The Impact of Changing GDP Accounting Conventions on Evidence for Decoupling

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Introduction

The problem of decoupling economic activity from resources, energy and pollution exercises many minds. For good reasons. The feasibility of relative and ultimately absolute decoupling determines whether the current global mode of social provisioning and reproduction couched around expansion of economic value can continue for the next decades and centuries. Rate, time of onset and persistence of decoupling are important for aggregate models of the economy and the environment. They are also at the heart of the green growth, circular economy, environmental Kuznets curve and the broader 'sustainability' debates. However, while the numerator of intensity measures has been subjected to close scrutiny and led to competing intensity and decoupling measures to assess environment impact of economic activity (e.g. whether to use territorial or consumption-based or 'footprint' indicators), the denominator of the intensity, gross domestic product (GDP), has received comparatively little attention.

But GDP is an accounting convention. Its measurement depends on social agreement, not on natural constants. If anything, it is more susceptible to variation than the physically measurable quantities that make up the numerator of decoupling measures. National accounting practice leads to frequent structural revisions, and this has been shown to have impacted retrospective business cycle analysis (Croushore and Stark, RESTAT, 2003). International comparisons are additionally affected by purchasing power parity (PPP) conventions that update with every International Comparison Program round and Penn World Table/World Bank revision.

In this paper, I analyze variation in decoupling evidence due to GDP redefinitions systematically. I collect a variety of GDP vintages for the US and for most countries, and the world and I combine these with data on primary energy for most countries for the period 1950-2014 to examine changes in the count of countries that decouple or recouple in a given time interval contingent on data vintage used. I also re-estimate the models in Grossman and Kruger's (QJE, 1995) seminal paper on the environmental Kuznets curve with later GDP vintages to check what a retrospective analysis would yield. Finally I examine how the IEA's global energy intensity rate of decline has changed in a span of 8 years for the period 1971-2010.

I contribute to the debate about decoupling (e.g. van Benthem, JAERE, 2015; Parry, Mylonas and Vernon, JAERE, 2021) by showing that results are, to some extent, contingent on data vintage used. While that may be consistent with the changing practice of GDP definitions, it is unclear whether the modelers and users are aware of this contingency, and whether models are updated consistently. To advance insight, debate and scenario modeling, rigorous reporting of GDP definitions, vintage, and the sharing of data for subsequent comparison and replication, is needed.

Data & Methods

I collect vintages of GDP for the US going back to the 1950s using archival material from the Bureau of Economic Analysis and for most countries going back to the 1990s using national accounts supplements from Penn World Table vintages. I also collect global GDP estimates from the last 8 editions of the International Energy Agency's (IEA) World Indicators. I review reasons for structural GDP revisions (i.e. other that simply better data quality) and give examples using US data.

I combine the cross-country GDP estimates with data on primary energy for most countries for the period 1950-2014 (Semieniuk et al., NatureClimCh, 2021) and examine changes in degree of decoupling and even changes of sign over business-cycle length intervals contingent on data vintage used. This method is reminiscent of checking inequality ranks contingent on inequality measure used (e.g. Atkinson, JET, 1970). I also reestimate the random effects model in Grossman and Kruger's (QJE, 1995) seminal paper on the environmental Kuznets curve with later GDP vintages to check what a retrospective analysis of their pollution data would yield. Finally I examine how the IEA's reporting of the historical global energy intensity rate of decline for the period 1971-2010 has changed over 8 years. Models of global energy and climate scenarios tend to use 1971 or 1980-2010 to calibrate business as usual trends in energy intensity.

Results

About 10-15% of up to 180 countries change from recoupling to relative decoupling or vice versa in ten year compound annual growth rates of energy intensity. About 2-3% even change to/from absolute decoupling (meaning the GDP growth rate switches sign over a ten year period). The extent to which the changes are clustered in subgroups of countries (e.g. geographically or by income level) is still subject to completion.

Some of the Grossman and Krueger results lose their characteristic hump-shape (the 'environmental Kuznets curve') – in some instance the curve (they estimate a cubic polynomial) even changes the sign of the cubic term. The results case some doubt over whether a researcher working 10 or 20 years later would draw the same conclusions about hump-shapes.

For the IEA global GDP estimates 1971-2010 that use World Bank PPPs (and extrapolate them backward prior to 1990) I find that successive data vintages show an accelerating decline in energy intensity. Over 8 years, the annual decline in energy intensity accelerates by 0.2 percentage points, leading to an 8% lower energy intensity in 2010 for the current vintage compared with the 2013 one. Almost all variance occurs after 1990.

Conclusions

My analysis shows that at least some variation in the evidence about the incidence and rate of decoupling may be due to structural revisions in GDP. Macroeconomists who follow national accounting closely may not be surprised, but to my best knowledge this problem is scarcely discussed in environmental economics. Perhaps most consequential is the accelerating decoupling in historical IEA data due to its importance for integrated assessment and other model calibration. Over 8 years, economically important 'autonomous efficiency' improvement was included entirely due to GDP data revisions.