Deflation in the Changing Wealth of Nations database

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Introduction

The Changing Wealth of Nations (CWON) database (World Bank, 2021) provides data on wealth for 150+ countries from 1995-2020, with measures on a broad range of wealth types that are comparable across countries and over time. To make cross-country comparisons, the database has long provided measures converted to US dollars using market exchange rates (MER). In the most recent edition of this database, a discussion was initiated on using purchasing power parities (PPPs) and that raises more general questions on what to compare and for what purpose.

In this report, we discuss two conceptual approaches that can be taken for comparing wealth across countries and over time and the practical implications of these approaches. The first of these is a *consumption-based approach*, which matches most closely to the current CWON database. Wealth is seen a store of value for future consumption and, for comparisons of wealth over time (and/or across countries), the consumption equivalent value of wealth is the key indicator. This measure can be seen in the light of discussions on sustainability: if wealth is non-decreasing, current consumption levels can be maintained.[2]

Second, we discuss a *production-based approach*, which views the different types of wealth as production factors. This would be a new approach for CWON, focused on productivity rather than sustainability. The requirements, in terms of conceptual framework and measurement, are distinctly different. Most notably, the production-based approach would start from a production function and relies on estimates of the distinct contribution of each asset to production. In the context of these two approaches, we discuss a general framework for deflation.

[1] The current draft of this report has been drafted primarily by Robert based on discussions with Erwin and Wulong, with Wulong contributing substantively on the measurement of human capital.

[2] This does not imply a one-to-one mapping between CWON and sustainability as the linkage depends on the model and measurement, see also the next section.

Especially regarding the production-based approach, the goal of this report is to highlight important issues that should be considered in development and provide a guide to the relevant literature and key empirical considerations. If this approach would be followed, this guide should be expanded into a true manual alongside a set of pilot calculations. However, a first consideration is whether it would be useful and attractive for users to have not just a consumption-based wealth measure but also a production-based measure. Is it deemed practical and realistic to present measures according to both approaches? Would the general approach that is sketched command enough expert support for further development?

Recommendations

Considering these issues and the current CWON measurement approach, we arrive at a set of concrete recommendations. In the following list, we indicate whether these can be achieved in the short (<3 months), medium (up to 1 year), or long term (>1 year):

1. [SHORT] Current methods use the GDP deflator for some purposes, these should be replaced by the consumer price index (CPI) (or household consumption expenditure (HCE) deflator) in the consumption-based approach.
2. [SHORT] To give a useful interpretation to changes in wealth over time, a deflated measure (based on CPIs) seems most sensible.
3. [SHORT] In providing PPP-based measures, using a PPP for consumption would be likewise desirable. Given the inconsistency between changes in PPPs and the CPI (Feenstra et al., 2015; Inklaar et al. 2022), we would see two options:
    a. Time series PPPs for nominal wealth across countries, i.e., deflating current/nominal wealth estimates with PPP timeseries, that is, with different PPP values for each year for the time period observed; and,
    b. Single year PPPs for real wealth over time, i.e., deflating constant/real wealth estimates with a single/fixed year PPP for the time period observed.
4. [SHORT] MER-based measures can exist alongside PPP-based measures, which would require careful explanation of the differences.
5. [MEDIUM] Under the consumption-based approach, wealth can increase because of greater investment (/smaller depletion) but also because of increases in the price of an asset relative to the CPI. Distinguishing volume effects from this revaluation effect will be helpful to the users.
6. [LONG] The current approach to incorporating urban land in wealth is based on an outdated assumption and can be misleading because it substantially understates

changes over time and differences across countries. Of all types of wealth, current practice is weakest in this area and should be a priority for improvement based on more extensive and recent statistical data and more plausible assumptions.

7. [LONG] Developing production-based wealth measures should be feasible based on many of the current sources but would require a longer-term investment to develop as a consistent accounting framework needs to be setup and a variety of empirical choices would need to be made.
8. [LONG] If a consumption-based wealth and production-based wealth measure is constructed, then in nominal terms these will (also) be different, as net foreign assets are relevant from a consumption perspective but not from a production perspective. More broadly, an additional wealth measure requires careful communication.

What is wealth (measurement) for?

There are two conceptual approaches that can be taken for making comparisons of wealth stocks over time and/or across countries, namely wealth as future consumption and wealth as productive capital.

The first approach sees *wealth primarily as a store of value for future consumption*, implying a consumption-based wealth measure. This corresponds to the origins of the CWON database, which has grown out of earlier World Bank efforts to quantify sustainability; early efforts are discussed in World Bank (1997) and Kunte, Hamilton, Dixon and Clemens (1998). The work of Lange, Wodon and Carey (2018) is a notable milestone and World Bank (2021) provides the latest release of data and breaking new ground on accounting for environmental degradation.

A good discussion of the conceptual background to this wealth measurement approach can be found in Arrow et al. (2004), who argue that consumption levels are sustainable as long as a broad measure of wealth is not decreasing. Such a broad wealth measure should include investments in produced and human capital, but should subtract depreciation, depletion of natural capital and environmental degradation. A more formal argument, along similar lines, would be the work of Basu, Pascali, Schiantarelli and Serven (2022), who argue for the relevance of per-capita wealth in assessing consumer welfare.[3] Note that the link of this type

[3] There are also differences, with Arrow et al. (2004) integrating productivity changes in their 'genuine wealth' measure, while Basu et al. (2022) consider the future path of productivity growth as a separate element. Furthermore, Basu et al. (2022) are not explicit about the scope of wealth and current measurement in CWON has expanded beyond the original Arrow et al. (2004) framework.

of wealth measure to sustainability only holds in the setting of the Arrow et al. (2004) conceptual framework. As they detail as well, this framework is stylised; for example, there may be nonlinearities, where a drop in natural capital below a certain level would have stronger negative effects on consumption possibilities. There can also be complementarities between types of capital that the model ignores.

This framework takes the perspective of the consumer, who uses part of their income for current consumption and saves a part for future consumption, building up (and drawing down) stocks of wealth. How then to compare that wealth over time or across countries? What matters from the consumer perspective is the *consumption equivalent value* of their wealth holdings, so the amount of consumption that can be bought with the amount of wealth available. So, under this approach, consumption prices are the appropriate deflator.

The second approach views *wealth as productive capital*, so a production-based wealth measure. Measuring wealth as productive capital is about the role that assets play in supporting and enhancing production. These are, of course, two sides of the same coin: investments in productive assets generate future income because those assets are useful in production. That income, in turn, allows for future consumption.

This can be best understood from a very simple framework where consumption C_t is some fraction c_t of production Y_t. This level of production, in turn, is generated using a set (denoted by k) of assets K_t^k and a productivity level A_t (equation 1a). The stock of assets K_t^k depreciates geometrically according to rate δ^k and is accumulated from investments I_t^k (1b). Finally, assuming a closed economy, the sum of investments equals savings, which is the part of income that is not immediately consumed (1c).[4]

$$C_t = c_t Y_t = c_t f\left(A_t, K_t^k\right) \tag{1a}$$

$$K_t^k = (1-\delta^k)K_{t-1}^k + I_t^k \tag{1b}$$

$$\sum_k I_t^k = S_t = (1-c_t)Y_t \tag{1c}$$

Under the consumption-based approach, we can see that consuming less today means higher savings and thus investments and higher consumption tomorrow. Under the production-based approach, we are interested in the contribution of each asset to total production, so to

[4] Basu et al. (2022) is an example of a study providing a fully developed model with optimization that comes to a very similar (general) conclusion: consumer welfare is determined by future TFP and the initial capital stock per capita.

the flow of productive services from each asset. As detailed below, that implies we are interested in the quantity of assets and the income they generate. This implies that assets will need to be deflated by asset-specific deflators, to measure the relative volume of productive services.

In equation (1a–c) we assumed a closed economy, but in practice consumers can also invest in foreign assets. So, one difference between nominal consumption-based and production-based wealth is that the consumption-based measure will include the stock of net foreign assets because it is a store of value abroad. The production-based measure will not include these assets, as that approach is concerned with assets used for domestic production.

In what follows, we will be more precise about deflation, the indexes needed for cross-country and over-time comparisons and, in the case of the production-based view, also about aggregation. But given these two conceptual approaches, we can already remark that, in our view, the GDP deflator is never a suitable deflator as the focus is either on consumption, and thus consumption prices, or on volumes of assets and thus investment/asset prices. Consumption prices also tend to deviate substantially from MER and, in the production-based approach, ignoring price differences between assets distorts measures of overall wealth.

Wealth as future consumption

When seeing wealth as primarily a story of value that can be used for future consumption, different forms of wealth can be considered as substitutes, so a single deflator can be used for the sum across assets of nominal wealth:

$$RW_t^i = \frac{\sum_k W_t^{ik}}{P_t^{iC}} \tag{2}$$

Where RW_t^i is consumption-based real wealth of country i at time t, W_t^{ik} is the nominal wealth value (in local currency units) of asset k and P_t^{iC} is the consumption price index.

Note that RW_t^i could increase for two reasons. First, the volume of an asset could increase. For instance, an increase in the acreage of forests would imply a higher level of wealth for that asset. Second, there could a revaluation of the asset. For example, if the price of oil rises relative to consumption prices, this implies the consumption-equivalent amount of wealth has increased. This revaluation effect is akin to a terms-of-trade effect, an increase in the terms of trade (price of exports relative to imports) makes it possible to buy more imports for a given quantity of exports, raising consumption possibilities. The revaluation effect is similar, increasing consumption possibilities for a given quantity of underlying assets.

The conceptual framework does not prescribe which consumption measure to use. The three most prominent options to consider are household consumption expenditure (HCE), actual individual consumption (AIC) and total consumption (TC).[5] HCE covers the direct consumption expenditure by households, AIC adds to that individual consumption expenditure (ICE, government consumption on that benefits specific individuals, such as health and education expenditure) and TC is equal to AIC plus collective consumption expenditure (CCE, government administration, defence, etc.). In summary: $TC = AIC + CCE = HCE + ICE + CCE$.

A reason to favour HCE could be that the CPI has the same scope and deflator measurement for ICE or CCE is less well developed in many countries (as is the case for PPP measurement for those categories). A reason to favour AIC is that it spans all consumption expenditure directly benefiting households and this is also used as the primary ICP consumption concept. A reason to favour TC is that it takes a national savings vs. national consumption perspective. Since many of the types of wealth are not individually owned or controlled, such a national perspective can more appropriately reflect the decision of consuming now versus later. Empirically, using TC PPPs will lead to smaller cross-country differences in wealth per capita than would HCE PPPs as the price-income gradient for ICE and CCE is steeper than for HCE.

To compare across countries at a point in time, the ICP provides PPPs for each consumption concept. For comparisons over time, National Accounts should provide similar information, but in practice tends to have more extensive coverage of deflators for HCE and TC. Additionally, the consumer price index (CPI) could be considered, which spans HCE and might be an argument for relying on that consumption concept.

Wealth as productive capital

The view of wealth as productive capital, entering a country's production function, is already well established when it comes to produced capital. It is widely used in growth accounting (how much of GDP growth can be accounted for by growth of factor inputs) and in development accounting (how much of the differences in GDP levels can be accounted for by differences in factor inputs). More recent efforts also show how to incorporate natural

[5] Naikal, Lange, Hamadeh and Rissanen (2021) have a similar discussion and include separate consideration of consumption expenditure by non-profit institutions serving households (NPISH) as well.

capital, again, in a growth context (Brandt, Schreyer and Zipperer, 2017) and in a comparative levels/development context (Freeman, Inklaar and Diewert, 2021).

While for consumption-based real wealth we are interested in the overall stock, for wealth as productive capital what matters is the flow of services generated by the stock. For example, a society builds up a stock of human capital through investments in human capital and that is a form of wealth. But it is the service flow from this stock that is used to generate economic production, in the case of human capital the total hours worked by workers with different characteristics (age, education, gender) over a period of time. For produced capital, a key innovation of Jorgenson and Griliches (1967) was to develop a measurement approach for assessing the service flow from a stock of (produced) capital, such as a truck or a computer, by computing the user cost of capital. Diewert and Fox (2016) discuss how to apply this reasoning to natural capital.

An implication of this service-flow approach to productive wealth is that a euro worth of wealth will generate different productive services depending on the type of asset. An often-used example is the contrast between buildings and computers. The productive life span of a building is in the decades while computers are seen to depreciate in about five years, so the service flow from a euro worth of computers has to be much higher than that of a building to recoup the investment. So, while we could sum across all assets to estimate consumption-based real wealth (equation 2), we need an asset-by-asset approach for the productive capital approach. As discussed below for individual assets, for some the productive capital approach simplifies measurement, as we can readily observe the net income generated, while for others we need additional assumptions.

Before proceeding, it is good to realise that the following is not yet a precise manual, laying out the choices and empirical steps in great detail. This is in part because we would need to have a complete accounting framework for all the production and corresponding income flows, see Diewert and Fox (2022). In particular where CWON is beyond the scope of the current SNA, i.e., regarding ecosystem services, this would require adjustments to the accounting framework. Second, the various choices would need to be carefully aligned to be consistent with this accounting framework. While this is feasible in principle, such an exercise, in our view, would be best undertaken in tandem with a pilot calculation. The following is thus best seen as an indicative guide to the type of measures and data choices that would need to be considered if a production-based measure were developed.

Aggregation: cross-country

A consequence of asset-by-asset deflation is that aggregation should be different for a series primarily aimed at cross-country comparisons than for a series primarily aimed at over-time comparisons.[6] For a cross-country comparison, we will want to make a PPP comparison in every year based on real assets:

$$K_t^{ik} = \frac{W_t^{ik}}{P_t^{ik}} \quad (3)$$

Where K_t^{ik} is the real productive capital stock for asset k in country i at time t and P_t^{ik} is the asset-specific price index—a PPP in this context. For example, for the stock of transport equipment, the PPP would for gross fixed capital formation in transport equipment. Given these real asset stocks, we should then aggregate over assets using a multilateral index for an overall measure of relative stocks of productive capital.

To do so, we need not just asset stocks, but also income shares, the ratio of each factor's payments to total income. How to do so in practice varies by asset, so the discussion below will not just cover deflation but also valuing the stream of income associated with each asset. But, for now, define:

$$s_t^{ik} = \frac{w_t^{ik}}{\sum_k w_t^{ik}} \quad (4)$$

Where s_t^{ik} is the income share of asset k and w_t^{ik} is the income stream associated with wealth stock W_t^{ik}.

Total income, $\sum_k w_t^{ik}$, may be equal to GDP at basic prices if all assets are within the scope of the SNA. That omits from overall GDP net taxes on products as these cannot be attributed to individual assets/production factors.

If we follow the conceptual framework of Inklaar and Diewert (2016) a sensible index of the overall flow of productive services from assets can be calculated as:

$$\log K_t^i - \overline{\log K_t} = \sum_k \frac{1}{2}\left(s_t^{ik} + \bar{s}_t^k\right)\left(\log K_t^{ik} - \overline{\log K_t^k}\right) \quad (5)$$

[6] This line of reasoning is also applied in the Penn World Table (Feenstra, Inklaar and Timmer, 2015), with series such as CGDPo or CK for cross-country comparisons, and series such as RGDPNA and RKNA for comparisons over time. See also Inklaar et al. (2022) for a more extensive discussion of the inconsistency between subsequent PPP comparisons and national deflators.

In equation (5), an upper bar denotes a cross-country arithmetic mean and this calculation yields a multilateral Törnqvist index, where the level of capital input in country i is compared to the 'average' country. An attractive feature of this index is that it is multilateral, like the GEKS index used in much of ICP. This means that rather than expressing the index relative to an average of countries, country i can be compared to a reference country, such as the United States. In addition, this index is exact for a translog production function, a flexible functional form. As discussed at greater length in Inklaar and Diewert (2016), such approach would yield a measure of overall factor inputs, which can be compared with relative GDP for a measure of relative country productivity. Although the natural expression of equation (5) is an index with (e.g.) USA=1, a money metric could be provided by multiplying the index by the US total value of income.

Aggregation: over time

Equation (5) provides an approach to estimate relative productive capital across countries at a point in time. To estimate growth over time, within a country, we would use real productive capital (as in equation (3)) but then based on a price index tracking prices over time. The relevant parallel to equation (5) would be a Törnqvist index:

$$\log K_t^i - \log K_{t-1}^i = \sum_k \frac{1}{2}\left(s_t^{ik} + s_{t-1}^{ik}\right)\left(\log K_t^{ik} - \log K_{t-1}^{ik}\right) \tag{6}$$

Where the growth in overall capital is a weighted average of asset growth rates where the weights are the two-period average incomes shares of the assets.

Wealth as productive capital: approach by asset

Given the general framework outlined with equations (3), (5) and (6), we now turn to a specific discussion of how to implement these for the specific (groups of) assets in the CWON database. The starting point for these discussions is the data on W_t^{ik} in CWON and the underlying figures, see the CWON methodology (World Bank 2021, Appendix A) for more details. Based on these, we discuss how to measure the quantity of productive services used and their unit price. The product of these is then the income flow from that asset stock.

Renewable natural capital

This category includes agricultural land, forestry, fisheries, mangroves and protected areas. The nominal value of agricultural land, forestry and fisheries is determined from the (expected) future stream of rents generated from this land. Rents for agricultural land are estimated from the revenue earned from selling agricultural products (crops, livestock) multiplied by the rent (cost) share of land and buildings, estimated by region in Evenson and Fuglie (2010). Similar approaches are followed for forestry and fisheries. To value mangroves, ecosystem services of forest resources and protected areas, estimates of the monetary value of those services are drawn from other studies.

In all cases there is a clearly defined income stream from the natural assets, namely the total rents (or other services), and an underlying flow of services, namely the quantities of production. This precisely the information needed to implement equations (3), (5) and (6).[7] Note that ecosystem services are not part of GDP, so the SNA accounting framework would need to be adjusted accordingly.

Non-renewable natural capital

This category covers fossil fuel energy and mineral resources, and measurement of current wealth is analogous to that of renewable natural capital in that stocks of resources are valued based on unit rents. The income stream from non-renewable natural capital is the unit rent (price of the resource minus extraction costs) times the amount extracted, and the quantity of the capital used is the extraction.

The main complicating factor compared with renewable natural capital is that not every country produces every type of energy or mineral resource. Combined with more resource-specific estimates of unit rents, a simple summation across resources is not feasible. As detailed in Freeman, Inklaar, Diewert (2021), it is possible to provide a practical solution to this problem. Rather than aggregating relative quantities of resources, as would normally be the suggested approach, they argue for estimating an (aggregate) relative price of these resources. And although countries without a resource have no observed unit rent, the world price of a resource serves as a sensible estimate of the reservation price.

Produced capital

This category includes the assets within the SNA asset boundary for gross fixed capital formation, so investment in structures, machinery, equipment and other assets including intangibles such as software and R&D. The standard approach is to cumulate and depreciate individual assets using the Perpetual Inventory Method (PIM):

$$N_t^k = (1 - \delta^k) N_{t-1}^k + I_t^k \tag{7}$$

[7] Note that the equations should be implemented at the level of individual products, so individual crops and forms of livestock in the case of agricultural land. In practice, CWON has to assume the same unit rent for each product in the three broader categories of agricultural land, forestry and fisheries.

Where N_t^k is the net capital stock volume of asset k at time t, δ^k the asset depreciation rate and I_t^k gross capital formation volume of asset k. The common assumption is that each unit of net capital stock provides the same flow of productive services. The appropriate price is the rental price, P_t^{Kk} of (produced) asset k:

$$P_t^{Kk} = P_{t-1}^{Nk} i_t + P_t^{Nk} \delta^k - P_{t-1}^{Nk} \Delta P_t^{Nk} \tag{8}$$

Where P_t^{Nk} is the price of the investment good, i_t is the nominal interest rate and ΔP_t^{Nk} is the change in the price of the investment good. Multiplying the rental price by the net capital stock volume then yields the income associated with that asset.

Implementing these equations require many practical choices, for example, on how to estimate initial capital stocks, what depreciation rates to use or how to estimate the nominal interest rate. Inklaar, Woltjer, Gallardo-Albarran (2019) provide an extensive discussion of these in the context of the Penn World Table (PWT).

Note that urban land is not part of these calculations. In CWON, urban land is estimated as a fixed 24 percent share of produced capital based on an earlier study by Kunte et al. (1998), who in turn base their estimates on Canadian balance sheet data for the period 1961–1984. A growing body of evidence[8] suggests this 24 percent assumption is not well supported; the actual share (when measured) fluctuates considerably over time and is very different across countries. We would encourage exploring alternatives to the current assumption. The growing scope of available data, such as national balance sheets data for a larger set of countries, makes it possible to use actual land value data for those countries and can inform more realistic assumptions. The availability in ICP of National Accounts data on the rental value of housing could prove to be useful in this context.

Human capital

This category of capital consists of the knowledge, skills, and health that people accumulate over their lives. It is estimated as the present value of future earnings for the labour force, employed and self-employed.

In that approach, human capital stock is estimated as the total present value of the expected future labour income of all individuals currently living in a country. This approach treats individuals as embodying a unit of capital with a "price" given by their future labour income.

[8] The APO Productivity Database provides estimates of the value and quantity of land used in production for 25 Asian countries. More recent Canadian data are also available.

The approach to measuring human capital has its foundation in the method used to measure produced capital. For produced capital, asset prices are observed directly from market transactions in investment goods; the user cost of capital or the cost of using the capital in a period is derived using the user cost of capital equation. For human capital, labour income or earnings correspond to the user cost of produced capital and are observed from transactions in labour markets; future labour incomes correspond to asset prices of produced capital and are derived by calculating the total present value of these future labour incomes (Jorgenson and Fraumeni, 1992a, 1992b; UNECE, 2016, Gu and Wong, 2010, Fraumeni, 2021).

To estimate human capital of a country, the lifetime income profiles for a representative individual cross-classified by age, gender, and education are estimated first. The lifetime income profiles for a representative individual are multiplied by the corresponding number of people in a country, and thus the human capital stock by age, gender, and education is calculated. Summing up the stocks of human capital across all classified categories generates the estimate of the aggregate value of the human capital stock for a country in domestic currency:

$$HC = \sum_{s,a,e} h_{s,a,e} POP_{s,a,e} \tag{9}$$

where HC is the human capital stock in domestic currency, $h_{s,a,e}$ is the present value of the lifetime income in domestic currency for an individual with age a, gender s, and education e, and $POP_{s,a,e}$ is the population of age a, gender s, and education level e.

To compare the relative level of human capital between countries, the PPPs or the relative price of human capital needs to be constructed first. The PPPs of human capital between countries is the relative level of future labour income of an individual in one country in domestic currency compared with the future labour income of a similar individual with same age a, gender s and education level e in other country. To account for the difference in age, gender and education level of the populations in the two countries, the PPP of human capital is derived from an aggregation of the relative ratios of future labour income across various types of individuals using weights based on their future labour income. The aggregation is similar to the aggregation method used for constructing the PPPs of other capital, and the CCD multilateral Törnqvist aggregation can be used (Caves, Christensen and Diewert, 1982).

If human capital is homogeneous or no distinction is made between different types of individuals with different lifetime income profiles, the PPPs or the relative price of human capital will be equal to the ratio of average lifetime profiles of a representative individual in domestic currency between the two countries, and the population difference represents the relative level of human capital stock. If human capital is heterogeneous and individuals in one country are more educated and younger than those in the other country, the PPPs of human capital will be lower than the ratio of average future labour income in domestic currency in two countries. Consequently, the relative level of human capital stock (estimated by deflating the value of human capital stock by the PPPs of human capital) will be different from what the population difference would suggest. The country with more educated and younger population will have the relative level of human capital that is more than what the population size would suggest.

Implicit in this calculation of PPPs for human capital is the assumption that the efficiency unit of an individual with same age, gender and education level is equal across countries. This assumption is problematic as there may be large difference in the efficiency unit of human capital, especially between countries with very different income levels. There is a need to adjust for the difference in the efficiency unit of human capital stock when comparing human capital between countries. This can be done by collecting quality indicators of education, but such data is limited in coverage of countries. A practical approach is to use the difference in labour productivity level between countries to adjust for the difference in the efficiency unit of human capital. The individual who is more productive is assumed to have more human capital stock. This is akin to productivity adjustment for estimating the PPPs of government services in the ICP (World Bank, 2003, Chapter 16).

Note that the preceding describes how to get real stock measures of human capital. Capital flow measures might be simpler as the flow of human capital services used in production is simply the hours worked by each category of worker and the price is the wage.

Net foreign assets

As discussed in the introduction, net foreign assets are part of consumption-based wealth as it impacts future consumption possibilities. These assets are not relevant for production-based wealth since production is viewed on a domestic basis.

Concluding remarks

CWON has made great progress in providing harmonised measures of wealth for a considerable period and large number of countries. Yet with this growing scope, the question how to make nominal wealth estimates comparable across countries and over time takes on greater urgency. In this report, we have outlined two main conceptual approaches and provided directions for practical implementation. In closing, we highlight key choices and considerations:

1. Wealth can be measured from a consumption-based or a production-based approach.
    a. A consumption-based measure requires deflation using consumer prices
    b. A production-based measure requires asset-specific deflation and an index-number approach to aggregate across assets
    c. We do not view the GDP deflator as a sensible deflator in either approach
    d. A consumption-based measure would include net foreign assets, a production-
2. If the aim is to provide a production-based measure, more specific choices are needed on whether to estimate capital services.

As indicated at the start, we make several concrete recommendations for the short, medium and long term, that we hope contribute to the development of CWON.

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