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Redefining GDP: Emissions, Inequality, and the Limits of a Flawed Measure

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A new definition of GDP is called for, one that is less "product-based" and more "returns-based", and incorporates emissions and inequality in the measure.

Background and Motivation

The widely used concept of Gross Domestic Product (GDP) is associated in its origins with the work of William Petty and Charles Davenant in the 17th century, but owes its modern application to Simon Kuznets in his report for the United States (US) Congress in 1934. Twenty years later, in his seminal contribution of 1955, Kuznets introduced a separate but equally influential idea: the celebrated inverted-U relationship between inequality and per capita GDP. While his 1934 work gave us the tools to measure national income, his 1955 work gave us a theory of how that income is distributed across a developing economy.

> We examine whether emissions correction and the incorporation of inequality have a differential impact on the size of GDP at different levels of development.

Though Kuznets himself warned against using GDP as a welfare indicator, the line between its legitimate use and misuse is blurred in the subsequent literature. This is not to deny the usefulness of GDP as an indicator of a country's growth, its attractiveness for foreign direct investment (FDI), and its bargaining power with respect to other nations. Notwithstanding methodological issues in its implementation-for example, whether the wholesale price index or the cost-of-living index is the appropriate deflator, or whether it should be based on national accounts data or survey data-GDP has been widely used in policy discussions.

In recent years, GDP has attracted particular attention in India, which ranks as the fourth largest economy on nominal GDP and third largest on purchasing power parity (PPP), though in per capita terms it falls well down the list. This is a significant milestone, reflecting high market power on account of its 150 million-plus middle income population, which surpasses the total population of many developed countries.

The high growth rates in India and China have been associated with large reductions in poverty in both countries. However, a comparison of their growth experiences with those of the "Asian Tigers" shows that GDP growth must be accompanied by policy interventions to achieve the welfare improvements that the latter countries recorded (Drèze and Sen 2013).

The motivation of this article is to subject GDP as defined by Kuznets to critical scrutiny. The objectives are threefold: first, to determine whether conventional GDP overstates productive performance in more emissions-intensive economies; second, to estimate labour and capital productivities across countries in the context of GDP calculation; and third, to examine whether emissions correction and the incorporation of inequality have a differential impact on the size of GDP at different levels of development.

In an inquiry titled "Beyond GDP", the United Nations (UN) constituted a high-level expert group headed by Kaushik Basu and Nora Lustig to examine the issue, whose report was published in early May. Our study is narrower than that of the UN, but provides evidence on a few aspects not covered in detail in the UN project.

While many of the limitations of the GDP concept are well known-it is money-metric, one-dimensional, and too aggregative to serve as an indicator of multidimensional living standards-we focus on the definition of GDP proposed by Kuznets as "the total monetary value of all finished goods and services produced".

In aggregating "goods" and "services", the concept overlooks a sharp distinction between the two, stemming from the different inputs they require and the returns associated with each. This distinction is particularly marked in countries like India, where services are produced by low-skilled labour in the informal sector, while goods produced in the formal sector require capital, a skilled workforce, and access to modern technology.

> In countries as large and diverse as China and India, with significant subnational variations in GDP between regions, it is misleading to speak of a nationwide GDP.

Underlying this distinction is the difference in productivity between the two inputs, which in turn determines the returns to those supplying them. The global productivity maps look quite different for the two. This has implications for inequality: while investors-typically capitalists-appropriate the returns from productivity in goods, the wages of low-skilled labour are guided by productivity in services. This is consistent with the argument (Piketty 2014) that when the rate of return on capital exceeds the economic growth rate over the long term, wealth inequality increases. In aggregating "goods" and "services", GDP overlooks this distinction and its link with inequality.

Closer to home, the divergence between the productivity maps of capital and labour holds true for India as well. The India map brings out another limitation of GDP. In countries as large and diverse as China and India, with significant subnational variations in GDP between regions-known as State Domestic Product (SDP) in India-it is misleading to speak of a nationwide GDP. There is a parallel in the PPP literature, where significant spatial variation in prices makes a country-wide PPP of limited value in a large, heterogeneous country.

Two further limitations of GDP are that it does not incorporate inequality and does not account for carbon dioxide (CO2) emissions, both of which affect the living standards of residents. We provide evidence on how incorporating these two factors affects GDP.

Data and Methodology

The global analysis is based on available data for the year 2023 (Base = 2021). We use cross-sectional data on several macroeconomic aggregates from the Penn World Table (Version 11), greenhouse gas emissions data from the World Development Indicators of the World Bank (2025), and world inequality data from the World Inequality Lab (2026). The cost of greenhouse gas emissions per metric tonne of CO2 emitted is $257 in 2024 (with 2026 as the year of analysis and 2023 as the year of emissions), which corresponds to $303.01 in 2021 prices (Institute for Policy Integrity 2026).

Following the World Bank classification by income levels, countries are classified into high income (60 countries), upper middle income (37 countries), lower middle income (32 countries), and low income (10 countries). Labour productivity is calculated as the ratio of value added to employment, and capital productivity as the ratio of value added to capital stock. The India analysis is based on a comprehensive dataset (2023-24) compiled from official Indian sources.

The inequality-corrected GDP is calculated as the product of real GDP and the inverse of a modified Palma Ratio (PR). The PR is defined as the ratio of the income shares of the top 10% to the bottom 40% of the population. Owing to the lack of data, we replace 40% with 50% in the Modified Palma Ratio (MPR).

> While nearly all countries in the high income group record higher-than-average labour productivity, most countries in the lower middle income and low income groups record lower labour productivity than the global average.

The correction factor of (1/5) that is multiplied with the inverse of the MPR in generating the inequality-corrected GDP ensures that no correction is required under conditions of perfect income equality. The higher the MPR-that is, the greater the inequality-the lower the corrected GDP will be relative to the uncorrected GDP. Sen (1976) proposed a variant of inequality correction based on the Gini coefficient. The emissions-corrected real GDP is obtained as: uncorrected real GDP minus (c × total emissions in tonnes).

The methodology for the India calculations is as follows.

To construct the productivity measures, we use data on three macroeconomic aggregates compiled by the Ministry of Statistics and Programme Implementation. These are net state value added (NSVA) from the Gross State Value Added/Net State Value Added (GSVA/NSVA) by economic activities; labour employment figures from the Periodic Labour Force Survey (PLFS), July 2023-June 2024; and the value of the stock of fixed capital from the Annual Survey of Industries (ASI) 2023-24. State-level labour and capital productivities are constructed respectively as the ratio of NSVA at constant (2011-12) prices to aggregate employment, and the ratio of NSVA at current prices to the total value of the stock of fixed capital.

The Results

Table 1 presents estimated labour and capital productivities relative to the global average, separately for the four income groups. The following pattern emerges.

First, wide variation in relative productivity estimates is observed both between countries and between the two productivity estimates within countries. The latter result is significant in the present context, as it underlines the inappropriateness of lumping together "goods" and "services"-with their different mix of labour and capital- in the definition of GDP.

Second, while nearly all countries in the high income group record higher-than-average labour productivity, most countries in the lower middle income and low income groups record lower labour productivity than the global average. This explains the low wages in the latter groups compared to the former, a difference reflected in international inequality.

Third, a considerable number of high income countries-most notably Canada, Australia, Italy, and the UK-record lower capital productivity than the global average. Besides diminishing returns to capital in these capital-abundant countries, this could also reflect a shortage of skilled labour to operate the machinery and high technology required in capital-intensive goods production, as these are also countries with strict immigration controls, particularly since Covid-19.

Table 1: Summary of Relative Productivity* by Region, 2023

Income Group of Countries	Relative Labour Productivity	Relative Capital Productivity	Regions
High income (62)**	≥ 1	≥ 1	Africa (1: Seychelles), Asia [East and Southeast] (2), Europe (10), Middle East [Western Asia] (3), North America [including Caribbean & Central] (5), South America (2), Oceania (1: New Zealand)
	≥ 1	< 1	East Asia (4), Europe (19), Middle East [Western Asia] (5), North America [including Caribbean & Central America] (7), Oceania (1: Australia), Southeast Asia (1: Brunei)
	< 1	≥ 1	NONE
	< 1	< 1	North America [Caribbean] (1: Barbados)
Upper middle income (46)	≥ 1	≥ 1	Africa (4), Central Asia (1: Kazakhstan), Europe (3), Middle East [Western Asia] (3), South America (1: Argentina), Southeast Asia (1: Malaysia)
	≥ 1	< 1	Central Asia (1: Turkmenistan), Europe (2), Middle East [Western Asia] (2), North America [including Caribbean & Central America] (3), South America (1: Suriname)
	< 1	≥ 1	Africa (3), Asia [Central, East and Southeast] (3), Europe (1: Republic of Moldova), North America [including Caribbean & Central America] (3), Oceania (1: Fiji), South America (3)
	< 1	< 1	Asia [East and Southeast & South] (3), Europe (2), North America [including Caribbean & Central America] (3), South America (2)
Lower middle income (44)	≥ 1	≥ 1	Africa (2)
	≥ 1	< 1	NONE
	< 1	≥ 1	Africa (17), Asia [Central, South and Southeast] (10), Middle East [Western Asia] (1: State of Palestine), North America [including Caribbean & Central America] (1: Honduras), South America (1: Bolivia)
	< 1	< 1	Africa (4), Central Asia (2), Middle East [Western Asia] (2), North America [including Caribbean & Central America] (2), Asia [South and Southeast] (2)
Low income (20)	≥ 1	≥ 1	NONE
	≥ 1	< 1	NONE
	< 1	≥ 1	Africa (16), Middle East [Western Asia] (1: Syrian Arab Republic)
	< 1	< 1	Africa (2), Middle East [Western Asia] (1: Yemen)

Notes: *With respect to global aggregate. **Figures in parentheses denote number of countries, including sovereign countries, territories, and special administrative regions.

Figure 1A: World Map of Labour Productivity, 2023 (Relative to global aggregate)

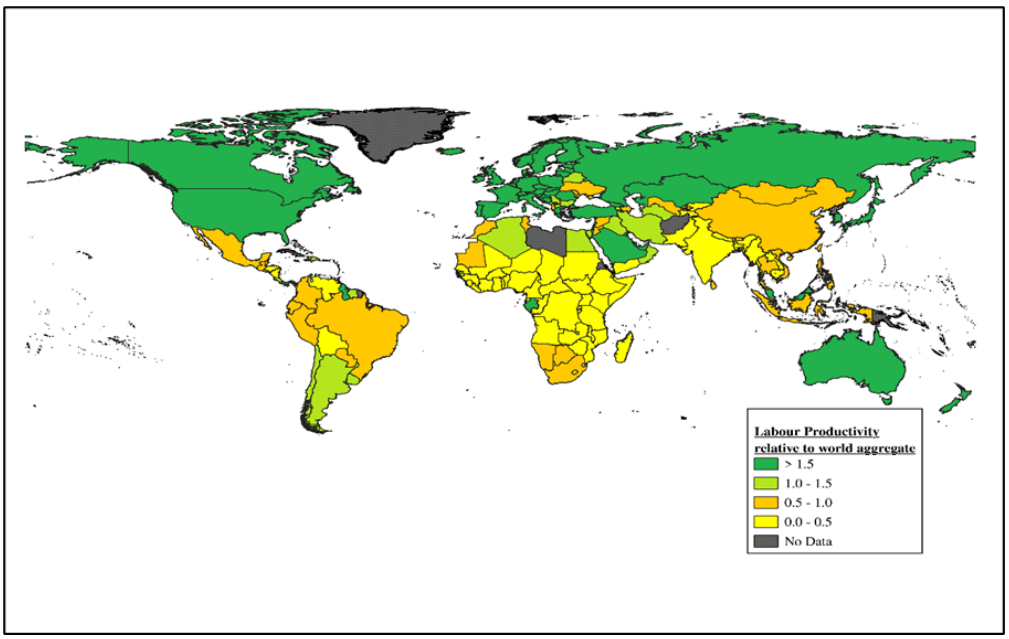
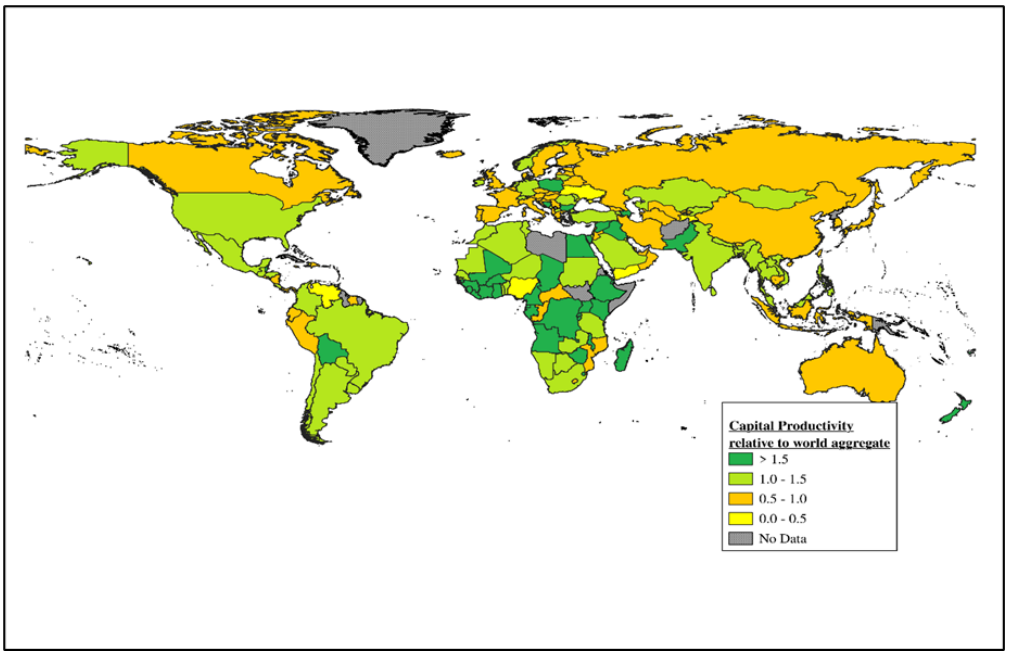


Figure 1B: World Map of Capital Productivity, 2023 (Relative to global aggregate)



The features of Table 1 are brought out clearly by the global maps in Figure 1A (Labour Productivity) and Figure 1B (Capital Productivity). Much of North America, Europe, Australia, and New Zealand are shown in green (higher labour productivity) and much of Sub-Saharan Africa, South Asia and China appear in yellow or grey recording lower labour productivity than the global average. The picture changes completely as we move to Figure 1B (Capital Productivity). Capital and technology are much more mobile between countries than labour and this may partly explain the sharp divergence between the two maps.

Figure 2A: Labour Productivity, 2023-24 (Relative to all-India aggregate)

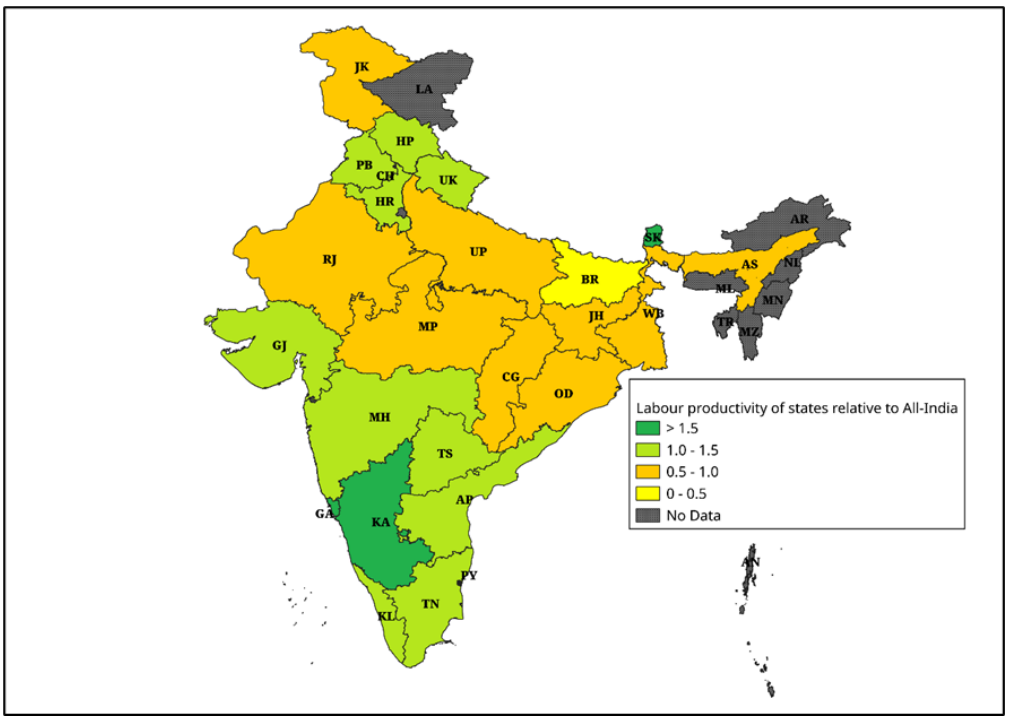
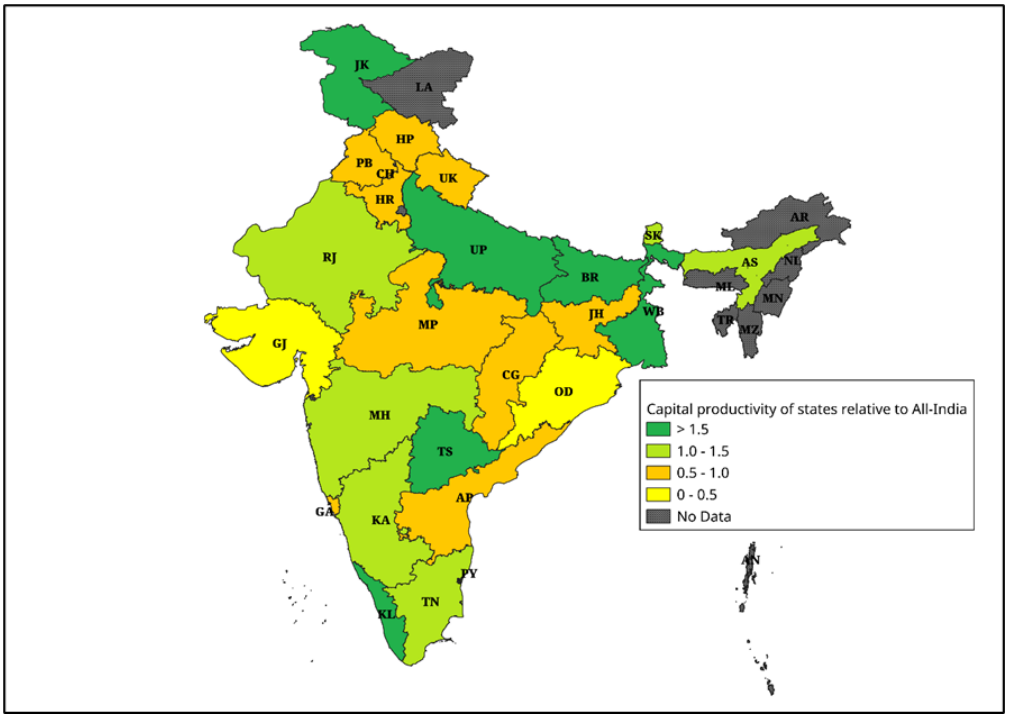


Figure 2B: Capital Productivity, 2023-24 (Relative to all-India aggregate)



Closer to home, Figures 2A (Labour Productivity) and 2B (Capital Productivity) present the corresponding maps for India. Besides recording the spatial heterogeneity in productivity within the country, Figure 2A shows the relatively higher relative labour productivity in the southern states (relative to the all-India average), and the reverse for the northern states, which is consistent with the remarks of Drèze, Sen and other economists on the economic divide between the two halves of India. Unlike the global maps, the two productivity maps do not change much for India. This shows that India's achievement of joining an elite group of countries on the size of its overall GDP ignores the spatial variation of its subnational SDPs, making countrywide statements based on aggregate GDP misleading.

Table 2: Country Group Specific Per-capita Real GDP in 2023: Unadjusted, Emissions Corrected, and Inequality Corrected (In million 2021 US$)

Income group	Emissions index	Inequality index	Per–capita Real GDP	Emissions corrected per–capita real GDP	Inequality corrected per–capita real GDP
High income	1.8209	0.8958	51,060	47,731	5,983
Upper middle income	1.0485	0.9526	19,133	17,332	950
Lower middle income	0.4974	0.9244	7,245	6,110	647
Low income	0.3667	0.9348	2,406	1,776	145
World	**1.1289**	**0.9183**	**26,401**	**24,280**	**3,063**

Table 2 presents the estimates of the Emission Index and of the Inequality Index by the four income subgroups. The estimate of emissions varies significantly across the subgroups with the high income group recording the highest emissions and declining monotonically as we move down the income groups.

In contrast, the inequality index, which also varies across the subgroups with the upper middle income group, recording the highest inequality is not monotonic nor is there any evidence of Kuznets' inverted U-shaped relationship based on per capita GDP. The last two columns are of particular interest as they show the magnitude of downward correction to GDP due to the incorporation of emissions and inequality in the GDP.

The downward revisions are quite evident in Figures 3A and 3B. In both cases, the fitted lines lie below the line of equality, which is the benchmark case of no required correction. The gap between the line of equality and fitted line in inequality corrected GDP is uniformly large. However, the emissions correction to GDP is large for the low income and lower middle income groups but declines as we move up the income ladder with the fitted line asymptotically coinciding with the line of equality for the upper income groups.

Figure 3A: Plot of Emission Corrected Per Capita Real GDP Against Per Capita Real GDP in 2023: Log Scale (In million 2021 US$)

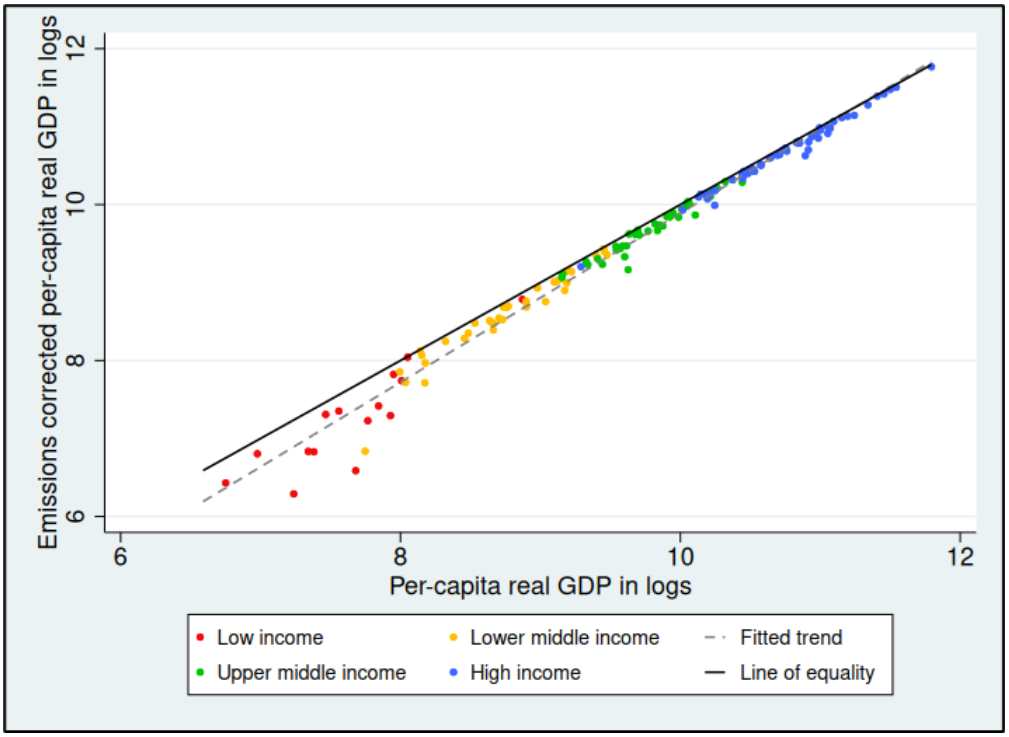
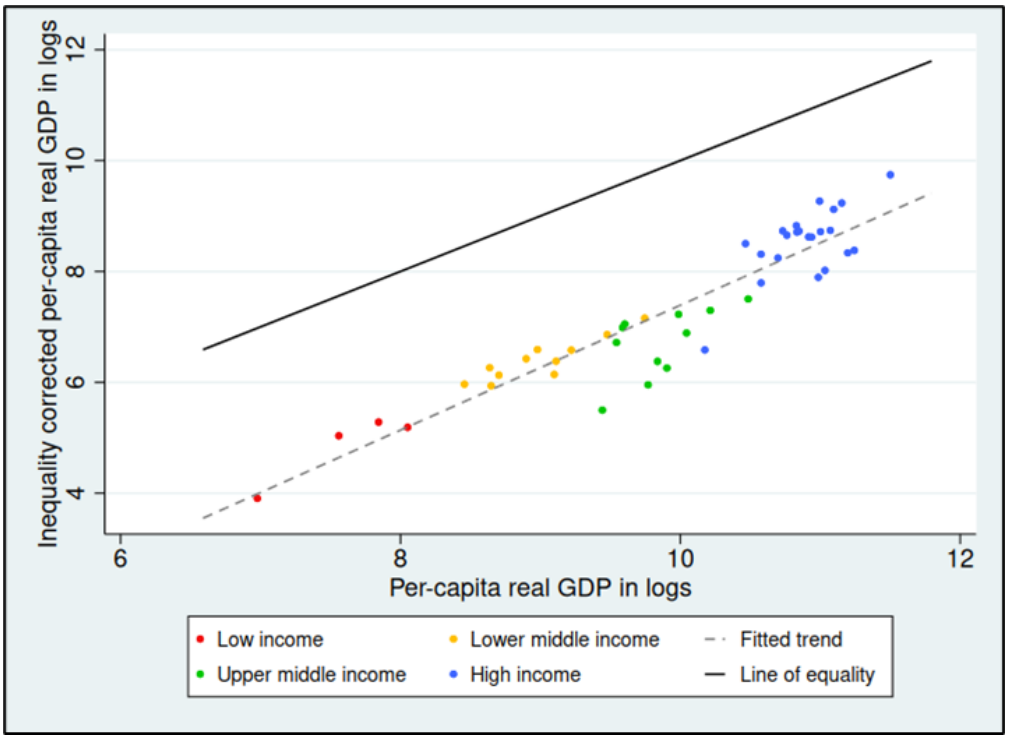


Figure 3B: Plot of Inequality Corrected Per capita Real GDP Against Per capita Real GDP in 2023: Log scale (In million 2021 US$)



Figures 4A and 4B report the relationships of Labour and Capital Productivities (y-axis), respectively, with Emissions Index (x-axis), defined as the ratio of country-level per-capita greenhouse gas emissions and the global average per-capita emissions. Figure 4A shows an inverted-U relationship between Labour Productivity and the Emissions Index, with labour productivity initially increasing as we move up the country income ladder and declining for very affluent countries. The former is due to the use of emissions controlling technology as countries develop. The latter reflects the emissions-induced health shocks in advanced countries that adversely affect labour productivity. In contrast, Figure 4B shows that capital productivity is insensitive to emissions.

Figure 4A: Plot of Labour Productivity against Emissions Index, 2023

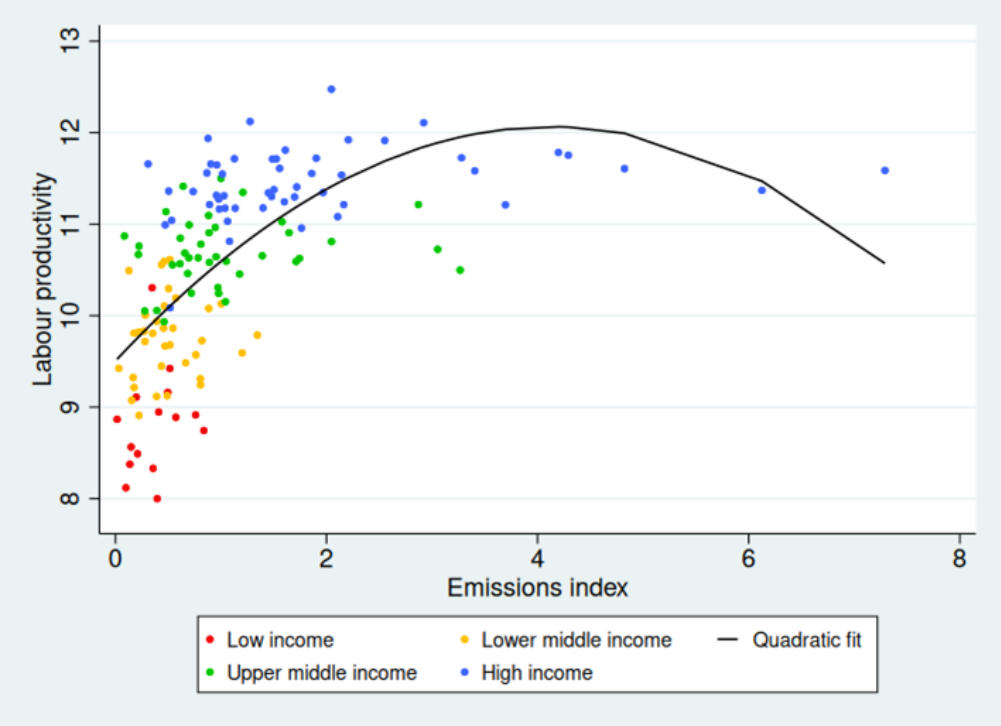
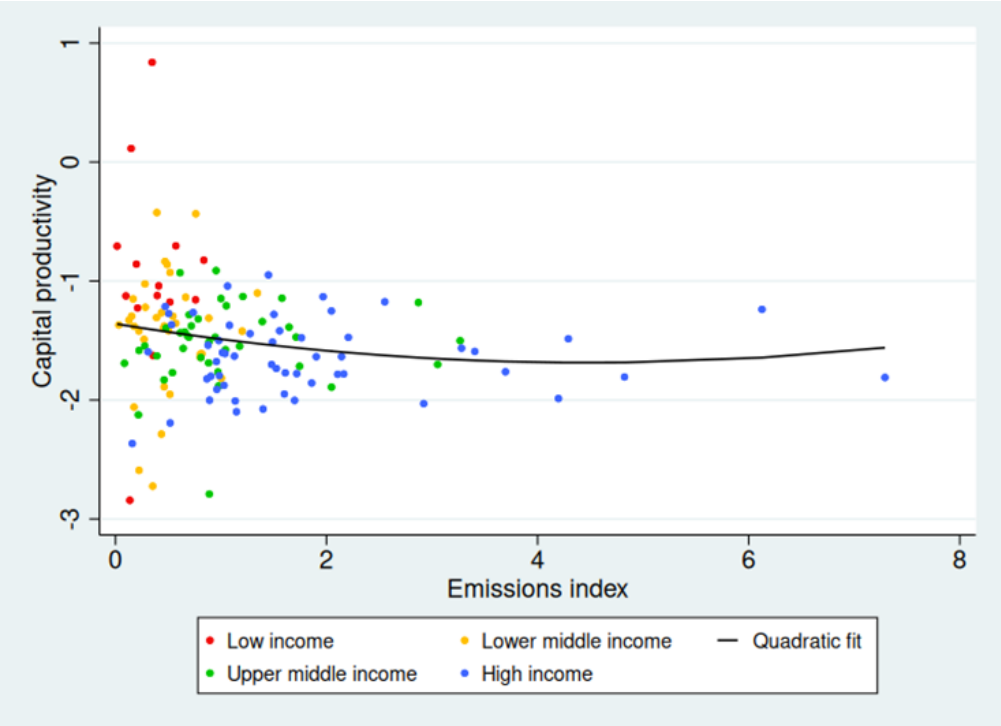


Figure 4B: Plot of Capital Productivity against Emissions Index, 2023



Concluding Remarks

The divergence between the two productivity maps underlines a limitation of GDP that stems from its aggregation of "goods" and "services". This ignores the differentials between the returns to the two components and their recipients. While the returns from "goods" produced in the formal sector are mostly appropriated by capitalists and skilled labour, those from "services" mostly accrue to unskilled labour. A new definition of GDP is called for-one that preserves this distinction, is less "product-based" and more "returns-based", and incorporates emissions and inequality into the measure.

Policy Inferences

First, the higher labour productivity in affluent countries suggests policy initiatives to encourage greater mobility of labour from developing countries, and the reverse for capital.

Second, affluent countries with higher per capita emissions require measures to reduce CO2 emissions; this applies less to poorer countries.

Third, in India, the greater labour productivity in the southern states-associated with their higher levels of literacy and female labour force participation-points to the need to improve these indicators in the laggard northern states.

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