Is Economic Growth Sustainable? Conflicting Signals from International Organisations

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Abstract

There has been widespread debate about whether the way in which we measure economic activity is fit for purpose in the twenty-first century. One aspect to this debate is to move away from measuring a nation's income (GDP), towards monitoring a nation's assets (their inclusive wealth), as a better indicator of sustainable economic development. We provide the first critical comparison of the approaches of leading international organisations – the World Bank and United Nations Environment Programme- to estimating changes in wealth. Our paper reveals important inconsistencies in how these organisations measure sustainability, and the conflicting messages that policy makers receive, despite a common underlying conceptual framework linking changes in a nation's wealth to future well-being. At the most extreme, countries that perform the worst according to the UN are shown to perform well according to the World Bank. This confusion in signals makes better policy making more difficult.

Keywords: Wealth, Sustainability, Natural capital, Sustainable Development

JEL Codes: Q01, Q32, Q56, N50, N10, O13, O44

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1 Introduction

Over the past 50 years there have been increasing debates surrounding the environmental impact of economic growth and its long run sustainability (e.g. Meadows et al. (1972); Rockström et al. (2009); Dearing et al. (2014); IPCC (2022)). This has led to efforts to change how economic progress should be measured, and the implications of increasing economic output for future well-being.

There is a growing consensus towards a move away from thinking about growth of national *income* and instead to focus attention on managing national *wealth* (Polasky et al., 2015; Clark and Harley, 2020). For example, the 2021 *Dasgupta Review on the Economics of Biodiversity* argues, 'in order to judge whether the path of economic development we choose to follow is sustainable, nations need to adopt a system of economic accounts that records an inclusive measure of their wealth'. The World Bank also adheres to this view and in its latest *Changing Wealth of Nations (CWON)* report argues that focusing on the change in wealth per capita could help manage risk and uncertainty, especially in the light of climate change (World Bank, 2021).

This wealth perspective is supported by a well established theoretical framework in the context of measuring wealth for sustainable development. Wealth, referred to as either 'Comprehensive' or 'Inclusive', includes all assets from which people obtain well-being over time, either directly or indirectly (Dasgupta, 2001), thus wealth measures the value of all forms of capital (produced, natural, and human) in a country. Changes in wealth per capita, whether positive or negative, are indicators of sustainable or unsustainable development (Hanley et al., 2015).

The wealth approach has been adopted by major international organisations, namely the World Bank (2006, 2011, 2018, 2021) and the UN Environmental Programme (UNU-IHDP and UNEP, 2012, 2014; UNEP, 2018a). In this note we highlight the pioneering empirical work of both the World Bank and the UNEP but we call for an increased dialogue and reflection on how to measure wealth. We first do this by highlighting the theoretical origins of the wealth framework and then how this has been unevenly applied in practice such that the sustainability signal is confused and/or obscured.

Despite sharing the same theoretical root, the signals about sustainability that countries get from the *application* of wealth concepts by the World Bank and by UNEP differ significantly (as shown in Figure 1). According to the World Bank (2021), over the last 30 years 20 out of 146 countries have experienced negative changes in wealth per person, whereas the UNEP (2018a)'s approach estimates that 45 out of 140 countries experienced negative change in wealth per person.[1] Moreover, there is little cross-over in terms of which specific countries that show

[1] The World Bank period of reference is 1995-2018, while the UN period of reference is 1990-2014. Table 1 shows a comparison of both World Bank and UN estimates across a comparable time period (1995-2014); in that period 17 countries on the World Bank list are reported as negative while the UN reports 44 as negative.

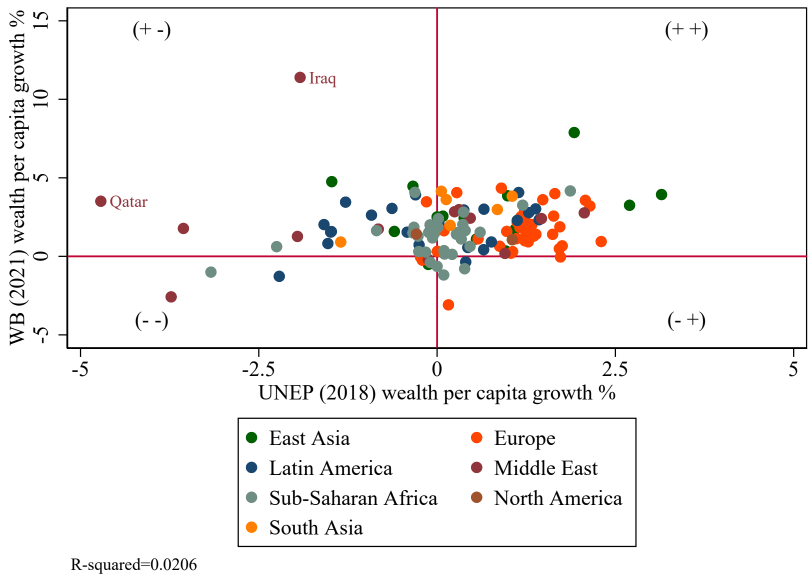

Figure 1: Growth in Wealth per capita

Sources: World Bank (2021); UNEP (2018a,b).

Note: World Bank (2021) reports wealth data for 146 countries from 1995-2018. UNEP (2018a) reports wealth data for 140 countries from 1990-2014. Only 128 countries are reported in both WB and UNEP data, only these data are presented here and only for a comparable period of time (1995-2014)

unsustainable paths (see Figure 1); only 9 of the 45 countries experiencing negative growth in the (UNEP, 2018a) list are in the World Bank (2021) list of unsustainable countries. Not only are the countries different, the signals are quite divergent. For example, the country with the highest negative growth (-4.72 percent per annum) in wealth according to UNEP (2018a) is Qatar, but judging by the World Bank (2021) Qatar's per capita wealth grew by a respectable 3.51 percent per annum.

The World Bank has deemed that *CWON* reports will be 'regular publication that will be updated repeatedly' (World Bank, 2021, p.49). While the latest UNEP (2022) report notes 'The World Bank, the OECD and the World Economic Forum agree. Decision-makers must focus on increasing wealth, and not simply GDP, if they want to ensure well-being in the 21st century.' This note shows that while these bodies may agree in principle, the empirical application differs significantly, producing confusing signals for policy makers. While there are two major international organisations providing estimates of wealth, we find limited evidence of dialogue between both the research teams behind the wealth accounts at both the World Bank and United Nations. For example, Damania et al. (2023), in one of the most recent additions to the World Bank's environment and sustainable development series, states that the *CWON* 'demonstrate that natural capital is in decline' and this provides motivation for the development of new economy-environment models, yet the disparity between estimates of natural capital from the *CWON* and the UNEP (2018a) is omitted in this discussion. As we document in Figure 1 there is no clear cut signal emerging from the work of either institution. Similarly, Yamaguchi et al. (2022), some of the authors of the UNEP (2018a), do not comment on or explain differences between the *CWON* and the UNEP (2018a) report. The major lesson from our paper is for an agreement to standardise wealth accounting, in a similar vein to what is done for national income (i.e., (UN, 2009)) and for reporting bodies to adhere to a standardised accounting framework.

2 Measuring the Economy: past, present, and future

Modern measurement of the economy dates from the mid-twentieth century. Constructed to quantify the monetary value of all goods and services entering into market exchange, Gross Domestic Product (GDP) is regarded as the 'invention of the 20th century' (Coyle, 2017; Masood, 2016). Data to allow the construction of GDP estimates is now standardized world-wide, adding to the utility of this indicator (e.g., (UN, 2009). However, there is a growing recognition that maximizing year on year growth in GDP is unlikely to be an achievable and/or desirable target for the 21st century due to numerous negative consequences, and that *sustainable development* has become the key to global survival (Rockström et al., 2009, 2013; Steffen et al., 2015).

One way GDP is conventionally measured (from the expenditure side of the economy) is from the following accounting identity:

$$GDP = C + I + G + NX \tag{1}$$

Where GDP is the sum of consumption (C), investment (I), Government consumption (G), and net exports (NX).

When constructing GDP estimates, factors that have negative impacts on society (e.g., pollution) are given equal weight to elements that are beneficial for society. In fact, pollution control efforts show up as a benefit to society when they are actually mitigating social costs. The recent IPCC (2021) report includes dire warnings of the dangers of future climate change, which, in the main, has been a direct consequence of following a GDP maximization goal. Unsurprisingly, there is now a growing call including from some of the most respected levels in the economics profession, for changes to be made to how we measure economic activity, economic development and wellbeing more generally (Stiglitz et al., 2009, 2018) and for for greater integration of both economics and sustainable development (Polasky et al., 2019). One avenue in which this is being expressed is through a shift in focus from measuring national income to measuring national wealth.

A well-defined economic theory of sustainability uses wealth as a starting point. For example, see the treatment of the concept in Dasgupta (2001) & Weitzman (2003) where wealth is defined broadly and comprehensively. For Dasgupta (2001) this means defining wealth as 'as the social worth of an economy's entire capital base',[2] while for Weitzman (2003) this means a definition of wealth where 'the underlying ideal is to have the list of capital goods be as comprehensive as possible'.[3]

Dasgupta (2001) expresses an economy's wealth at a specific point in time as:

$$W_t = \sum_i (p_{it} K_{it}) + \sum_j (h_{jt} H_{jt}) + \sum_k (r_{kt} S_{kt}) + \sum_m (q_{mt} Z_{mt}) \tag{2}$$

That is wealth is composed of the value (price x quantity) of different forms of capital; manufactured (K), human (H), natural (S), and knowledge (Z) (Dasgupta, 2001, eq 9.1). While Weitzman (2003) shares this view he defines wealth in a more general way:

$$W_{(t)} \equiv V(K^*_{(t)}) \tag{3}$$

Where K is a composite index of all forms of capital:

$$K = K_i \tag{4}$$

Wealth relates to sustainable development through its relationship with well-being. Specifically, Arrow et al. (2004) defines sustainability as a relationship between between well-being and wealth. Firstly, defining wealth as the present value of future consumption, as in equation 5:

$$V_t = \int_{s=t}^{\infty} U[C_{(s)}] e^{-\delta(s-t)} ds \tag{5}$$

and then by equating well-being and wealth, whereby:

$$V_t = V(K_t) \tag{6}$$

Alternatively, wealth is seen as the foundation of future income and hence welfare, as changes in wealth (saving/investment) provide an indication of the feasibility of future, sustainable, development paths; where sustainable development is defined as non-declining wellbeing over

[2] Arrow et al. (2004), where Dasgupta is second author, define wealth as 'genuine wealth is the accounting value of all capital assets, including population.'

[3] In later work Weitzman (2016) expanded on this definition of wealth as an 'all-encompassing' measure of capital and 'Generally speaking, every possible type of capital ought to be included - to the extent that we know how to measure and evaluate at efficiency prices the associated flow of net investments'.

time for the representative agent (Hanley et al., 2015). In effect, this sees a country's income (e.g., GDP) as effectively a return on its assets (wealth or capital). These assets are comprised of produced, human, and natural capital. The relationship between GDP comes from how economists perceive income to be derived from a production function, which is based on capital stock (physical), as in Solow (1956), and then extended to include natural capital, as in Solow (1974), and other forms of capital.

$$Y_t = f(W_t) \tag{7}$$

Where Y represents income, e.g. income as in equation 1, and W represents wealth along the lines represented in equations 2 and 3.

2.1 Change in wealth and social welfare

As shown in Arrow et al. (2004, 2012), the current change in wealth is equal to the discounted value of social welfare over time, providing a theoretical link between wealth accounting and sustainable development as a concept. Arrow et al. (2004) relate the the change in the capital stock gives an indication of sustainability. Such that:

$$dV/dt = \sum_i (\partial V/\partial K_{it})(dK_{it}/dt) = \sum p_{it} I_{it} \tag{8}$$

where, $\sum \mathrm{p}_{it}\mathrm{I}_{it}$ refers to the 'genuine investment as the change in society's genuine wealth', with p_{it} the shadow price and I_{it} the change in the the capital stock.

Dasgupta (2001) defines how wealth increases, namely if there is net investment in the capital stock, defined as:

$$I_t = \sum_i (p_{it} dK_{it}/d_t) + \sum_j (h_{jt} dH_{it}/d_t) + \sum_k (r_{kt} dS_{kt}/d_t) + \sum_m (q_{mt} dZ_{mt}/d_t) \tag{9}$$

Where I_t measures the 'change in wealth' at time t (Dasgupta, 2001, eq 9.2). Likewise, Weitzman (2003) defines the change in wealth as net investment.

$$I_{i(t)} = \dot{K}_{i(t)}. \tag{10}$$

Here we see a connection between our accounting identity (equation 1) and the change in wealth in equations 8, 9, and 10, this is through investment. However, equations 8, 9 and 10 define investment more broadly.

Before the World Bank began focusing explicitly on wealth estimates it had placed emphasis on a metric that proxied the change in wealth, known as Adjusted Net Savings or 'Genuine

Savings'(GS)[4]. Estimates of GS have been published in the *World Development Indicators* since 1997 (World Bank, 1997) and World Bank estimates for *GS* have been made as far back as the 1970s for some countries (Hamilton and Clemens, 1999).

GS is calculated by the following equation:

$$GS = GNP - C - \delta K - n(\Delta N) - \sigma Pol + m \tag{11}$$

Where Genuine Savings (*GS*) are derived from Gross National Product[5] (GNP) minus consumption (C) (i.e., savings), the depreciation rate of produced capital (δK), the value of resource rents (n(ΔN)), the value of pollution damages (σ Pol), and change in human capital (proxied by education expenditure, *m*). While it may not be immediately apparent, there is a clear relationship between equation 11 and equations 9 and 10. This stems from the theoretical view that equates savings with investment, such as the 'savings-investment identity' as used in Solow (1956). The other aspects of equation 11 are either direct or indirect variants of the elements in equations 9 and 10.

The *CWON 2021* report emphasises the importance of the *change* in wealth per capita (Δw) as an indicator of sustainable development and that Δw provides 'a forward looking indicator of sustainability' (World Bank, 2021, p.28, p. 29). Equation 12 represents *changes* in wealth per capita (with lower case symbols representing division by population) that are derived from *W*.

$$\Delta w = \Delta k_P + \Delta k_N + \Delta k_H + \Delta net_{FA} \tag{12}$$

The main drivers of Δk_P are depreciation (-) and investment (+). The drivers of Δ k_N for nonrenewables are extraction (-), reduction in economic reserves from either a fall in market prices or an increase in extraction costs (-), and increases in economic reserves because of higher prices or lower extraction costs (+). For renewables Δk_N is driven by the rate of net natural growth, minus harvesting (+ or -). For Δk_H this depends on prevailing wage rates, education levels, and labour force growth (population growth and net migration).

While *GS* is seen as a complementary indicator to Δw and has 'the advantage of being easy to understand'. This is drawn from the earlier work of Hamilton and Clemens (1999) that showed how positive/negative *GS* implies sustainable/unsustainable paths.[6] However, *GS* is criticised for only providing a partial view of how wealth changes (World Bank, 2021, p.51). The *CWON 2021* states that the 'preferred measure of sustainability is the change in total wealth per capita' (World Bank, 2021, p.54). Although empirical evidence to support this preference is

[4]Although it may also be referred to as "Genuine Investment" as in Arrow et al. (2004)

[5]The distinction between Gross National Product and Gross Domestic Product presented in Equation 1 is that GNP is GDP + net overseas income.

[6]However, this simple interpretation is not without challenge (Pezzey, 2004).

not provided, whereas there is now a large body of work providing evidence that GS is a good predictor of future well-being (Ferreira and Vincent, 2005; Ferreira et al., 2008; Hamilton and Hartwick, 2005; Greasley et al., 2014).

Conceptually, this new metric (Δw) is not dissimilar from GS. Each aspect that drives the change in wealth in equation 12 is represented in equation 11. Notable differences are capital gains and the discovery of new resources, although it is possible to include capital gains (Rubio, 2004; Pezzey et al., 2006) and resource discoveries (Qasim et al., 2020) in GS estimates.

One of the main reasons for giving the change in wealth per capita preferential treatment is because it takes account of population growth. However, one of the misconceptions of the report is that *GS* does not do this. This is an incorrect assertion. In World Bank publications *GS* is traditionally presented as a percentage of GNI or GDP for cross-country comparability, but it is straightforward to present savings in per capita terms (GS/Population) using information provided in the World Bank (2022b). In fact, this is the approach in the existing academic literature where the metric analysed is a per capita measure of *GS* (Ferreira and Vincent, 2005; Ferreira et al., 2008; Greasley et al., 2014; Asheim et al., 2023).

3 Measuring wealth and the change in wealth

While there are thus strong theoretical foundations underpinning the wealth concepts, these assume comprehensive coverage of capital goods and complete national income accounting (Weitzman, 2003, p.211-212). These assumptions are tested in the real world, where approximating the idealised view of capital is more complicated.

The World Bank has been at the vanguard in the push for a shift in focus from income to wealth and has published influential reports on the *Wealth of Nations* since 2006 (World Bank, 2006, 2011, 2018, 2021). The *CWON 2021* report estimates wealth (W), *changes* in wealth (ΔW), and changes in wealth per capita (Δw), for 146 countries over the period 1995 to 2018 (World Bank, 2021).[7]

The UNEP is another international organisation that has been pioneering the development of wealth accounts. The UNEP has published these estimates since 2012 (UNU-IHDP and UNEP, 2012, 2014; UNEP, 2018a), with a recently updated version scheduled for release. The coverage of UNEP (2018a,b) provide estimates of wealth from 1990 to 2014. UNEP draw explicitly on the wealth framework above reproducing equations 5 and 8 (UNEP, 2018a, p.3).

[7] The main distinction between the World Bank's earlier work World Bank (2006, 2011) and its recent work World Bank (2018, 2021) is a methodological change in how total wealth was constructed. In the former reports wealth was estimated using a top down approach based on discounted value of consumption (World Bank, 2006, 2011), in the latter it is based on the aggregation of capital stocks in purchasing power parity (PPP) dollars (World Bank, 2018, 2021). In the latest *CWON* there are additions to what is measured in natural capital and these are retrospectively included in measures of natural capital back to 1995.

The conceptual distinction between *W* and *GS* is that *W* (equations 2 & 3) measures the aggregate stock of wealth and *GS* (equation 11) measures changes in wealth, but not wealth directly. The main methodological differences between the UN and World Bank measures of *W* and the World Bank's measure of *GS* are highlighted in Table 1. For the most part the concepts are similar as they are derived from the same underlying system of national accounts. In terms of K_P, the stock of capital represents the accumulated value of all investment in produced capital minus depreciation; which is similar to net savings (gross savings minus depreciation) in *GS*.

For K_N, the distinction primarily relates to what elements of K_N are measured and how they are valued. The monetary valuation of K_N is based on the discounted stream of expected future earnings (World Bank, 2021, p. 46), this is done directly for commercial K_N and indirectly for non-monetised (or rather non-traded) forms of K_N such as some ecosystem services. *GS* by contrast only focuses on commercial aspects of ΔK_N and does not take resource discovery (nonrenewables) or net natural growth (renewables) into consideration. K_H is measured using discounted life time earnings in W, while in *GS* the ΔK_H is proxied by current education spending.

Pollution, is treated differently in both. In *W* it is only included indirectly in terms of the impact it has on the depreciation of the various forms of capital. UNEP (2018a) include carbon damages as an adjustment to the benchmark *W* estimate. While in *GS* both particulate damage and CO_2 damages are included, the latter through health impacts. Given the ongoing climate crisis (IPCC, 2021), motivation for the inclusion of pollution more explicitly is compelling. Here both *W* and *GS* overlook recent advances in the academic literature. For example, McGrath et al. (2021) show how World Bank *GS* estimates are very sensitive to the inclusion of pollutants and this inclusion places many countries on unsustainable growth paths. Likewise, Pezzey and Burke (2014) show how changing the price of CO_2 can align global *GS* with ecological indicators.

Finally, only the UN estimates of *W* include an adjustment to the benchmark estimates to includes a measure of technological change (i.e. Z from Equation 2). The theoretical literature deems technological progress to be an integral aspect of sustainability (Weitzman, 1997, 1999). Also, empirical studies attribute the poor predictive capabilities of the *GS* metric for high-income countries to the absence of a measure of technological progress (Ferreira and Vincent, 2005). Other estimates of *W* and *GS* do incorporate measures of technological progress (Pezzey et al., 2006; Greasley et al., 2014; McLaughlin et al., 2014). Therefore, incorporation of technological progress is an important omission in both the World Bank's estimates of *W* and *GS*.

Table 1: Distinction between Wealths and change in wealth (Genuine Savings)

	Comprehensive	Inclusive	GS
K_P [ΔK_P]	perpetual inventory method (machinery, buildings, equipment, intangible wealth & mineral exploration, urban land)	perpetual inventory method (machinery, buildings equipment, intangible wealth & mineral exploration, urban land)	Gross savings minus depreciation
K_N [ΔK_N]	**Nonrenewables**		
	Discounted Earnings (fossil fuels & minerals)	Stock * Shadow Price (fossil fuels & minerals)	Resource rents (fossil fuels & minerals; only depletion, not discoveries)
	Renewables		
	stock * shadow price (timber, agricultural land protected areas, mangroves & marine fisheries)	stock * shadow price (timber, agricultural land)	price * extraction (only depletion not net natural growth)
K_H [ΔK_H]:	Discounted value of life time earnings of the working population	Based on returns to education, using population educational attainment	Current spending on education
Net_{FA}	Sum of external assets & liabilities	-	Included in Gross savings
Pollution damages	Direct(excluded) Indirect (depreciation of produced & natural capital)	Direct (Carbon damages)	Particulate damage & CO2 emissions
Adjustment Adjustment		Total Factor Productivity Carbon damage Oil Capital Gains	

Sources: World Bank (2021); UNEP (2018a); Yamaguchi et al. (2019); Hamilton and Clemens (1999); Bolt et al. (2002)

4 Comparing measurement

Comparison of the change in wealth per capita (Δw) from both the World Bank and UN, as well as *GS* is shown in Table 2.[8] The coverage of Δw from the UN and World Bank differs, the former begins in 1990 and ends in 2014, while the latter starts in 1995 and ends in 2018. So while combined they provide estimates of wealth from 1990 to 2018, they only overlap for a shorter window of time (1995 to 2014).[9] Thus, any comparison of the metrics needs to focus on this overlapping window. In terms of data availability, coverage over time is one current advantage of *GS* as World Bank estimates extend back to 1970 for most countries (Hamilton and Clemens, 1999).[10]

The signal from the ΔW also differs from *GS*. Only 4 countries experienced negative ΔW and 20 countries experienced negative Δw, primarily driven by high population growth. In contrast, *GS* signals an unsustainable path for 34 countries. This is an important distinction for policymakers: What is the message for sustainable development if during the last 23 years only four countries have decreased their *W*? Does this imply that the current path is sustainable? Given that all 3 measures are based on the same underlying theory, why are the sustainability signals so different?

Figure 2 and Table 3 illustrate the correlation between the different measures of the Δw. They show how they vary by region and income classification. The World Bank and UN measures of Δw show strongest correlation in South Asia and for low income groups. GS has a higher correlation with the World Bank's measure of Δw and this is strongest in the Middle East and South Asia and for Low and Low and middle income countries. This contrasts somewhat with the UN's measure of Δw which has negative correlation in the Middle East and in High income countries. Overall, it appears that there is more alignment between the two metrics produced by the World Bank (Δw & GS) than when comparing the metrics produced by the UN and the World Bank.

At a glance, the correlation coefficients appear to suggest that the natural resource dependence may be a driver of the conflicting findings. Table 4 attempts to address this by incorporating measures of resource rents in regression analyses. Oil rents in particular have differing impacts on the growth of wealth per capita in the World Bank and UN measures of wealth per capita, but the impacts appear to be low.

[8]The comparisons are of benchmark estimates and do not include the adjustments made in UNEP (2018a).

[9]There are also three historical estimates of comprehensive wealth. These are for Britain from 1760-2000 (McLaughlin et al., 2014), an estimate for Sweden from 1850-2010 (Lindmark and Andersson, 2016), and an estimate for India from 1975-2013 (Agarwal and Sawhney, 2021). Although, only McLaughlin et al. (2014) is a comparison of the UN (2014) and World Bank (2011) methodologies.

[10]In fact, recent research has extended these measures as far back as the 1750s for Britain and the 1800s for other countries using comparable data (Rubio, 2004; Lindmark and Acar, 2013; Greasley et al., 2014; Hanley et al., 2015; Blum et al., 2017; McLaughlin et al., 2023).

Table 2: Comparison of data coverage

	$\Delta\ w$		
	UN (2018)	WB (2021)	GS
	Number of countries		
Time coverage	1995-2014	1995-2014	1995-2014
Number of countries	140	146	156
	Income group		
Low	18	20	20
Lower-middle	39	42	48
Upper-Middle	35	39	40
High (non-OECD)	14	13	14
High (OECD)	34	32	34
	Region		
East Asia & Pacific	17	15	21
Europe & Central Asia	40	44	45
Latin America & Caribbean	25	24	24
Sub-Saharan Africa	33	38	40
Middle East & North Africa	16	17	17
North America	2	2	2
South Asia	7	6	7
	Δ W <0 (Reference period: 1995-2014)		
Total number of countries	7	4	37
	Δ w <0 (Reference period: 1995-2014)		
Total number of countries	44	17	-

Note: The comparisons are of benchmark estimates of W & w UNEP (2018b); World Bank (2021) and do not include the adjustments outlined in Table 1. Sources: UNEP (2018b); World Bank (2021, 2022b). Income groups and region classification derived from World Bank (2022a)

While the evidence from Table 4 suggests that it is differences in how natural capital is measured that may drive differences in the growth of wealth per capita, there is still considerable geographic variation. This is further explored in Figure 3 which looks at the growth in the various types of capitals that make up wealth (e.g., as shown in Table 1). Figure 3 purposely uses the same scales across each quadrant and includes R2 of the capital estimates.[11] Unsurprisingly, the closest match is physical capital as both World Bank (2021) and UNEP (2018a) use the same established methodology to measure what is conventionally considered capital. The largest variation is in natural capital growth, but equally problematic is the measurement of human capital. As shown in Table 1, this differences reflects different methodological approaches to valuing human capital, one based on discounted life times earnings and another on returns to education. As natural capital and human capital are large components of wealth in low-income

[11]The final wealth growth index is, in effect, a weighted average of the growth of each capital stock and the country specific weights depend on the share of each capital stock in a country's total wealth of a country.

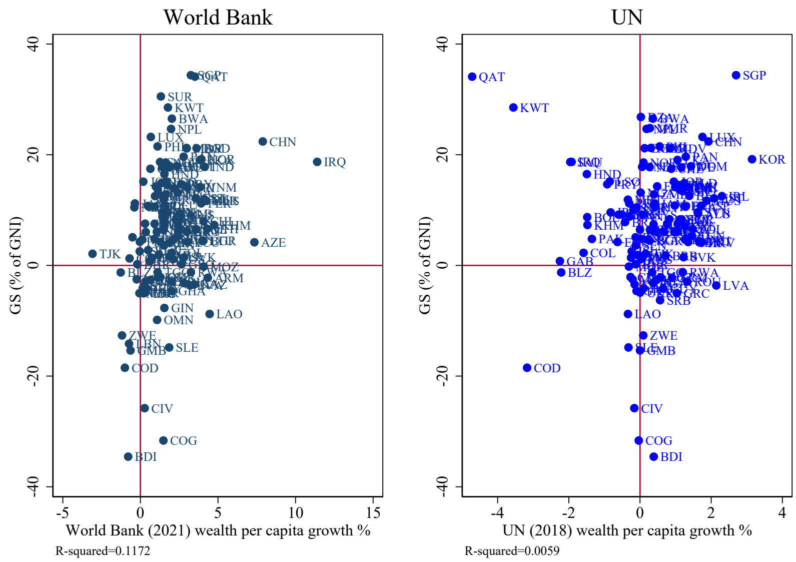

Figure 2: Change in wealth and Genuine Savings

	Δw (WB) & Δ w (UN)	Δw(UN) & GS	Δ w (WB) GS
Overall values	0.144	0.077	0.342
	Geographic Region		
East Asia & Pacific	0.236	0.655	0.295
Europe	0.241	0.358	-0.044
Latin America	0.304	0.277	0.244
Sub-saharan Africa	0.424	0.185	0.409
Middle East	-0.003	-0.693	0.412
North America	-	-	-
South Asia	0.709	0.791	0.543
	Income group		
Low	0.437	0.226	0.472
Lower middle	0.020	0.058	0.425
Upper middle	0.108	0.324	0.284
High	0.233	-0.341	0.227

Table 3: Correlation between indicators of change of wealth (World Bank & United Nations)

and high income countries respectively, this explains the difference in the underlying estimates of the change of wealth. The analysis is further expanded in appendices to this paper, the inconsistencies are also apparent when the measures of wealth are not measured in per capita terms (see Appendix A3).

	(1)	(2)	(3)	(4)	(5)	(6)
	Δ w (WB)	Δ w (UN)	Δ W (*GS*)	Δ w (WB)	Δ w (UN)	Δ W (*GS*)
GDP %	0.66***	0.14***	0.92**	0.61***	0.15***	0.91*
	(0.099)	(0.041)	(0.386)	(0.115)	(0.046)	(0.531)
	Resource Rents (share of GDP)					
Minerals	-0.11	-0.05	0.00	-0.11	-0.05	-0.13
	(0.090)	(0.044)	(0.533)	(0.104)	(0.045)	(0.624)
Coal	0.06	-0.12	0.68***	0.06	-0.13	0.07
	(0.227)	(0.086)	(0.166)	(0.235)	(0.092)	(1.182)
Oil	0.05**	-0.06***	-0.07	0.05*	-0.06***	-0.18
	(0.020)	(0.017)	(0.127)	(0.027)	(0.018)	(0.205)
Gas	-0.02	-0.36**	1.13**	-0.14	-0.42***	0.08
	(0.031)	(0.157)	(0.489)	(0.152)	(0.155)	(1.592)
	Income Classification					
Low	-0.49	-0.69*	-12.19***	-0.66	-0.81*	-18.55***
	(0.491)	(0.380)	(3.917)	(0.560)	(0.472)	(5.964)
Lower-Middle	-0.62	-0.57**	-8.34***	-0.66	-0.66**	-11.34***
	(0.400)	(0.281)	(2.660)	(0.442)	(0.287)	(3.018)
Upper-Middle	0.04	-0.41*	-5.09**	-0.02	-0.45*	-5.68**
	(0.349)	(0.213)	(2.042)	(0.380)	(0.232)	(2.289)
High	Reference Group					
	Regions					
East Asia	0.84**	-0.24	8.25***	0.99**	-0.07	9.51***
& Pacific	(0.364)	(0.302)	(2.495)	(0.401)	(0.332)	(3.215)
Latin America	0.63*	-0.69***	6.24***	0.70*	-0.69***	6.48***
& Caribbean	(0.376)	(0.221)	(2.251)	(0.400)	(0.247)	(2.373)
Middle East	0.54	-0.02	10.22***	0.65	-0.14	16.88***
& North Africa	(0.467)	(0.393)	(3.831)	(0.524)	(0.494)	(5.407)
North America	0.36	-0.52	-0.85	0.37	-0.52	-0.24
	(0.249)	(0.403)	(1.402)	(0.286)	(0.393)	(2.005)
South Asia	1.17**	-0.59*	17.96***	1.26**	-0.65*	18.80***
	(0.453)	(0.318)	(3.224)	(0.509)	(0.329)	(3.338)
Sub-Saharan	0.20	-0.50*	3.33	0.21	-0.44	4.02
Africa	(0.464)	(0.275)	(2.802)	(0.496)	(0.309)	(3.750)
Europe & Central Asia	Reference Group					
Constant	-0.13	1.00***	6.03***	0.01	1.02***	6.45***
	(0.319)	(0.141)	(1.555)	(0.334)	(0.151)	(1.897)
Observations	146	140	161	128	128	120
R-squared	0.59	0.53	0.29	0.54	0.57	0.39

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 4: Regression of changes in wealth, 1995-2014

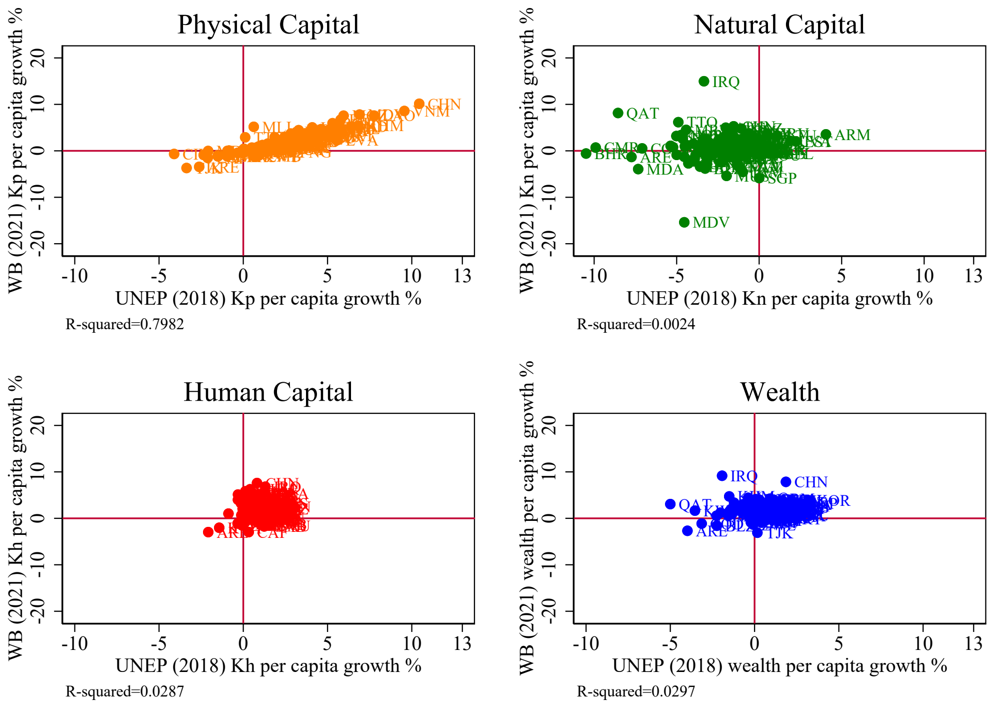

Figure 3: Comparing the Components

4.1 Wealth and GDP growth

Given that wealth has been touted as an additional indicator for conventional measurement of national economy's, an important question is whether the growth in wealth per capita differs from growth in GDP per capita. Does measuring national economic performance using GDP send different signals than measuring the same performance using changes in wealth?

As Figure 4 shows, we find a clear deviation in terms of the relationship between the annual growth rate of wealth from the World Bank and wealth as measured by the UN. For the former, there is a strong positive correlation between both wealth and GDP per capita growth, while for the latter there is no clear relationship between the two. While GS, both including and excluding particulate matter damages, shows a weaker correlation with GDP growth than either the World Bank or UN measure of the change in wealth (see Figure 5).

This is further elaborated in pairwise correlations across regions and income categories, shown in Table 5. The World Bank's measure of wealth is strongly correlated with GDP growth across all regions and all income groups. Whereas, the UN's wealth measure is only strong correlated in South Asia and is highest in the Upper Middle Income and High Income countries. Table 5 also includes Genuine Savings, this too is weakly correlated with GDP growth but shows signs of strong correlation in South Asia and in the low and lower-middle income groups.

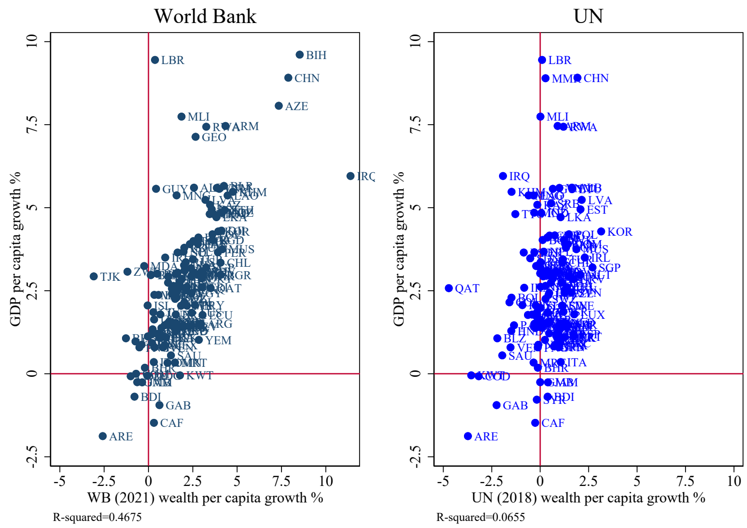

Figure 4: Wealth per capita growth and GDP per capita growth

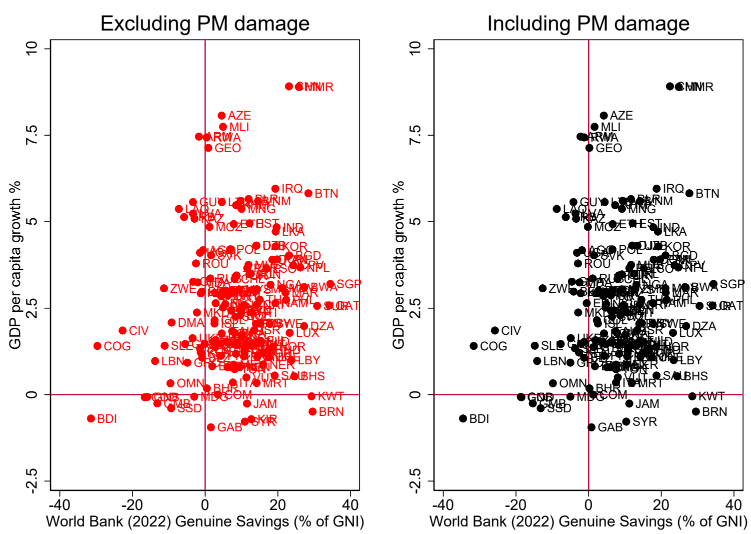

Figure 5: Genuine Savings and GDP per capita growth

	Δw (WB) & GDP%	Δw(UN) & GDP%	GS & GDP%
Overall	0.684	0.256	0.162
	Geographic Region		
East Asia & Pacific	0.897	0.060	0.190
Europe	0.799	0.077	-0.361
Latin America	0.467	0.252	-0.023
Sub-saharan Africa	0.521	0.385	0.400
Middle East & North Africa	0.853	0.247	0.206
North America	-	-	-
South Asia	0.903	0.718	0.770
	Income group		
Low	0.539	0.338	0.467
Lower Middle	0.630	0.099	0.403
Upper Middle	0.740	0.439	-0.059
High	0.836	0.441	-0.133

Table 5: Correlation between indicators of change of wealth (World Bank & United Nations) and GDP growth

5 Discussion

We have argued above that both the World Bank and the United Nations have recognised the importance of wealth-based indicators of sustainable economic development. However, it is clear that both international organisations are doing wealth differently. We sought to understand what is driving these differences and if this is a problem.

The World Bank *CWON 2021* report argues that the change in wealth per capita is a good predictor of future sustainability. However, the sustainability signal from this metric differs significantly from the UN's measure of Δw and *GS* over the same period, which in turn offers a more optimistic view of the future than the work of scholars emphasising 'Planetary Boundaries' (Steffen et al., 2015) or the prognosis of the IPCC (2021).

While the World Bank efforts are admirable for collating data for 146 countries there is an element of superficiality to this exercise. As Lange and Naikal note 'given the need to harmonize data across countries, the wealth accounts for any country are unlikely to be as accurate as the accounts that the country might construct itself using its own, more accurate and comprehensive data sources' (World Bank, 2021, p.46). Therefore future work is needed to create an agreed set of definitions of what should/should not be included in such wealth accounts in order for countries to build upon this body of work. Moreover, wider efforts beyond the WB in gathering and estimating *GS* must be taken into account.

While there are agreed international standards for measuring GDP, and agreed international standards for measuring natural capital (e.g. the UN System of Environmental-Economic

Accounts (UN, 2014)), there is no international convention on how to measure or report wealth-based indicators of sustainable development and national economic performance. We echo calls for further and consistent incorporation of SEEA accounts into wealth measurements to narrow the gap between the measures of wealth (Hamilton, 2016). However, as shown above, estimating human capital is equally problematic and an agreed framework is necessary in order to fully incorporate this important aspect of capital into estimates of wealth.

One possible reason that different practices might have emerged is that there are conflicting objectives of organisations promoting wealth research. The World Bank is part of the so-called 'Washington Consensus', with a different organisational structure that is controlled by western funding nations. Whereas the United Nations is part of the so-called 'New York Dissent' with a more democratically determined mandate. The different goals of each institution could be a factor driving the divergence in the sustainability message. Perhaps the differences in wealth estimates are a manifestation of the institutional preferences of each organisation

6 Conclusion

There have been calls to replace how we measure national economic activity, in a way which recognises the challenges to long-term sustainable development. The World Bank and the UNEP have been in the vanguard in efforts to change how we measure economic progress. However, there is an urgent call to increase dialogue between stakeholders about how we account for wealth. Different assumptions lead to very different outcomes and signals from these measures. We have illustrated the lack of coherence between the research programmes of both organisations, and the conflicting international signals on sustainability which result. These differences in estimated wealth do not help in the replacement, or complementarity, of GDP debates. Future work needs to acknowledge these discrepancies and come to agreed standardisation in order for the concept to be used in any meaningful way. Reaching consensus on how changes in natural and human capital are measured seem to be key to resolving this problem.

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Appendices

A1 Figures by Region and Income Group

Figure 6 replicates Figure 1 from the main text but breaks the regions into separate graphs. It is clear from this figure that the Middle East & North Africa is one of the most troublesome in respect to conflicting signals from these metrics.

Figure 7 presents the data from Figure 1 broken into income groups. These are presented as separate income groups in Figure 8. Figures 6 and 8 corroborates the findings about regional and income differences reported in Table 4 in the main text.

A.2 Growth rates: Averages and end points

As noted in the main text, there is a difference in the data availability from both World Bank (2021) and UNEP (2018a,b).

The World Bank's *CWON* provides annual data from 1995 to 2018, whereas UNEP (2018b) provides data at a quinquennial intervals. Throughout the main text we use average annual growth rates, In this section, we illustrate the same figures as the text using endpoints to calculate growth rates. Firstly, Figure 9 replicates Figure 1 using endpoints to calculate growth rates using a geometric growth rates:

$$Growth\% = ((W_{t+1}/W_t)^{(1/n)}) - 1) \tag{13}$$

In Figure 10 we illustrate wealth per capita growth rates across sub-periods. Surprisingly, of the four time periods presented, the period furthest back in time (1995-2000) shows the greatest correlation (correlation coefficient of 0.374) while the most recent period (2010-2014) has the weakest correlation (correlation coefficient of 0.064).

A3: Comparison of Total Wealth

The main text presented all wealth figures as *per capita* growth rates. As Table 1 illustrated, there was a difference between the countries reporting $\Delta W<0$ and $\Delta w<0$. Therefore, distortions may arise from the treatment of population growth. This section looks at the growth in the total wealth and the component series.

Firstly, Figure 11 presents growth in total wealth for both series. While there are fewer countries displaying negative growth, there is considerably variation in the wealth estimates and the reported R-squared is quite low. The correlation coefficient is 0.285, which is higher than the correlation coefficient of 0.144 reported in Table 3.

Figure 12 shows growth rates by sub-period, this should be read in conjunction with Figure 10. While the figures 12 report slightly higher R-squared than in Figure 10, these are still quite low. Again, correlation is strongest in the period 1995-2000 (correlation coefficient of 0.327) with the weakest correlation is for the period 2000 to 2005 (correlation coefficient 0.110).

Figure 13 replicates Figure 3 from the main text, again we see strong correlation in the two estimates of physical capital but the major discrepancies are in terms of the estimates of natural

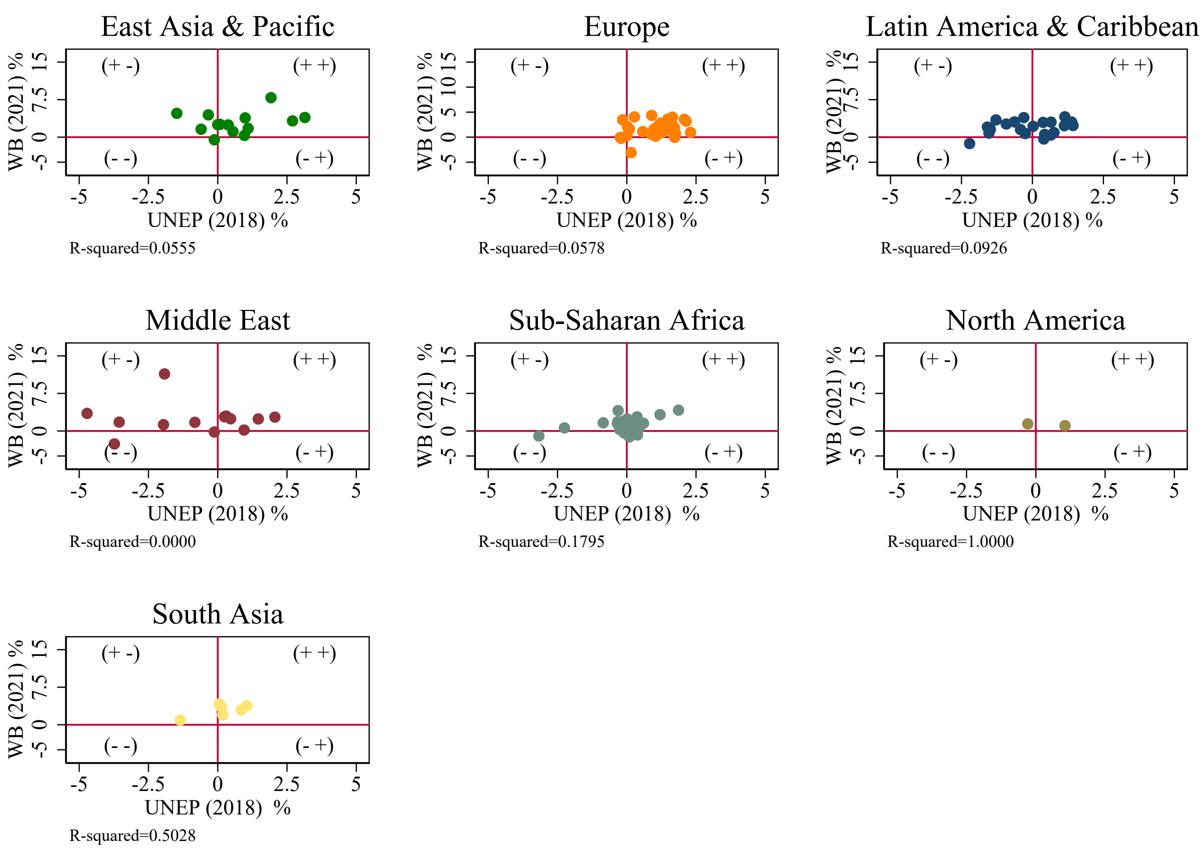

Figure 6: Growth in Wealth per capita by region

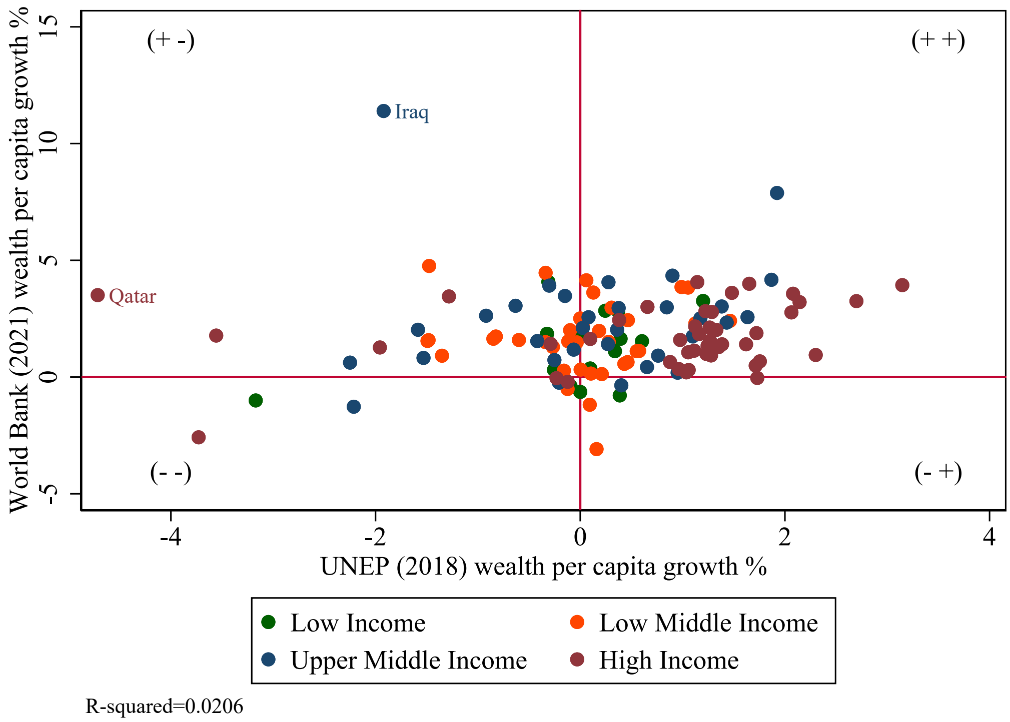

Figure 7: Growth in Wealth per capita by income classification

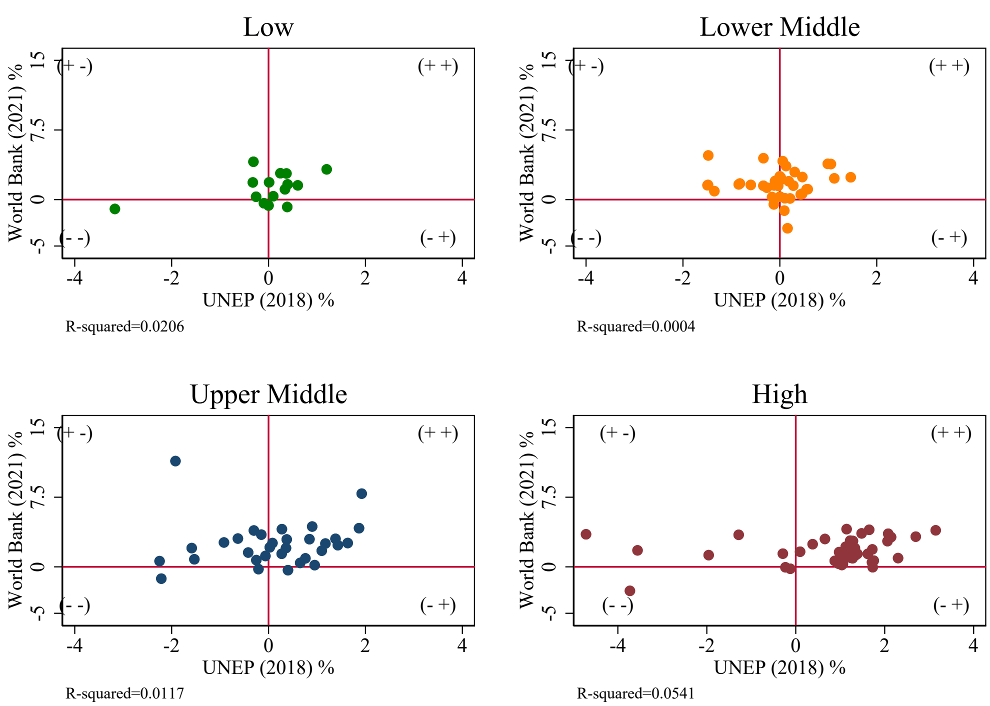

Figure 8: Growth in Wealth per capita by income classification

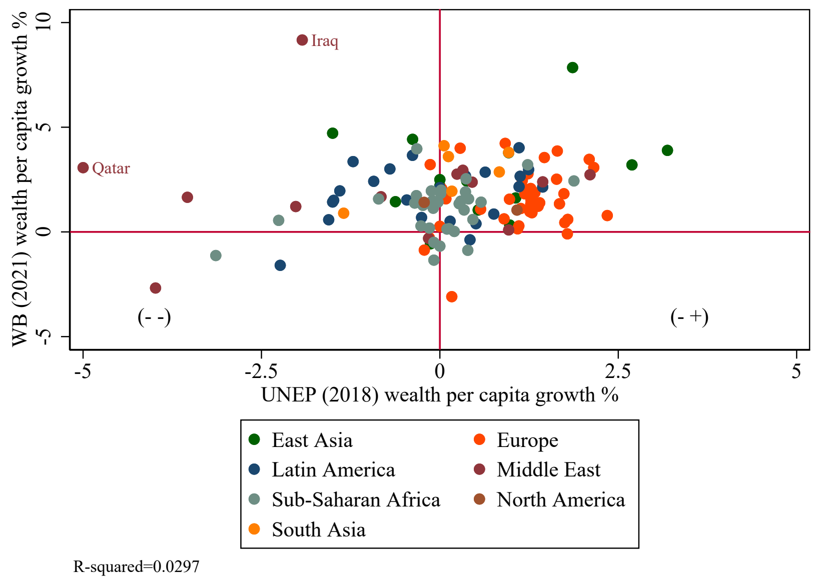

Figure 9: Growth in Wealth per capita (growth rates using end points)

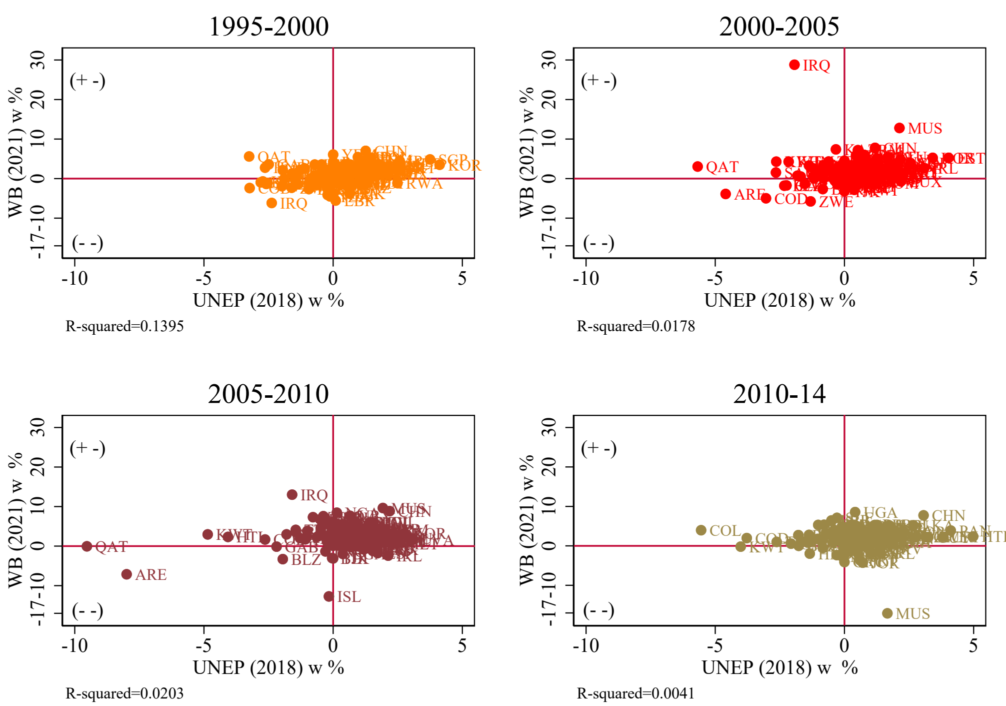

Figure 10: Growth rate in Wealth per capita by sub-period, 1995-2014

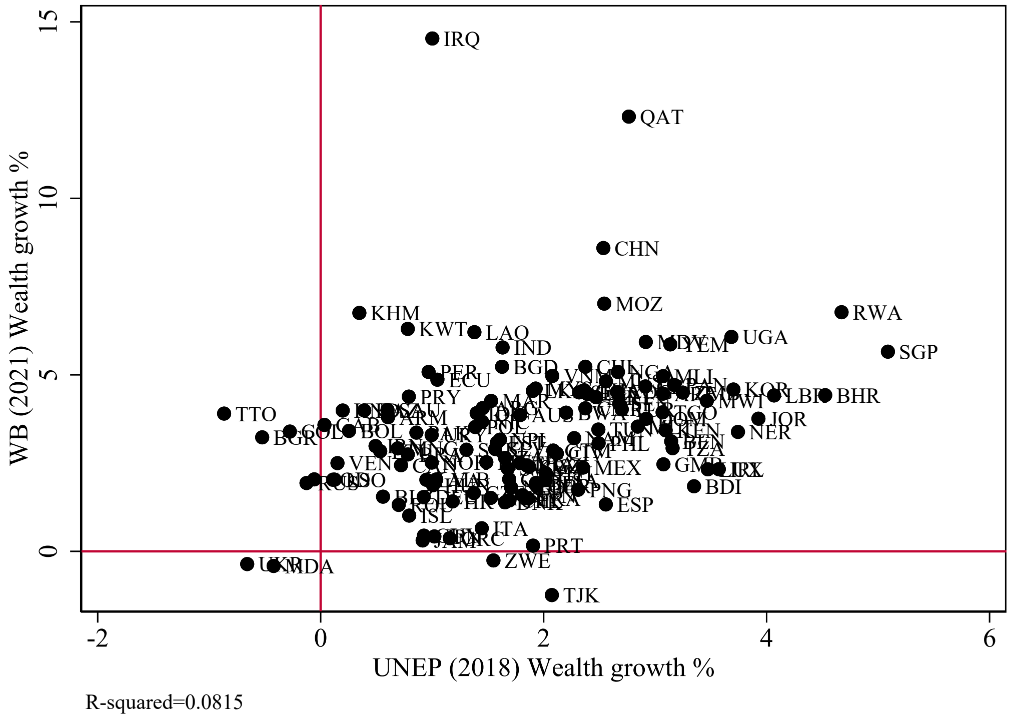

Figure 11: Wealth growth %, 1995-2014

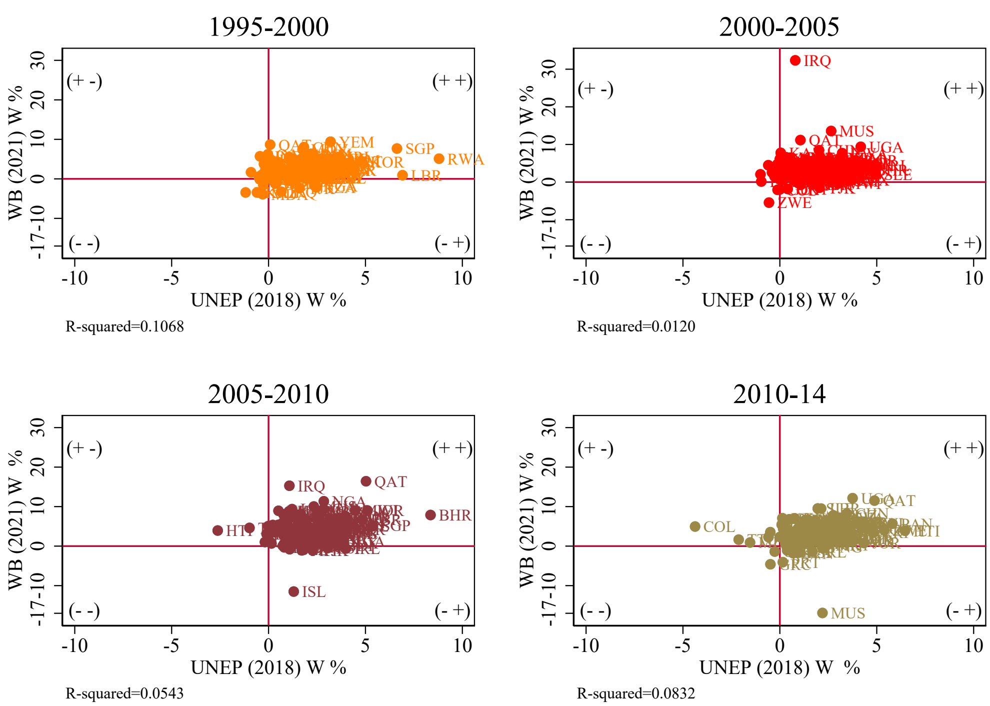

Figure 12: Wealth growth % by subperiods, 1995-2014

capital (correlation coefficient of -0.05) but less so for human capital (correlation coefficient of 0.429).

A.4 Comparison between different price deflators

A final point relates to how exactly should the series should be deflated. In essence the answer to this question depends on why we are deflating. If the view is that wealth is essentially a proxy for well-being then a CPI index might be more appropriate, or if we see wealth as the foundation for future income generation than a GDP deflator might be more useful (Inklaar et al., 2023).

Whatever the purpose, while not identical, the CPI & GDP deflators provide good approximations for the other, as shown in figure 14. This is reassuring as both the World Bank (2021) and UNEP (2018a) use GDP deflators.

A.5 Comparison between different GDP deflators

Could the divergence be due to how inflation is treated by the respective research groups? World Bank (2022a) reports wealth in constant 2018 US dollars while UNEP (2018a) are reported in "million US dollars, 2005". The World Bank research team outline how 'a country specific GDP deflator is used for all natural capital components to bring the nominal values to constant 2018 US dollars at market exchange rates.' However, it is unclear what deflator was used by the UNEP research team. UN data reports implicit price deflators in national currencies and in US dollars (UN, 2023). If it is the former, then it is almost identical to what is used in the *CWON*, if it is the latter there would be a significant divergence.

To illustrate this point, Figure 15, compares the different GDP deflators for the period 1995-2014 available on the World Bank (2022b) and UN (2023). While a slight difference in methodology for the World Bank (2022b) series in terms of GDP deflators. Series 'NY.GDP.DEFL.ZS', states it is a 'GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency'. Whereas series 'NY.GDP.DEFL.KD.ZG.AD' states that 'this series has been linked to produce a consistent time series to counteract breaks in series over time due to changes in base years, source data and methodologies'. Figure 16 compares the deflators from the respective institutional databases. When they are national currency deflators there is a tight correlation, however when the methodology is a USD deflator this leads to divergent results.

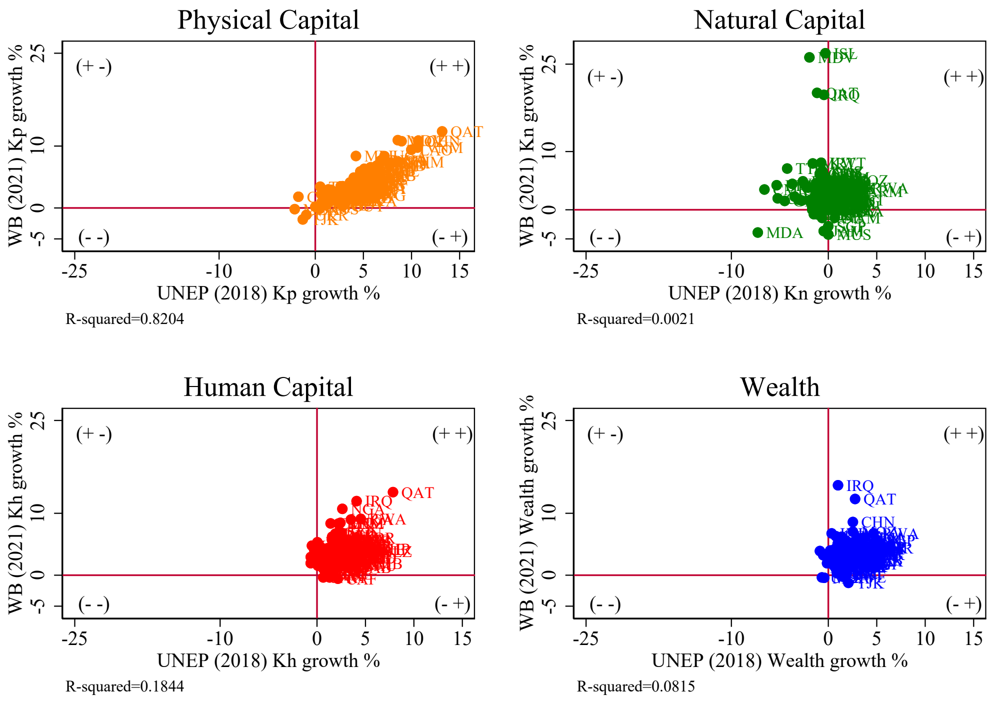

Figure 13: Wealth growth by components %

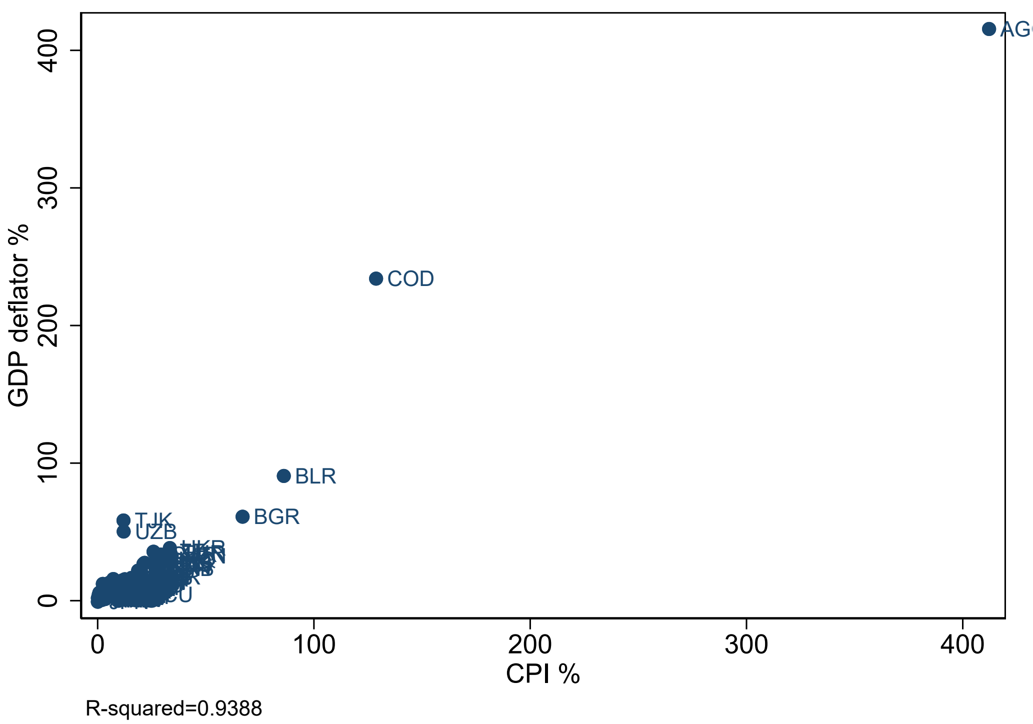

Figure 14: Comparing inflation measures, GDP deflators and CPI (1995-2014)

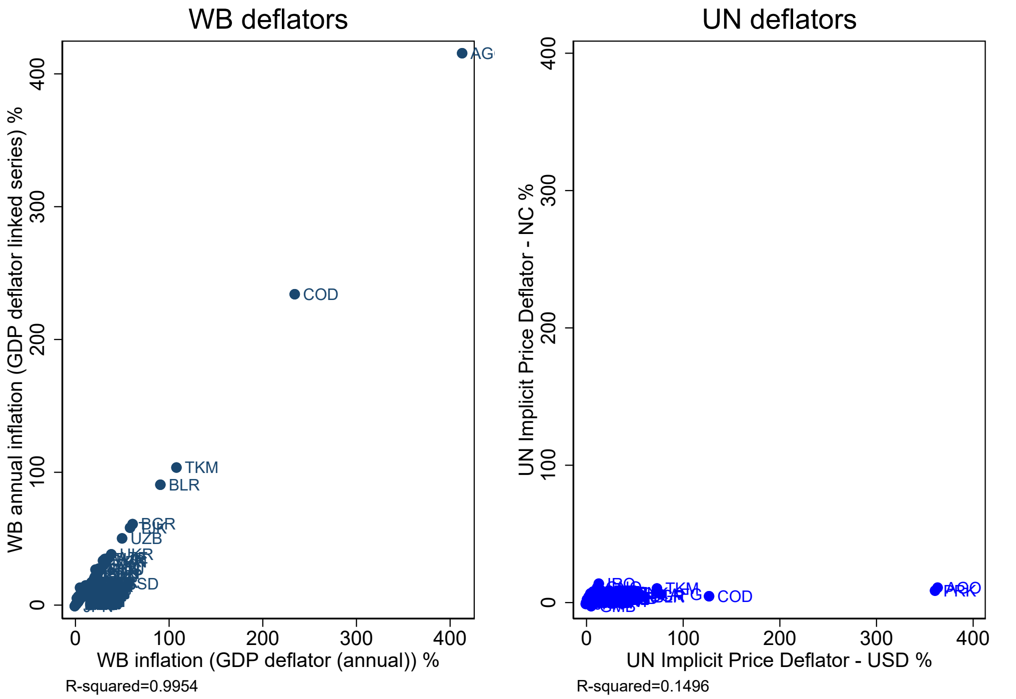

Figure 15: Different GDP deflators from World Bank and UN databases

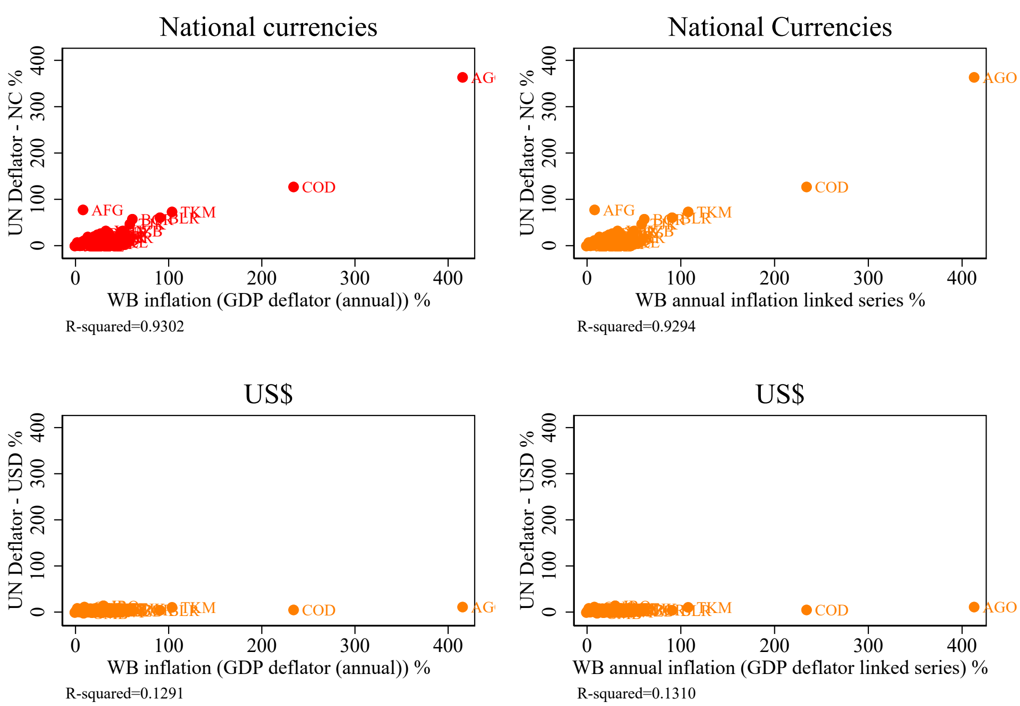

Figure 16: Different GDP deflators