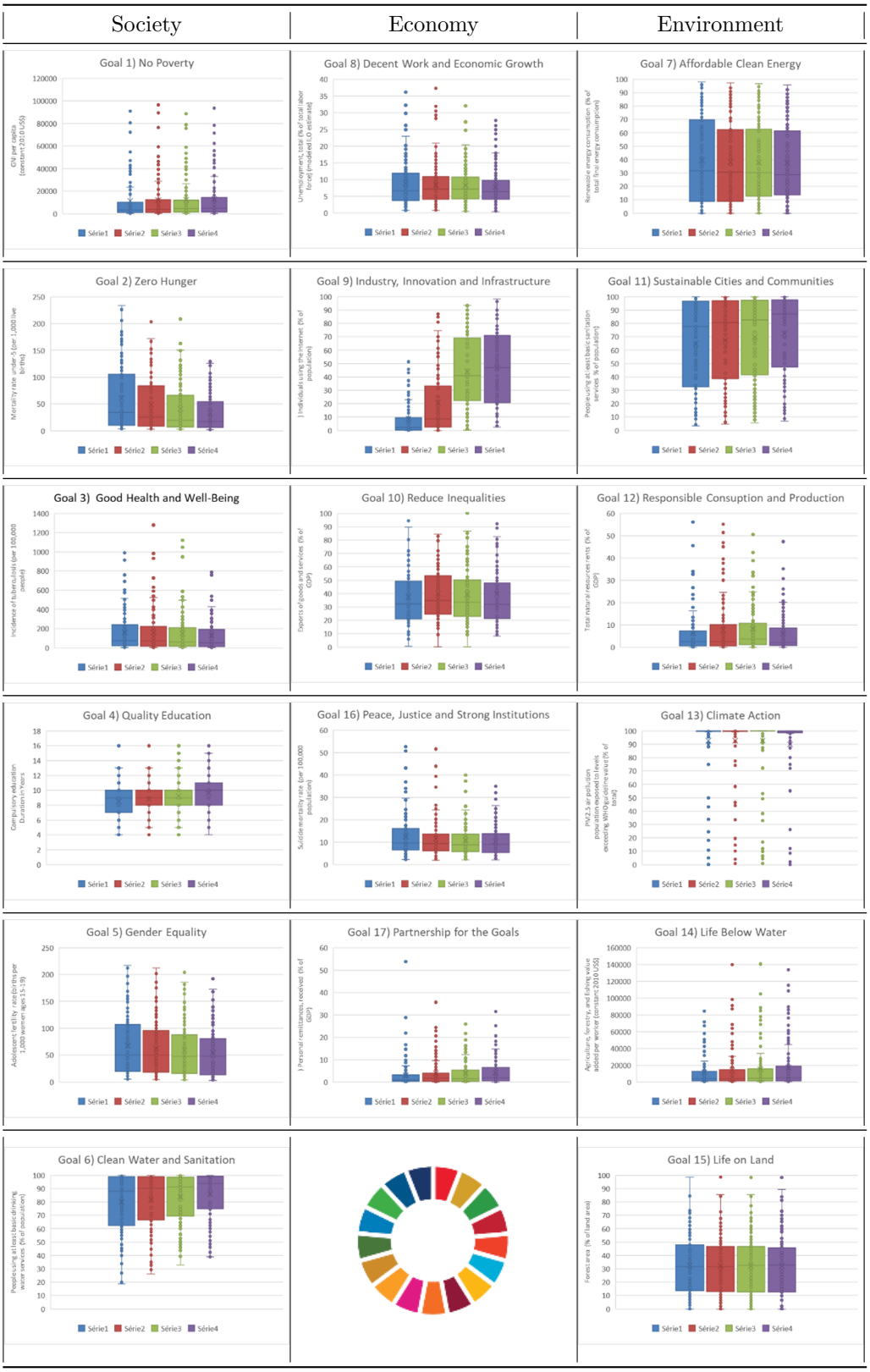
Goal 9 aims to build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation. Assuming that SD comes first from industrialization, investment in research and development and financing of small and medium enterprises would increase investment and productivity. The World Bank indicator of the percentage of individuals using the internet increased sharply until 2010 but stabilizes after the depression years. There are recent signs of industrial recovery in the developing world, after the shift from big public companies to private companies in the 1990s and after the great depression at the end of the first decade of the 21$^{st}$ century.

The reduction of spatial inequality within and among countries is the design of Goal 10. The growth of indebted countries strongly refrains and rural-urban migrations signal major inequalities within countries. Trade is a proxy indicator of inequality between countries and, looking at Figure 2, it can be seen a decrease in the percentage of exports in the product of the countries since 2010.

Goal 11 is the one more related to sustainable urbanization. The aim is to make cities and human settlements safe, inclusive, resilient, and sustainable. Looking at the indicator of the percentage of people using basic sanitation, there seems to be a clear improvement. The issue is that the average indicator per country does not report the tragic situation of many marginal slums associated with urbanization. Furthermore, urban waste is mounting; air pollution is unbearable in many large metropolises; traffic congestion seems unmanageable, and green spaces are short and degraded in many towns of the developing world.

Goal 12 tries to ensure sustainable consumption and production patterns, reducing the human footprint in the environment, improving the efficiency of resource use, and promoting healthy consumption patterns. The percentage of the rents from natural resources on the product might be an interesting indicator and looking at Figure 2, there are small positive signs globally.

Goal 13 refers to the urgency of actions to combat climate change and its impacts. There are many plans to reduce emissions and programs to adapt to the impacts. The




*Note*: Based on data from World Bank (2019).

Figure 2: Evolution of Indicators of Sustainable Development Goals in 2000 (Series 1), 2005 (Series 2), 2010 (Series 3), and 2015 (Series 4)

World Bank indicator was the number of particles in the air breathed by humans, but the signs of improvement were very low in the last few years.

Goal 14 proposes to conserve and sustainably use the oceans, seas, and marine resources for sustainable development. This involves the reduction of land-based pollutants, the decrease of acidification of the seas, and the sustainable management of fish stocks. The World Bank database does not provide a suitable indicator for the seas. The proxy indicator is the agriculture, fishing, and forestry value added per worker that, as Figure 2 shows, there is a small increase but still a long way to go to the benchmark of the best performers.

Goal 15 proposes to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and biodiversity loss. The number of species at risk of extinction are increasing, the proportion of degraded land is very high, mainly in developing countries, and the forest area is decreasing (Figure 2).

Goal 16 defends the promotion of peaceful and inclusive societies for sustainable development, access to justice for all, and the creation of effective, accountable, and inclusive institutions at all levels. The suicide rate is marginal but a strong indicator of this goal and shows some improvement exactly in countries with extreme values of suicides.

Finally, Goal 17 favors the strengthening of the means of implementation and revitalization of the Global Partnership for Sustainable Development. It rightly defends the mobilization of global and local funds, recognizing that personal remittances from migrant workers abroad are becoming the largest source of external financing in developing countries (Figure 2); although for extreme cases remittances decrease, there is an increase over the total average.

## 5 Results and discussion on the connection between UN Development Goals

Table 2 presents the estimative of regression 1. The variables and coefficients in bold are the ones statistically significant at the 0.05 level. The goals G8 (unemployment), G9 (use of the internet), G10 (exports), and G11 (basic sanitation) have the expected effect on per capita income. The higher the unemployment rate, the lower the income per capita; increases in exports and accessibility to the internet, and improvement in access to basic sanitation can lead to increases in a country's per capita income.

The results from Goals 7 (use of renewable energy) and 12 (natural resources rent) bring some interesting evidence. The percentage of renewable energy consumption has a negative correlation with the per capita income because most of it relates to the use of wood as the main source of energy. The rent from natural resources negatively affects income, but only in lower and middle-income countries, showing a lack of adequate governance in the management of natural resources in poor countries. This result finds support in other analyses. Ament et al. (2020) evidenced that economic growth is negatively associated with health and environment indicators and Pradhan et al. (2017) argued that Goal 12 is most commonly associated with trade-offs (negative correlations) regarding the other goals. Thus, potential conflicts between different agendas must be managed to pursue a sustainable development path, especially in low and middle-income countries.

The urbanization rate is statistically significant at 0.05 level only for countries in Central Asia (2) and Eastern Europe (6). In those countries, urbanization has been a good policy to increase the per-capita income. The year's specific coefficients are also statistically significant at 0.01 and have the expected positive sign.

Results of Table 3 show the factors that can affect the suicide rate, a proxy for non-happiness (Equation 2). There is a strong relationship between per-capita income (estimated in regression 1) and suicide rate: the richer a country, the lower its suicide rates. The coefficient of G3 (Incidence of tuberculosis per 100,000 people) is statistically significant and positive only for countries in Europe and North America. In such countries, the incidence of tuberculosis or the fear of catching it may affect well-being. The coefficient of G4 (compulsory education) is statistically significant at the 0.05 level and

Table 2: Goal 1 (per-capita income) explained by Economic and Environmental Goals

| *Dependent variable: ln_G1 – Ln of GNP per capita (constant 2010 US$)* | | | |
|---|---|---|---|
| Code | Variable | Coef. | Std. Err. |
| | Intercept | 8.215* | 0.412 |
| G7 | Renewable energy consumption | -0.293* | 0.044 |
| G8 | Unemployment, total | -0.012* | 0.003 |
| G9 | Individuals using the Internet | 0.188* | 0.030 |
| G10 | Exports of goods and services | 0.073* | 0.021 |
| G11 | People using at least basic sanitation services | 0.266* | 0.037 |
| G12 | Total natural resources rents | 0.000 | 0.003 |
| G12 | Total natural resources rents – Lower and Middle Income Countries | -0.006* | 0.003 |
| G13 | PM2.5 air pollution | 0.000 | 0.002 |
| G14 | Agriculture, forestry, and fishing, value added per worker | 0.000 | 0.000 |
| G15 | Forest area | 0.005 | 0.004 |
| G17 | Personal remittances received | 0.003 | 0.002 |
| *Urbanization* | | | |
| 1 | Central America and Caribean | -0.005 | 0.005 |
| 2 | Central Asia | 0.359* | 0.138 |
| 3 | Eastern Africa | 0.001 | 0.009 |
| 4 | Eastern and South Eastern Asia | -0.001 | 0.011 |
| 5 | Eastern Asia | 0.010 | 0.008 |
| 6 | Eastern Europe | 0.040* | 0.015 |
| 7 | Middle Africa | -0.006 | 0.009 |
| 8 | Northern Africa | -0.012 | 0.012 |
| 9 | Northern America | -0.024 | 0.053 |
| 10 | Northern Europe | -0.023 | 0.021 |
| 11 | Oceania | -0.001 | 0.106 |
| 12 | South America | 0.002 | 0.014 |
| 13 | South-Eastern Asia | 0.006 | 0.006 |
| 14 | Southern Africa | -0.018 | 0.010 |
| 15 | Southern Asia | -0.007 | 0.009 |
| 16 | Southern Europe | -0.001 | 0.007 |
| 17 | Western Africa | -0.011 | 0.006 |
| 18 | Western Asia | -0.010 | 0.009 |
| 19 | Western Europe | -0.021 | 0.011 |
| *Year* | | | |
| | 2005 | 0.055* | 0.020 |
| | 2010 | 0.127* | 0.031 |
| | 2015 | 0.173* | 0.042 |
| | R-sq within= 0.6730 | | |
| | F(134, 362) = 51.00; Prob > F = 0.0000 | | |
| | Hausmann test (fixed x random effect): chi2(31)= 151.47; Prob>chi2 = 0.0000 | | |

*Note*: * . . . significant at the 1% level.

has a positive sign, meaning the suicide rate increases with education level. This result may be different from what is expected, but there is some hypothesis that can explain it. The average suicide rate in Upper (14.586) and Upper Middle (12.215) income countries is much higher than the rate in Low (7.332) and Lower Middle (8.960) income countries. One of the reasons is because of the sub-notification of suicides in countries from the group of low and lower middle income. The other reason is that individuals with more years of study may be more prone to suicide when they face failures, public shame, and high premorbid function, as suggested by Pompili et al. (2013).

The country-fixed effects estimated in regression 1 are plotted in Figure 3 and represent the country-specific factor influencing per capita income. The higher the value (darkest colors) the more unobservable national factors are explaining the per capita income. As can be seen in developed and some developing countries like Argentina, Brazil, Chile, Mexico, South Africa, Turkey, and Uruguay, there are unobservable factors influencing positively the growth rates. In other countries, like Russia, India, and some in the African continent, the unobservable effects are pushing down the per-capita income.

Figure 4 presents the country-fixed coefficients for Regression 2. Countries like Russia, China, India, The USA, and Canada have the highest positive values, which means they have factors not included in the regression that explain their suicide rate. On the

Table 3: Goal 16 explained by Economic and Environmental Goals

| Code | Variable | Coef. | Std. Err. |
|---|---|---|---|
| | *Dependent variable: G16 – Suicide mortality rate (per 100,000 population)* | | |
| | Intercept | 46.345* | 6.876 |
| ln_G1 | Ln of GNP per capita (estimated in regression 1) | -4.915* | 0.867 |
| G2 | Mortality rate, under 5 | 0.012 | 0.007 |
| G3 | Incidence of tuberculosis | -0.001 | 0.002 |
| G3 | Incidence of tuberculosis, Europe and North America | 0.209* | 0.020 |
| G4 | Compulsory education, duration | 0.191* | 0.090 |
| G5 | Adolescent fertility rate | -0.013 | 0.015 |
| G6 | People using at least basic drinking water services | 0.043 | 0.030 |
| | R-sq within = 0.3723 | | |
| | F(7,388) = 32.87; Prob > F = 0.0000 | | |
| | Hausmann test (fixed x random effect): chi2(7)= 50.02; Prob>chi2 = 0.0000 | | |

*Note*: * . . . significant at the 1% level.

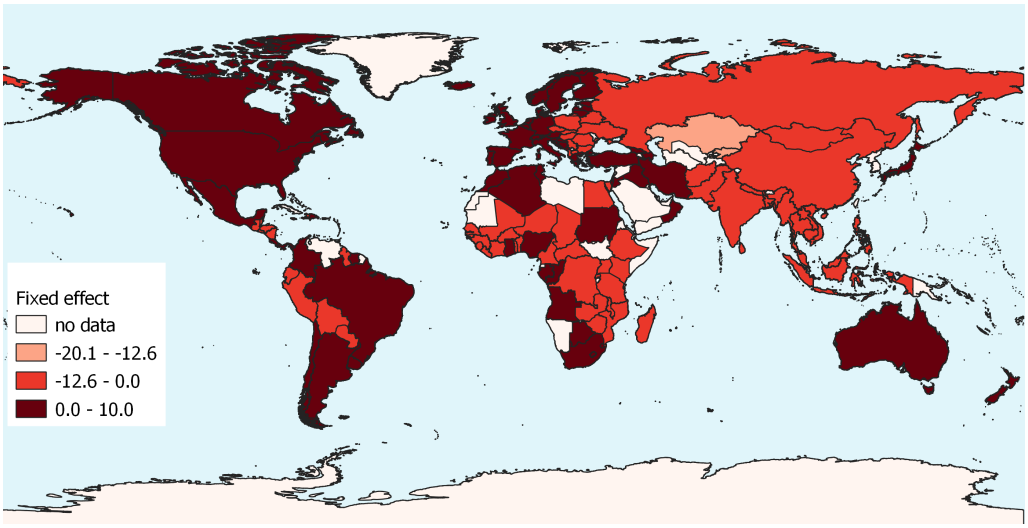



Figure 3: Countries' fixed effects, per-capita income (regression 1)

other side, in countries like Brazil, Colombia, Peru, Ecuador, Mexico, and some African countries unobservable factors are reducing the suicide rate.

Our interpretation of the evidence on the maps is that the quantitative indicators used in the regressions are not enough to explain the level of wealth and happiness of a country. Especially in the case of the suicide rate. Cultural, religious, and institutional factors not easily measure are affection positively and negatively the observable national rates. The challenge is how to measure them and analyze their influence on the achievement of the SDGs.

## 6 Conclusions

The paper aims to systematize data on SDGs, proposing a conceptual integrated model of sustainable development and estimating it econometrically with World Bank indicators. In summary, it is possible to observe that economic factors seem to be the most important determinant of the wealth of a nation. On the other hand, the model did not suggest that environmental factors can increase the income level. The rents of natural resources are bad for low and middle-income countries, indicating the need for improved governance in the management of natural resources in such countries.

To some extent, there is the confirmation of the hypothesis that there is some instrumental association between indicators of SDGs, as shown by the two interrelated models. Instead of targeting all the sustainable development goals with specific policies, it may be wise to look at the governance of natural resources in poor countries, question overall

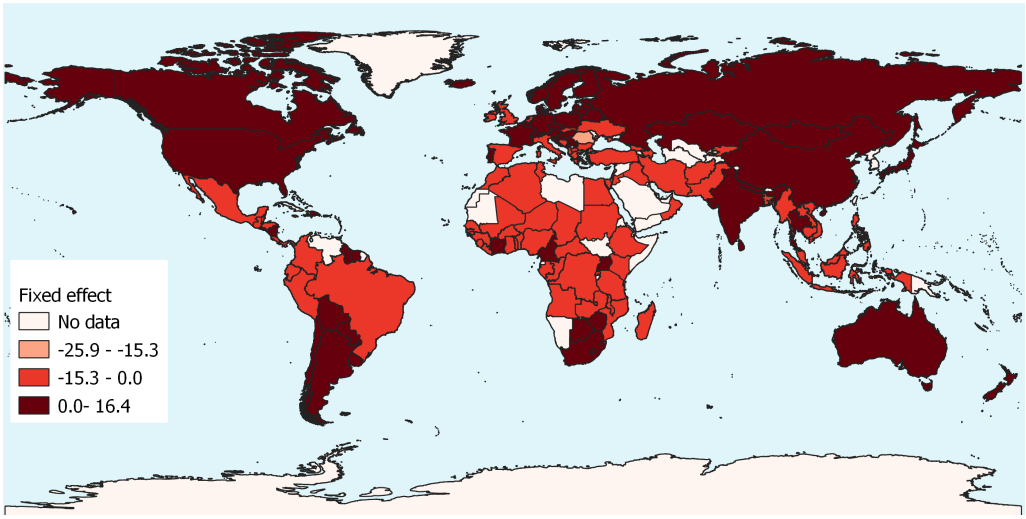



Figure 4: Countries' fixed effects, suicide rate (Regression 2)

urbanization policies and trends, look carefully at the education systems, and go further in explaining the country-fixed effects: why the Andes, most of Africa, and most of Asia do not grow as much as expected? And why do tropical countries seem to be happier than others?

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