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Measuring Economic Welfare: What and How?

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MEASURING ECONOMIC WELFARE: WHAT AND HOW?

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EXECUTIVE SUMMARY

Calls for a more people-focused approach to statistics on economic performance, and concerns about inequality, environmental impacts, and effects of digitalization have put welfare at the top of the measurement agenda. This paper argues that economic welfare is a narrower concept than well-being. The new focus implies a need to prioritize filling data gaps involving the economic welfare indicators of the *System of National Accounts 2008 (SNA)* and improving their quality, including the quality of the consumption price indexes. Development of distributional indicators of income, consumption, and wealth should also be a priority. Definitions and assumptions can have big effects on these indicators and should be documented. Concerns have also arisen over potentially overlooked welfare growth from the emergence of the digital economy. However, the concern that free online platforms are missing from nominal GDP is incorrect. Also, many of the welfare effects of digitalization require complementary indicators, either because they are conceptually outside the boundary of GDP or impossible to quantify without making uncertain assumptions.

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Glossary

CPI	Consumer Price Index
DGI	Data Gaps Initiative
DINAs	Distributional National Accounts
EGDNA	Expert Group on Disparities in National Accounts
GDI	Gross Domestic Income
GDP	Gross Domestic Product
HDI	Human Development Index
NSO	National Statistics Office
OECD	Organisation for Economic Cooperation and Development
SNA	*System of National Accounts*
STiK	Social Transfers In-Kind
UNCTAD	United Nations Conference on Trade and Development
WID	World Inequality Database

INTRODUCTION

1. Calls for a more people-focused approach to statistics on economic performance, and concerns about inequality, environmental impacts, and effects of digitalization have put welfare at the top of the measurement agenda. A shift of focus from growth to people's well-being was recommended by the Stiglitz commission (Stiglitz, Sen and Fitoussi, 2009), which urged development of welfare indicators "beyond GDP" and more attention to the welfare indicators already included in the *System of National Accounts 2008 (SNA)*. Indicators of inequality, sustainability and the environment, and other aspects of well-being were also called for by the United Nations' Sustainable Development Goals (SDGs). Separately, the emergence of the digital economy led to a debate over the accuracy and adequacy of the welfare indicators of the *SNA*. Digitalization is therefore one of the topics being addressed in the work on updating the *SNA*, work which also includes inequality, environmental accounts, unpaid household activities and time use, health, and human capital.

2. "Beyond GDP" is often understood as meaning beyond the scope of GDP statistics in general, but it is important to remember that the indicators of the *SNA* already go far beyond GDP and cover aspects of welfare involving income, consumption, prices, and wealth. The *SNA* indicators have the advantage of largely depending on transactions and positions that are, at least in principle, observable; in particular, they do not require the sort of uncertain assumption needed for indicators that assign money values to aspects of well-being not traded in markets. Work on compiling household income, consumption, and wealth has been fostered by the G20 Data Gaps Initiative (DGI) recommendation to compile accounts for institutional sectors. A further DGI recommendation calls for distributions of household income, consumption, saving, and wealth.

3. The 2018 IMF Statistical Forum on *Measuring Economic Welfare in the Digital Age: What and How?* considered the measurement challenges posed by digitalization. Many digital products are free (except, perhaps, for the time cost of viewing advertisements and intangible cost of surrendering one's personal data). Others enable consumers to do things that they previously could not do. In either case, the welfare gains that are difficult to measure, and some are not necessarily within the scope of GDP.

4. This paper develops a framework for categorizing indicators of well-being and economic welfare, highlights the importance of compiling and using the welfare indicators already in the *SNA*, and discusses distributional indicators of income, consumption, and wealth in a national accounts framework. It also considers what can be done to measure the *welfare effects of digitalization*. The indicators of climate change and environmental sustainability are not explored because they will be covered in a future paper.

5. The structure of this paper is as follows. It first considers economic welfare and its place in a measurement framework that extends to broader aspects of well-being. The economic welfare indicators of the *SNA* are examined next, and NSOs are encouraged to fill data gaps involving consumption, income, wealth, and deflators as steps towards better measurement of welfare.

The discussion then turns to distributional indicators in a national accounts framework, with advice for both data compilers and data users. Finally, a section on the welfare effects of digitalization discusses their measurement in GDP and in complementary indicators. The concluding section summarizes key findings and main recommendations. These recommendations, and the more detailed recommendations at the end of each section, include items that are practical for countries at all levels of statistical development.

ECONOMIC WELFARE IN THE SYSTEM OF MEASURES OF WELL-BEING

6. The shift of emphasis from growth to well-being has been marked by more attention to the economic welfare indicators of the *SNA* and development of broader indicators of well-being. The OECD *Dashboard on Households' Economic Well-Being* helps to give greater prominence to the SNA welfare indicators in data dissemination and includes household disposable income, consumption, and wealth. The OECD has also begun to publish broader indicators of well-being as part of its *Better Life Initiative* has (van de Ven, 2018). The World Bank's report on *The Changing Wealth of Nations 2018* and associated datasets has indicators of comprehensive wealth (which includes natural and human capital components) and of net saving with adjustments for natural resource depletion and damages from CO2 emissions. Environmental indicators to inform policymaking are also part of Stanford's Natural Capital Project. Furthermore, many countries are developing well-being indicators of happiness and life satisfaction, social and civic engagement, trust, and other aspects (Exton and Shinwell, 2018), and New Zealand prioritizes aspects of well-being in policymaking (Durand and Exton, 2019).

7. Work in the 1970s and 1980s on indicators beyond GDP laid the groundwork for later progress. Nordhaus and Tobin (1973) imputed monetary values for household nonmarket production and leisure as part of their index of economic welfare, which also adjusted gross national product (GNP) to exclude depreciation and items that do not contribute to welfare. A sustainable version of the index also adjusted for over-exploitation of natural resources. In the late 1970s the World Bank began to publish a variety of welfare and well-being indicators in the *World Development Report,* and the successor to these reports, the World Development Indicators database, covers income and consumption, poverty and inequality, education, health, and the environment, in addition to growth. Morris (1978, 1979) combined non-monetary indicators of literacy, infant mortality and life expectancy in the *Physical Quality of Life Index* to analyze whether the very poor were benefitting from economic growth. Later, the United Nations Development Programme (1990) created the Human Development Index (HDI), with the definition of human development based on Sen's (1985) conceptual framework of capabilities to achieve valued outcomes ("functionings") of being and doing. (The HDI is now supplemented by an inequality-adjusted HDI, and indexes of multi-dimensional poverty and gender inequality.)

8. Economic welfare includes key items needed to complete the picture given by the indicators of the *SNA*. GDP encompasses market production and near-market production by

government, nonprofit institutions, and households.[1] Economic welfare also includes nonmarket production, such as unpaid work in the home or by volunteers and households' production of services for own consumption using their time budget. Inequality and the distribution of household economic welfare are also aspects of the aggregate economic welfare of a population.

9. Broader aspects of well-being are also critical. The contrast between the effects of the digital economy on well-being and economic welfare is an example of the need to consider well-being. Discussions of digitalization and economic welfare focus mostly on gains. In contrast, research on effects of the internet on aspects of well-being such as happiness, health, hate crimes, and social cohesion often finds evidence of negative effects. Privacy costs of collection of people's data could also be considered in an analysis of digitalization and well-being.

A. Definition of Economic Welfare

10. Economic welfare and well-being are different concepts. Well-being includes intangible aspects that cannot be traded in a market, such as happiness, trust, and bio-diversity. Economic welfare is the part of well-being having to do with broadly-defined current and lifetime consumption and the resources that enable the consumption (income, comprehensive wealth, and households' time endowment).

11. Definitions of economic welfare based on current consumption and sustainable consumption are both relevant. The current consumption approach considers the utility generated by market and near-market goods and services consumed by households, nonmarket goods, and services produced for own consumption or by volunteers, time use for leisure, and aspects of environmental quality that affect households directly, such as pollution. Households' nonmarket production of services for own consumption plays a noteworthy role in analyses of the effects of digitalization on economic welfare.

12. The sustainable consumption approach considers the stream of consumption that will be attainable in the future, bringing into play net saving, wealth, and certain effects of environmental degradation (e.g. the impact of pollution on life expectancy analyzed by Bannister and Mourmouras, 2017). *Real net disposable income* is a measure of sustainable consumption.[2] Net disposable income represents the resources used for current consumption or saving, taking into account depreciation, and taxes and transfers (Annex I). Positive net saving allows higher consumption in the future, and under certain assumptions net saving can be added to current consumption to capture the present value of the extra future consumption enabled by the saving.

[1] Household near-market production includes owner-occupied housing and goods for own consumption (Quirós and Reinsdorf, 2018). Solar electricity for own consumption would also be appropriate to treat as near-market production. In the *SNA*, fixed assets always produce output, and solar panels should qualify as fixed assets.

[2] In practice, a gross measure of household disposable income is often used for distributional indicators and other welfare questions. In effect, depreciation of residences and fixed assets of household businesses is ignored.

Note, also, that for real income to be a measure of sustainable consumption, the deflator must be an index of consumption prices (Oulton, 2004). Wealth is also an aspect of sustainable consumption.

13. The inequality aspect of aggregate economic welfare is not captured by simple totals of households' consumption, income, and wealth. Assume that the marginal utility of consumption is a declining function of the level of consumption. In this case, inequality reduces the level of social welfare corresponding to a given level of per capita consumption. For example, Jones and Klenow's (2016) index of consumption-equivalent welfare (Box 1) includes an adjustment for inequality based on an assumption that the marginal utility of consumption is inversely proportional to its level. The assumption makes social welfare depend on the geometric mean of the consumption distribution, ensuring that a given percentage change in a household's consumption has the same impact on social welfare regardless of how well-off the household is.

14. The effect of inequality on social welfare indexes is part of the motivation for treating inequality as an element of economic welfare. Social welfare indexes are useful summary statistics, but the main application of the conceptual framework of economic welfare in this paper is to identify and interpret the indicators that are relevant to economic welfare. Items related to net disposable income, consumption deflators, and changes in wealth can also be identified as part of the analysis of economic welfare.

Box 1. Indexes of Well-Being and Economic Welfare

The numerous dimensions of well-being create a data dissemination challenge. Dashboards that show multiple dimensions in one place can help. However, a single number, or *index*, that summarizes the various dimensions may be desired to facilitate comparisons over time or space. For example, the Indonesia Sustainable Welfare Index contains 22 indicators covering economic, social, and democratic governance areas (Achyunda and Arini, 2018).

Well-being indexes are an effective communication device for comparisons involving multiple countries or years. Nevertheless, the lack of a conceptual framework for combining dimensions measured in different units can make them hard to interpret, and their weights may embody questionable trade-offs. An axiomatic approach to index design can help, and Bhutan's Gross National Happiness index is based on an approach from the multi-dimensional poverty literature (Alkire and Foster, 2011). Online data users can also be allowed to choose the weights. The users of the OECD's *Better Life Index* select weights for housing, income, jobs, community, education, environment, civic engagement, health, happiness, personal safety, and leisure.

Indexes of economic welfare generally have a well-defined conceptual framework (though the weights may still be arbitrary). Jones and Klenow (2016) develop an index of consumption and time spent in leisure or home production, which is also adjusted for inequality and for the effect of life expectancy on the expected value of lifetime consumption.

B. A Taxonomy for Indicators of Economic Welfare and Well-being

15. Surrounding a core group of economic welfare indicators in the *SNA* is a set of complementary indicators providing more detail and covering items beyond the scope of GDP (Figure 1). Yet another set of the indicators covers broader aspects of well-being. The well-being

indicators are part of a complete view of economic performance and social progress. For example, health outcomes are an aspect of well-being, while real consumption of health care services and access to them are aspects of economic welfare.

16. The *SNA* indicators listed in the bottom rectangle of Figure 1 include measures of (real) household consumption and disposable income.[3] The measure of real net disposable income for the total economy receives little attention, but a related national income concept is widely used. Disposable income includes remittances, which are a major source of income for many economies (Barne and Pirlea, 2019). A welfare analysis that is limited to net national income can therefore be misleading.

17. Table 1 and the left-hand rectangle in Figure 1 contain complementary indicators that provide additional detail on who receives, or has access to, items included in *SNA* aggregates. Distributions of income, consumption, and wealth are among these indicators. So are the related indicators of access to financial services and to other kinds of services, and indicators of net saving that adjust for depletion of natural resources.[4] This rectangle also contains examples of items outside the GDP production boundary that are part of economic welfare, such as effects of digitalization on household nonmarket production, and natural capital (which affects sustainable consumption). Table 2 provides an overview of economic welfare items beyond the scope of GDP.

18. The right-hand rectangle of Figure 1 shows some broader aspects of well-being for which indicators have been developed or proposed. They include both happiness and things that contribute to happiness (e.g., health, education, and social cohesion). They also include aspects of natural capital and ecosystem services that contribute to collective well-being, such as bio-diversity.

C. Recommendation

19. A division of labor is needed for development of well-being indicators. For example, macroeconomic statisticians do not have the experience and training to measure aspects of well-being such as happiness and trust. However, they already compile many indicators of economic welfare, and are well-situated to develop others that would fill gaps in understanding economic performance.

[3] Actual consumption and adjusted disposable income include imputations for in-kind transfers such as free education and free health care.

[4] Increases in loss rates from wind, floods, and fire due to climate change are another possible adjustment to depreciation. Disasters are part of "other changes in volume of assets" in Annex I, and increases but *expected* losses can be included in depreciation. Estimates of property insurance output, prices, and volumes may also be distorted by effects of climate change on loss rates.

Figure 1. Economic Welfare Within the System of Measures of Well-Being

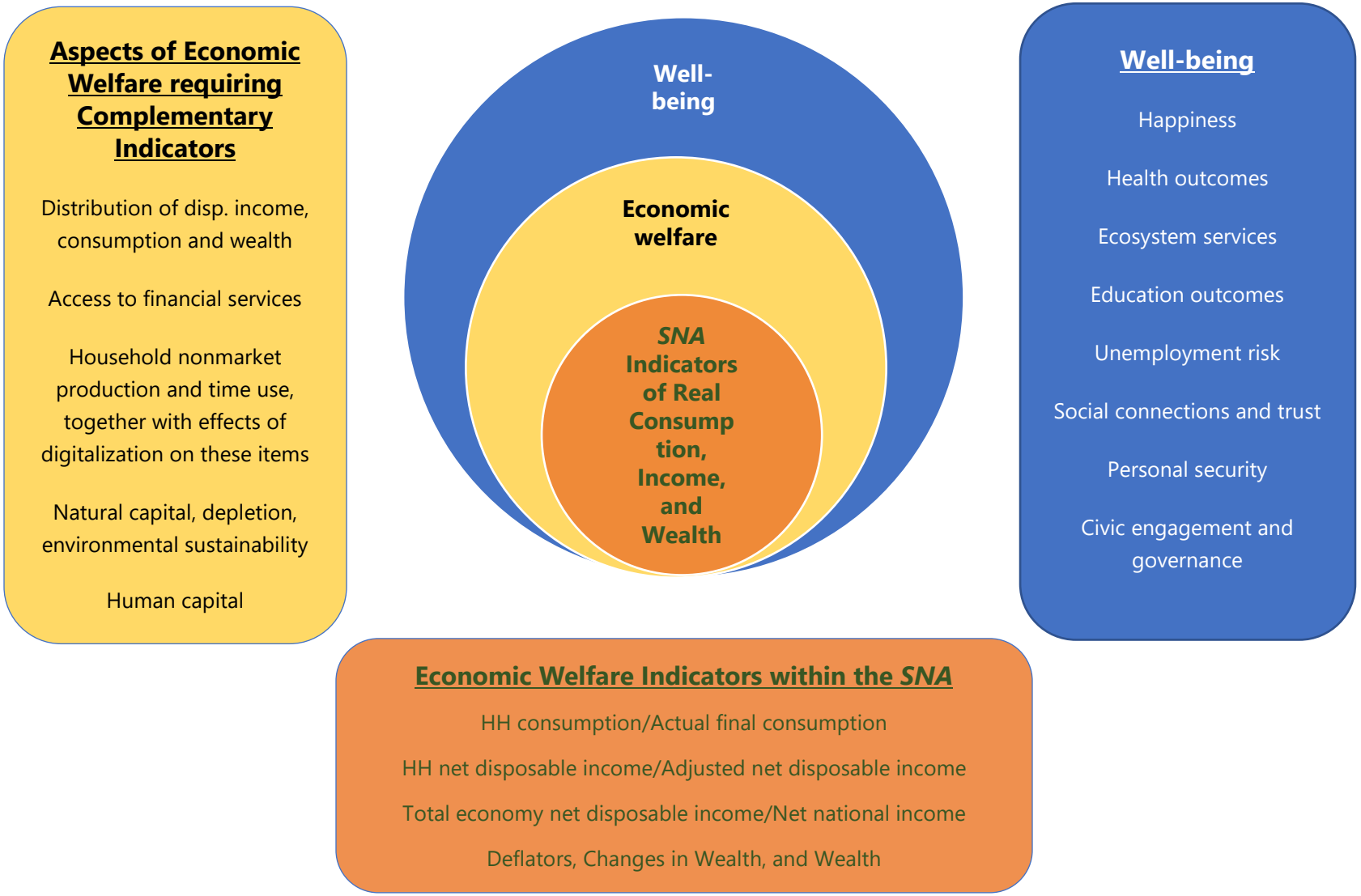


Table 1. Economic Welfare Indicators in the *SNA* or Providing Additional Granularity on Items in the *SNA*

Level of Aggregation	Indicators of the *SNA*	Complementary Information on Distributions and Alternative Approaches
	Real Income, either Gross or Net of Consumption of Fixed Capital	
Total economy	Domestic income National income	Distribution of the national or disposable income benefitting each household (e.g. by quintile and household characteristics)
	Disposable income	Net income adjusted for depletion of natural resources
Households	Balance of primary incomes Disposable income	Distributions of households' primary income and disposable income
Households, with social transfers in-kind (STiK)	Adjusted disposable income	Distribution of households' adjusted disposable income
	Real final consumption	
Households	Final consumption expenditure	Distribution of households' final consumption expenditures (e.g. by income quintile and demographic characteristics)
		Percent of households with access to critical types of services
		Consumption of digital goods and services
Households, with STiK	Actual final consumption	Distribution of households' actual final consumption expenditures
	Prices/deflators	
Total economy	Deflator for gross domestic final expenditure	Experimental price indexes for new and improved digital products
Households	Final consumption expenditure deflator	Deflators for basket consumed by each income quintile
		Consumption deflators adjusted for new and free digital products
Households, with STiK	Actual final consumption deflator	Separate deflators for baskets consumed by each income quintile
	Wealth	
Total economy	Nonfinancial assets	Data as an asset
	International investment position	Proven and probable reserves of natural resources
Households	Assets, Liabilities, Net worth	Distributions of household assets, liabilities and net worth

Table 2. Indicators of Aspects of Economic Welfare beyond the Scope of GDP	
Area	**Indicators**
Time use and household nonmarket production	Unpaid work in the home, other nonmarket services for own consumption, unpaid work of volunteers, leisure
	Gender aspects of unpaid work in the home
	Effects of digitalization on time budget and telecommuting
Health and education outcomes	Life expectancy, quality-adjusted life years, human capital
Environment and natural resources	Renewable natural resources
	Carbon emissions
	Damage to property linked to degradation of the environment or climate change
	Damage to health to degradation of the environment
	Expenditures to protect against environment externalities
Digitalization	Unpaid production of open source software
	Households' time use producing services enabled by digital inputs
	Value of community-generated and user-generated content

ECONOMIC WELFARE IN THE *SNA*

A. Needs to Communicate, Disseminate and Use the Existing Welfare Indicators of the *SNA*

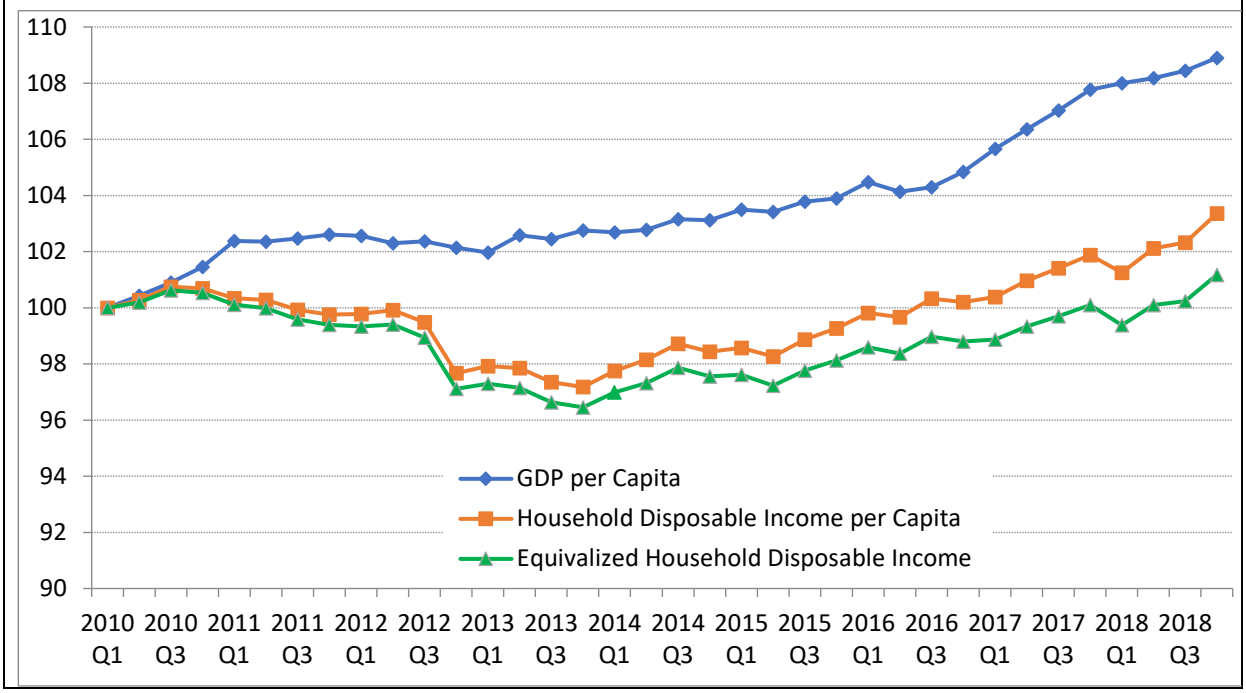
20. Criticisms of the national accounts as disregarding welfare tend to overlook the information on welfare conveyed by the *SNA* measures of income, consumption, wealth and prices. Economic analysts also overlook these welfare indicators when they focus exclusively on GDP and the GDP deflator.

21. GDP growth can diverge substantially from the indicator that are designed to measure welfare. In France, for example, real household disposable income per capita grew by 6 percentage points *less* than real GDP[5] per capita over 2010–2018 (Figure 2). Growth of household disposable income can differ from growth of GDP because of differences in deflators and because of changes in taxes and government transfers. Figure 2 also shows the effects of adjusting for a distributional indicator of the effect of household size on how well a household with a given income can live. *Equivalized household income* that gives a weight of 1 to the first household member, 0.5 to each additional adult, and 0.3 to each child below 14. Falling household sizes reduce the growth of

[5] Most NSOs, and also the *SNA*, use the term "GDP volume", not "real GDP". This paper uses the term "real GDP" because it may be more familiar.

equivalized household income by 2 percentage points compared with unadjusted household disposable income.

Figure 2. Real GDP and Real Household Disposable Income, France
(per capita or per equivalized household, 2010 Q1 = 100)



22. Data gaps in compiling the welfare indicators of the *SNA* are common. Key data on households are not yet provided in the institutional sector accounts, including by many participants in the G20 DGI. Also, a global survey of data availability in countries' national accounts as of 2017 found that 30 countries did not yet compile expenditure approach GDP in constant prices and more than 60 countries did not compile income approach accounts (Berry *et al.*, 2018).

23. Filling these data gaps is essential. If expenditure approach national accounts are not yet available, a first step should be development of estimates of final consumption expenditures. On the income side, information on the economy's disposable income is often missing but could be provided by combining GDP and data on net cross-border income including current transfers from the balance of payments accounts. Dissemination of disposable income of the total economy would aid in analysis of economic welfare questions such as income distributions that include remittances.

B. Central Role of Deflators in Measuring Welfare

24. Nominal GDP does not measure welfare, so the measurement of changes in welfare requires price and volume indexes. One reason that nominal GDP does not measure welfare is that prices—which are used to value the different goods that compose GDP—do not reflect overall importance for welfare as measured by *average* utility. In other words, the welfare impact of

eliminating all consumption of an item would not be proportional to the amount paid for that consumption, as can be seen by considering the example of cheap, but vital, water and expensive, but inessential, diamonds (Figure 3). But prices do provide the right weights for measuring welfare growth with price and volume indexes because, in the absence of rationing, prices are proportional to *marginal* utility.

Figure 3. Prices Used to Value Water and Diamonds in GDP Reflect Scarcity, not the Importance for Welfare

25. Critics of GDP sometimes offer examples in which a new digital technology eliminates a cost for consumers (such as long-distance calls) and GDP falls. These paradoxes can be resolved by remembering that measuring welfare is not the job of nominal GDP and considering the downward effect on the GDP deflator. Thus, what these examples really illustrate is the central role of deflators for welfare measurement. As is logical, the falling deflator causes measured productivity to rise when technology eliminates a cost. Note also, that the supposition that nominal GDP would fall does not take the effect on other spending into account, and with nominal GDP flat and the deflator falling, real GDP should rise.

26. The increased focus on measuring welfare implies a need to prioritize development of deflators for final expenditures if they are not yet compiled and improvements in deflators that have weaknesses. Quality change is a longstanding challenge in constructing deflators that measure welfare. Areas of focus in the literature on quality adjustment include the digital economy, health care (Dauda *et al.*, 2019), and government services (Foxton *et al.*, 2018). However, uncertain assumptions may be needed to estimate quality adjustment for items with unique features. Techniques used to compile official GDP and CPI estimates should be replicable and objective, and so quality adjustments requiring uncertain assumptions may be included in complementary indicators.

27. Keeping price index baskets, weights and samples up-to-date may significantly improve the measurement of welfare change (Quirós and Reinsdorf, 2018). Prompt inclusion of new products in the index basket allows their distinctive patterns of price change to be captured,

annual updating of weights helps to capture substitution effects, and representative outlet and variety samples ensure that the indexes reflect the prices that consumers are paying.

C. Welfare Measurement and the Deflation of Income

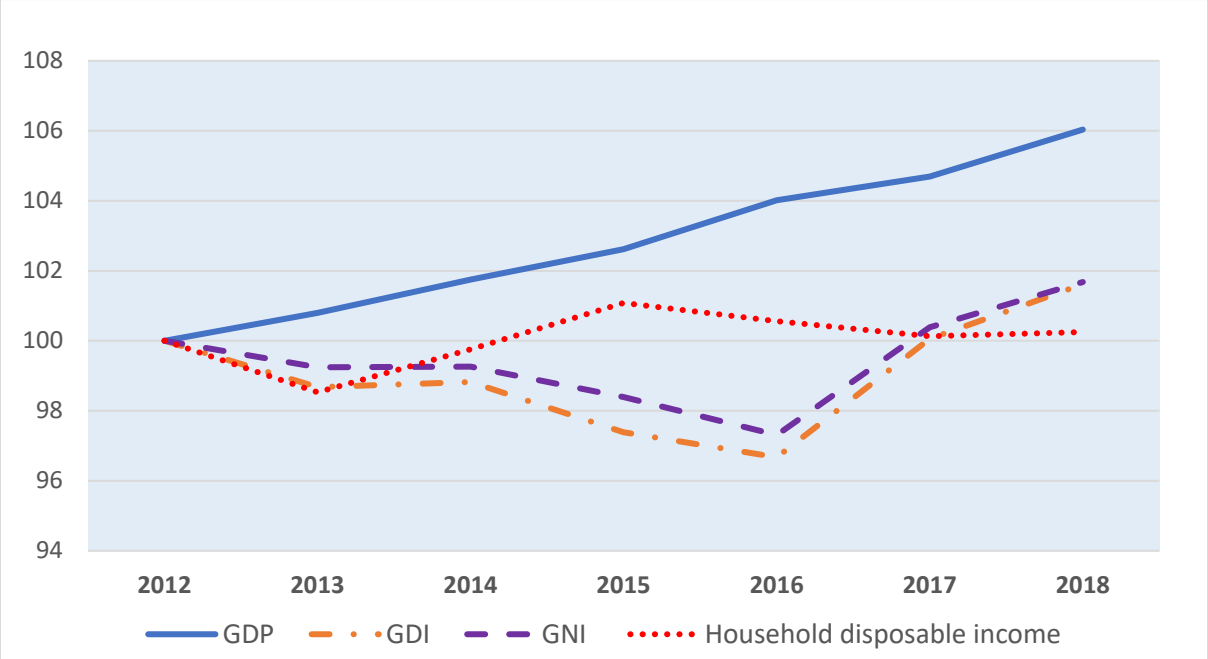
28. For output or expenditures, the composition of the deflator should match the composition of the aggregate being deflated, but this principle does not always apply to income. Income sources are fungible: the purchasing power of total income depends on the prices of the things the income is used to buy, not on the mix of income sources. Consistent with this, the deflator used to calculate real household income is usually a price index for final consumption (or the CPI). However, the operational definition of an economy's real income in the *SNA* is not entirely consistent with this. It allows use of a special deflator for income that comes from net exports.

29. Analysts often use the GDP deflator based on the expenditure approach as an all-purpose indicator of general inflation. If the purpose requires a welfare measure, this has two undesirable effects. First, export prices are treated as though they were paid by domestic residents. Second, changes in prices that residents really do pay are ignored if they are caused by changes in import prices—the negative weights on import prices in the GDP deflator have the effect of canceling out the import-induced price changes in other parts of the GDP deflator.

30. The export and import components of GDP are not present in the *SNA* concept of *gross domestic final expenditures*. The deflator for these expenditures covers the prices paid by domestic residents for final consumption and investment items and is well suited to measuring an economy's real income.[6] In economies with significant trade in volatile commodities, the final expenditures deflator may differ greatly from the GDP deflator. In Australia, for example, the gap was 4.4 percentage points over the six years ending in 2018. Consequently, a 6 percent increase in real GDP was accompanied by an increase of just 1.6 percent in real gross domestic income (labeled GDI in Figure 4). In comparison, the gap between real income growth at the household and total economy levels was just 1.4 percentage points.

[6] Some authors instead recommend the household final consumption deflator for deflating the economy's income to measure welfare from sustainable consumption (Oulton, 2004, and Sefton and Weale, 2006).

Figure 4. GDP Volume and Measures of Real Income, Australia, 2012–2018
(2012=100)



Source: Australian Bureau of Statistics. GDI: Gross Domestic Income; GNI: Gross National Income.

D. Recommendations

31. The *SNA* indicators of income, final consumption, wealth and price change, which are a foundation for understanding economic welfare, are often either not compiled or compiled improperly. Filling these data gaps should be a priority. If accounts for the household sector are not yet compiled, data from financial regulators may enable compilation of a financial account. Also, household expenditure survey data and an analysis of the detailed uses of commodities may allow estimation of household final consumption expenditures.

32. Compilation procedures should be improved if necessary to better capture welfare growth in GDP statistics. The deflator for national income should be well suited to measuring the purchasing power of this income. Also, price indexes should have up-to-date product lists, weights, models and outlet samples and incorporate quality adjustments where feasible. Quality adjustments based on uncertain assumptions should be incorporated in complementary indicators.

33. NSOs should also give the *SNA* welfare indicators a prominent place in data dissemination. This will encourage increased use, an important objective because analyses that treat GDP per capita and the GDP deflator as welfare indicators can be misleading. A dashboard of welfare indicators is an effective way to disseminate information on welfare. The disposable income of the total economy should also be disseminated if it differs significantly from national income.

In addition, a complementary measure of net income that adjusts for depletion of natural resources may be needed. If it is disseminated, the underlying assumptions should be identified.

DISTRIBUTIONAL INDICATORS IN A NATIONAL ACCOUNTS FRAMEWORK

A. Why Calculate Distributional Indicators in a National Accounts Framework?

34. Although the income, consumption, saving, and wealth measures of the *SNA* provide important perspectives on economic welfare, they do not provide a complete picture. Understanding welfare requires indicators of how these items are distributed, and information on the joint distribution of income and wealth is also needed for a complete picture. Indicators of access to financial services (measured in the IMF Financial Access Survey) and to services affecting multi-dimensional poverty are also important.

35. Distributional indicators of income, consumption, and wealth would fill important information gaps in national accounts statistics. Per capita income and wealth calculated from national accounts aggregates are likely to be unrepresentative of the circumstances of the typical person because of the influence of the upper tail of the distribution.[7] Furthermore, policymaking priorities of reducing inequality and making growth inclusive require insight into the circumstances of those further down the income distribution.[8] The SDG on reducing inequality includes indicators of consumption and income growth of the bottom two quintiles, and indicators of frequency of income below half the median.

36. Micro data on income and wealth distributions in household surveys have long been available[9] but development of income distributions in a national accounts framework will have important benefits. The standardized, comprehensive definitions of income of the *SNA* enable more meaningful international comparisons—most household income surveys cover only certain types of income. Furthermore, benchmarking to national accounts totals by type of income should improve accuracy. Household surveys typically suffer from widespread income under-reporting and from non-participation by the rich. Types of income predominately received by either the rich or the poor often have much smaller totals in household survey data than in the national accounts (which are based on data from income payers). For example, comparisons of survey data with national accounts benchmarks for European Union countries imply average

[7] For example, Batty et al. (2019) estimate that 1 percent of wealth as measured by net worth was held by the lower half of the distribution in the U.S. in 2018.

[8] Research on links between inequality and growth and on other unfavorable consequences of extreme inequality includes Dabla-Norris et al. 2015, Berg and Ostry, 2017, and Ostry et al., 2019).

[9] See the Luxembourg Income and Wealth Studies, and the OECD income distribution database, the Federal Reserve Survey of Consumer Finances, and the ECB Household Finance and Consumption Survey.

coverage rates for property income in household surveys of around 30 percent. Improvements in the quality and availability of micro data sets on income would also be helpful.

B. Work on Distributional Indicators Linked to National Accounts

37. Many NSOs are developing distributional indicators for income, consumption, and wealth as measured in national accounts, and some have released official statistics. The OECD *Expert Group on Disparities in a National Accounts Framework* (EGDNA) has fostered this work. The indicators include decompositions by income quintile, main source of income, family composition, and age. The items being analyzed are household disposable income, final consumption, saving, and wealth. Annex II summarizes the five steps for compiling distributional indicators for income. Differences in concepts and coverage must be adjusted for when using household survey data and tax data to distribute the totals in the national accounts for each type of income.

38. In addition to some NSOs, academic researchers have developed distributional indicators of income in a national accounts framework. The World Inequality Database (WID) contains distributions of pre-tax net national income for more than 60 countries (Alvaredo *et al.*, 2016, 2017, and 2018). They show that within-country inequality rose over 1990–2016. Also, researchers working with the WID have developed estimates of the evolution of a combined income distribution for most of the world (with purchasing power parities used to compare countries). Charting income growth by decile or percentile in the world income distribution results in an "elephant curve", with the elephant's upturned trunk showing that the global 1 percent captured 27 percent of overall income growth over 1980–2016 (Chancel, 2018).

39. Survey data on household consumption may be available even if data on income are lacking. The distributional indicators of the World Bank's Global Consumption Database draw on consumption surveys from many countries, and most countries conduct periodic household expenditure surveys for purposes of compiling CPI weights. Distributional statistics on consumption can provide valuable insights into inequality and poverty. Another useful statistic for distributional analysis that does not require micro data on income is labor's share of total income from production or of GDP (Box 2).

Box 2. Labor Share of Income as an Inequality Indicator

Labor's share of income from production, or value added, is an aspect of inequality that can be calculated from income approach national accounts. This avoids the need to analyze micro data.

Many studies have found that labor's share of GDP has declined. However, corrections for factors that could distort the results may reverse the finding of a declining labor share (Cette, Koehl and Philippon, 2019). Compensation of employees is often used as the measure of labor income. This measure omits the labor component of *mixed income*, which is the *SNA*'s term for the income of unincorporated businesses. Mixed income may come from self-employment, including work in the gig economy, or from informal employment. NSOs could enable more accurate labor share estimates by improving procedures for measuring self-employment income (Elsby, Hobijn and Sahin, 2013) and treating the income of family members employed in family businesses as compensation rather than profits (Lequiller and Blades, 2014).

Capital's income may also need to be adjusted. Expenses for depreciation and property taxes should be deducted. Finally, omitting rental income should be considered, as fast-rising rental income may reflect real estate prices.

C. Sensitivity of Results to the Definition of Income and Unit of Analysis

40. Measures of income inequality may be misinterpreted if the effects of the definition of income and the unit of analysis are not considered. The *SNA* contains many income concepts, including the income received by the economy or by the household sector, and income before or after current transfers. The net national income concept used in the WID has the advantage of taking account of the benefits of equity ownership by including retained earnings of corporations—an important driver of stockholder wealth.[10] However, distributions based on *disposable* income could also capture the important effects of remittances on the income of the poor.

41. NSOs should focus on the distribution of household income. Household disposable income should be highlighted in data dissemination, as it reflects the resources that households can consume or save. To show the distributional impact of taxes and transfers, the distribution of household income before taxes and transfers should also be disseminated.

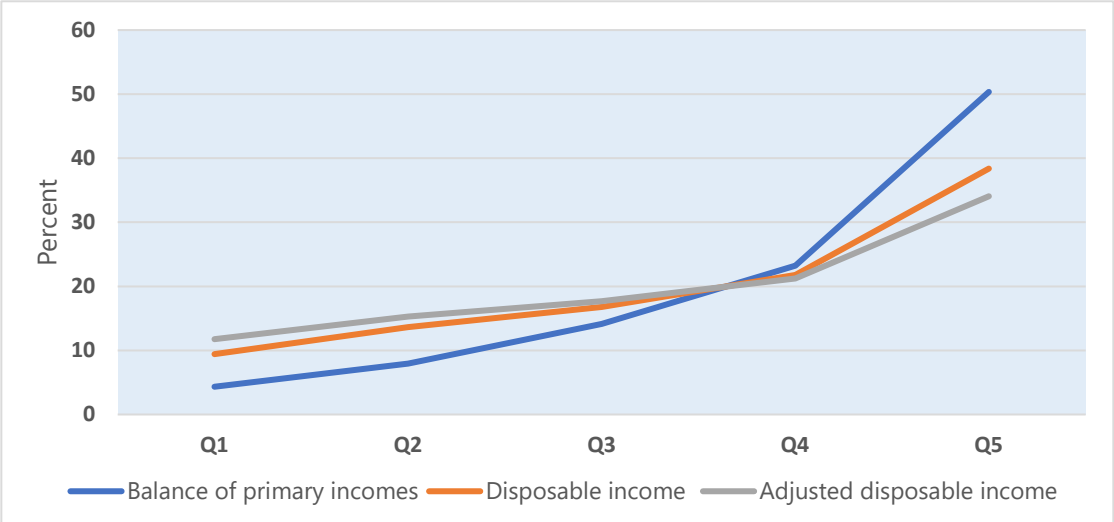
42. The income concept used must be clearly identified when disseminating distributional indicator. This will make mistakes of comparing distributional indicators based on different definitions of income less likely to occur. Household income before taxes and transfers (labeled "balance of primary incomes" in the *SNA*) exhibits more inequality than household disposable income (Figure 5). Note also, that consumption is more equally distributed than income. In Figure 6, adjusted disposable income of the bottom quintile normalized by the population average is centered around 0.5, but in Figure 7 the corresponding measure of consumption of the bottom quintile is centered around 0.7.

[10] Unfortunately, retained earnings are assigned to the economy of residence of the corporation, not the stockholders.

43. The unit of analysis (individuals, households or equivalized households) also affects the results. The WID results are difficult to compare to the distributional indicators produced by the NSOs participating in the EGDNA. The WID uses the income per adult individual, while the EGDNA uses equivalized household income. *Equivalized income* is widely used and is generally well suited for analysis of welfare growth.[11] Average household size has fallen in most advanced economies, slowing the growth of equivalized household income (Nolan et al, 2019).

44. An international standard on the definition of quintiles could improve international comparability of distributional indicators. Australia divides the data into quintiles based on numbers of *individuals*, while Canada and the Netherlands use numbers of households. Australia's definition brings more households into the bottom quintile, contributing to the comparatively high-income share of that quintile in the data published by Australia (Figure 8).

Figure 5. Quintile Shares Under Different Definitions of Household Income
(United Kingdom, 2013)



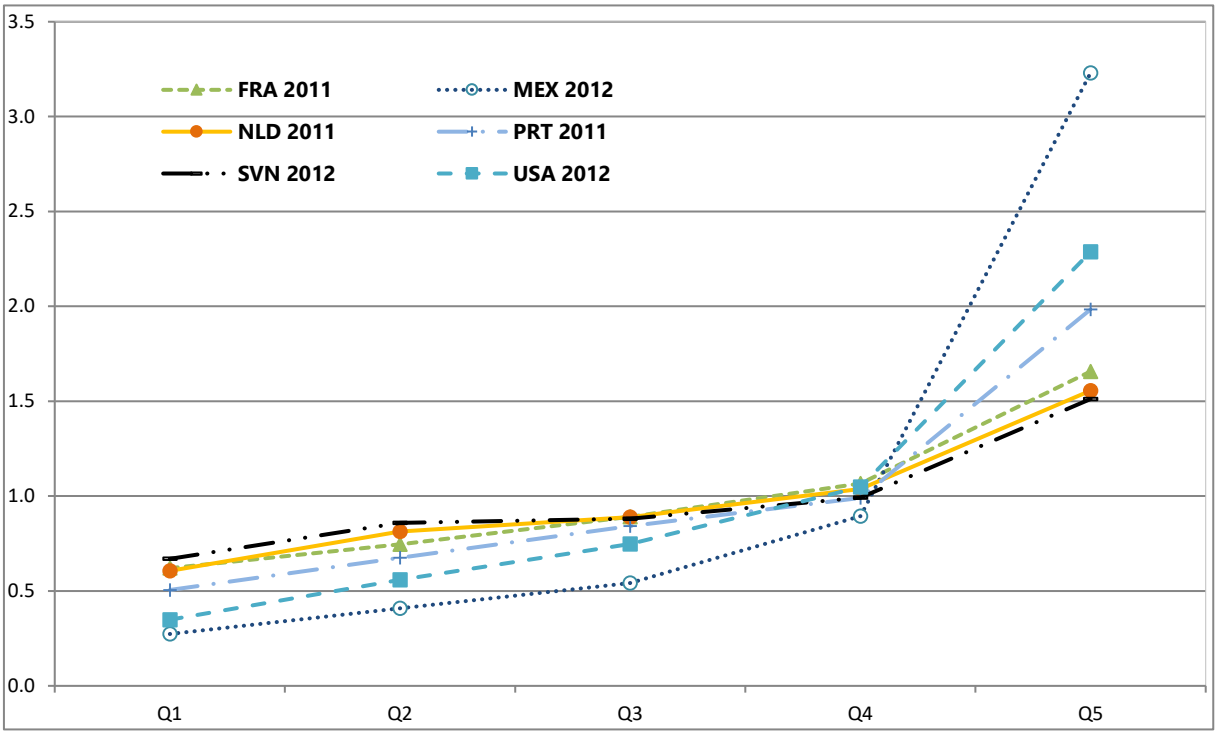
Source: ONS, "Results from the OECD Exercise on the Distribution of Household Income, Consumption and Savings".

https://www.ons.gov.uk/economy/nationalaccounts/uksectoraccounts/datasets/resultsfromtheoecdexerciseonthedistributionofhouseholdincomeconsumptionandsavings

[11] The OECD equivalence scale may not be applicable in economies where housing costs are low and the budget share of food is high (Mysíková et al., 2019).

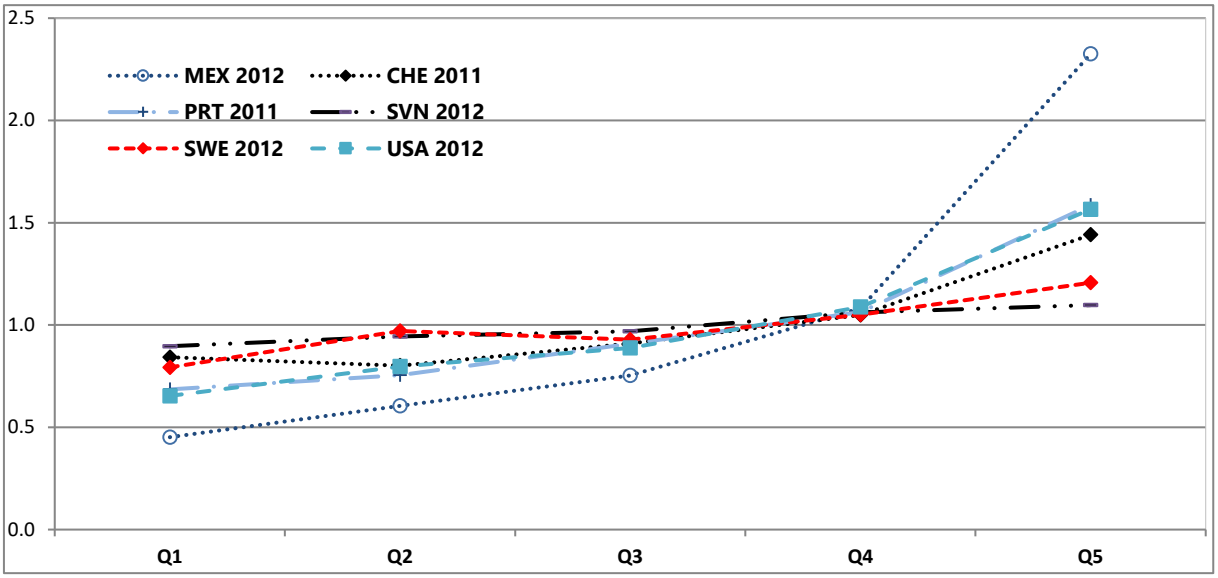
Figure 6. Equivalized Adjusted Disposable Income by Quintile
(Ratios to the Overall Average)

Adjusted disposable income per consumption unit for each group to the average adjusted disposable income per consumption unit in the country.



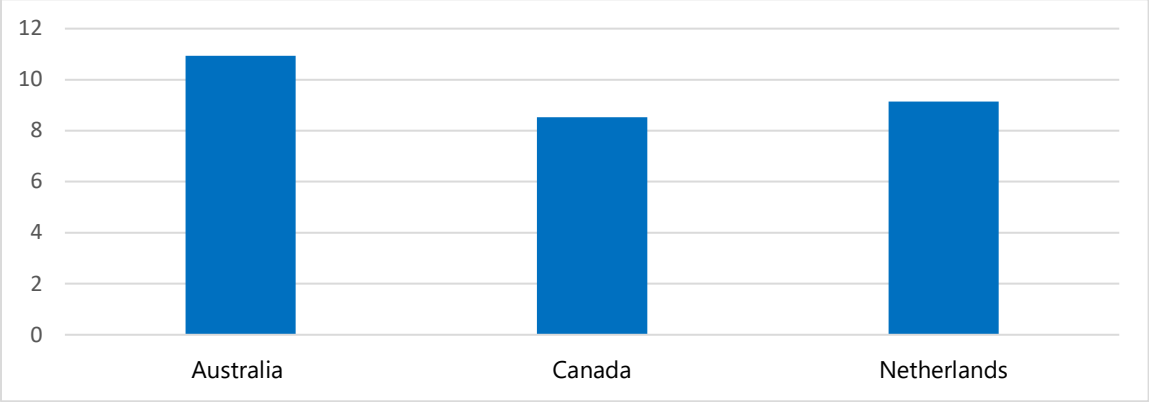
Source: Zwijnenburg *et al.*, 2017.

Figure 7. Actual Final Consumption of Equivalized Households by Quintile
(Ratios to the overall average)



Source: Zwijnenburg *et al.*, 2017.

Figure 8. Bottom Quintile's Share of Adjusted Disposable Household Income 2017
(percents)



Sources: ABS Australian National Accounts dataset 5204.0.55.011; Statistics Canada Table 36-10-0587-01; CBS Statline https://opendata.cbs.nl/statline/#/CBS/en/dataset/84103ENG/table?ts=1542973915638. Australia data are for 12 months ending in June 2018.

Note: Adjusted disposable income reflects taxes, transfers, and social transfers in-kind such as health care and education. Depreciation of household fixed assets is not deducted. The quintile definition is based on persons in Australia.

D. Price Changes Experienced by Households with Different Incomes

45. Analyses of the inclusiveness of the growth of income generally apply the same deflator across the entire income distribution, but inflation can vary between quintiles. For example, price indexes based on mixes of products bought by different quintiles in the United States show an inflation rate of 1.87 percent over 2004–2015 for the bottom quintile, but a rate of just 1.21 percent for the top quintile (Jaravel, 2019). In another study, the bottom quintile was found to have faster income growth than the next three quintiles when the definition of income included government transfers and the same deflator was applied to everyone (Congressional Budget Office, 2018). Because of high inflation in health care prices, transfers for health care made the nominal income of the bottom quintile grow relatively quickly. A deflator whose weights reflected the greater importance of health care in the basket consumed by the bottom quintile would have implied slower growth of its real income.

E. Recommendations

46. Distributional indicators of household disposable income, final consumption, saving, and wealth should be developed in a national accounts framework. These indicators will fill important information gaps in the national accounts and may be more accurate and more internationally comparable than indicators based purely on survey data. The quintiles and decompositions by types of households that have been emphasized in the distributional work of the NSOs are appropriate priorities. However, some additional indicators are needed. Medians are needed as representative indicators of the circumstances of the typical person. The top decile and

top 1 percent are needed to understand income and wealth concentration, and Gini coefficients would be appropriate to disseminate, as they are standard indicators of inequality.

47. If household income and consumption are not yet published in the national accounts, these measures should be developed as a step towards distributional indicators. Also, work on the distributional indicators for consumption should proceed regardless of whether data are available for compiling the income distribution.

48. To enhance the accuracy of the income distribution estimates and facilitate measurement of after-tax distributions, NSOs should have access to tax data. These data should have sufficient detail to identify different types of income included in the *SNA*. Also, opportunities for improving the quality and availability of the survey data on household income, consumption, and wealth should be explored.

49. Definitions and assumptions should be mentioned in the documentation of income and wealth indicators and considered by the users of these indicators. Distributional indicators based on alternative definitions of income should be disseminated to show the effect of taxes and transfers on inequality. The documentation should also discuss the underlying assumptions and sources of uncertainty of the estimates.

50. Future research should examine the distributional effects of digitalization. Innovations such as mobile money, free video calls, and other free digital services may have had important effects on the distribution of real consumption.

WELFARE AND DIGITALIZATION

51. Productivity growth slowed in advanced economies at around the time online platforms, e-commerce, and the smartphone began to change life profoundly. The rapid uptake and intensive use of the digital services and devices suggest that they generated substantial welfare gains. Nevertheless, growth statistics in advanced economies indicated stagnation, leading some to suspect mismeasurement. A 2016 article in *The Economist* seemed to confirm the suspicions.[12] It argued that a growing fraction of innovation was not being measured in GDP because the sharing economy, free items, benefits of new goods, and volunteer-produced content and software were omitted. Note that some of these hypotheses of underestimated growth also imply overestimation of inflation by the CPI.

52. Table 3 lists three possible sources of unmeasured welfare growth from digitalization. They include e-commerce (particularly online shopping) and household nonmarket production enabled by new digital devices, services, and information. Other areas of concern (discussed in Quirós and Reinsdorf, 2018) are fintech developments such as mobile money and cross-border digital transactions. Note, also, that domestic consumption of digital goods and

[12] "The Trouble with GDP", *The Economist*, April 30, 2016. https://www.economist.com/node/21697845/print

services, which is the focus for welfare measurement purposes, differs from domestic production because of imports and exports. Corrections to consumption growth could therefore leave GDP growth virtually unchanged after the corresponding correction to import growth.

Table 3. Hard-to-Measure Sources of Economic Welfare Growth from Digitalization

Source of Growth of Economic Welfare	Welfare Impact conceptually within GDP Production Boundary?	Welfare Impact Measurable without Uncertain Assumptions?	Practical to measure in official GDP and CPI?
Digital products supplied as outputs of market producers			
Quality change from new models and varieties of existing products	Yes	Usually yes	Sometimes
New goods and product capabilities	Yes	Usually no	Usually no
Free services of online platforms	In theory, yes	No	No
Memo: Price changes of continuously existing items	*Yes*	*Yes*	*Yes*
Household nonmarket production enabled by digital products and information			
Utilization of digital products in nonmarket production for own consumption	No	Varies	Usually no
Improvements in HH nonmarket production technologies enabled by digital information	No	No	No
Volunteer-produced software and content	No	No	No
Online shopping and the sharing economy			
Lower prices	Yes	Usually yes	Sometimes
More choice of varieties	?	No	No
Convenience (Time savings)	Probably yes	No	No

A. Nonmarket Production and the GDP Production Boundary

53. Households combine their time with inputs from the market to produce the outcomes and experiences that they ultimately consume. Hulten and Nakamura (2019) argue that digitalization has improved households' ability to do this, resulting in faster growth of economic welfare than GDP. Welfare growth attributable to changes in households' nonmarket production must be viewed as beyond GDP. But welfare growth made possible by innovations and improvements in the products used as inputs in the household nonmarket production is conceptually part of GDP growth.

54. Inventions and product innovations enable improvements in nonmarket production of services for a household's own consumption. They may reduce the time cost or the money cost of achieving an outcome, enable the household to achieve a new or better outcome (e.g. better variety selection), or enable the household to use leisure time for new kinds of experiences (e.g. video games). Economic history includes many inventions with sizeable impacts on households' time costs and money costs (Gordon, 2016).[13]

55. Digital innovations enabling money savings can sometimes be analyzed as replacing market production by nonmarket production (Coyle, 2019). For example, resources available online, and the diverse capabilities of the smartphone, have reduced or eliminated expenses that were once part of households' cost of living. Travel agents, film developing, SMS text fees, postage, and long-distance calling have been replaced by digital products that allow households to achieve an equivalent outcome for free (at least before the cost of digital devices and communication services is considered). Also, open access courses and lectures have enabled free learning.

56. Nevertheless, the welfare change due to the appearance in the market of a new good or service remains within the GDP boundary even if consumption of the good involves inputs of households' time. The impact of the initial appearance of a new good or service will generally be appropriate to attribute to the market production of that good or service, making it conceptually relevant for GDP growth.

57. Measures of households' utilization of a good or service may be regarded as indicators of their production of services for own consumption. For example, utilization of internet services may be measured by petabytes of data and utilization of services of digital devices may be measured by time use. Byrne and Corrado (2019) find that expanding the GDP production boundary to include household production utilizing the internet and digital devices increases the growth rate of U.S. GDP over 2007–2017 by 0.44 percentage points.

58. An economic welfare index that includes this household production of services for own consumption would be a useful complementary indicator. An expansion of the production boundary in order to bring these services into GDP can be ruled out. If the expansion were selective, it would create inconsistencies. Yet a general change in the treatment of all household production of services for own consumption would cause such large imputations of output and income that GDP would become unsuitable for key policy questions involving income, employment, and government finances. If production of services is imputed, expenditures on the services, and the income funding those expenditures must simultaneously be imputed. But imputed spending does not create jobs,

[13] For example, the automobile shortened travel times. Electricity reduced the time costs of laundry, cooking, and cleaning (Greenwood et al., 2005), or the money cost if you paid someone else to do it for you. As an indication of the time cost savings from running water, UNICEF recently estimated that women and girls in places without running water spend 200 million hours per day fetching water (UNICEF press release, 29 August 2016). The safety razor is an example of a money cost savings, as it replaced barbershop shaves.

and imputed income cannot be saved, taxed, spent on other things, or—in the case of a producer—used to pay employees.

B. Digital Products Supplied as Outputs of Market Producers

59. Quality changes in new models and varieties, including improvements enabled by new technology, can be challenging to measure. When a new model replaces an existing model, the welfare change may be captured by adjusting the price of the new item for quality differences, perhaps using hedonic regression techniques.[14] Based on the literature on hedonic quality adjustments for digital devices and services, Reinsdorf and Schreyer (2019) assume that overlooked quality improvements cause a 5 percentage point overstatement of the annual rate of price growth for most digital devices and services, a 10 percentage point overstatement for telecom services, and 2 percentage point overstatement for products with significant digital content such as automobiles. Applying the weights of the average OECD basket of household consumption expenditures gives upper bounds for the potential effect on the annual growth rate of the household consumption deflator of 0.4–0.5 percentage points.

60. Standard techniques for adjusting for quality differences (such as hedonic regressions or the production cost of the new feature) cannot be used for truly novel new goods such as the smartphone. Approaches that estimate the money value of the time savings, improved outcomes, and new uses of leisure time may also be hard to implement.

61. In theory, the consumer surplus from the appearance of the new good can be measured using a reservation price, defined as the price just high enough to drive demand for the good to zero.[15] Suppose that good N appears as a new good in period t at price p_{Nt} and that consumer purchase q_{Nt} units at that price. The shape and position of the demand curve implies that at a price of p^* zero units would be demanded, so p^* can be treated as the good's price in the period t–1. Multiplying the assumed price decline from p^* to p_{Nt} by the quantity demanded at the lower price, q_{Nt}, would over-estimate the consumer surplus. However, the consumer surplus can be calculated as $(p^* - p_{Nt})q_{Nt}/2$ if the demand curve is linear. Note, also, that if estimation of the reservation price requires uncertain assumptions, the impact of incorporating the new good's reservation price in the CPI or GDP deflator should be shown in a complementary indicator.

62. When a new good reduces the money cost of achieving the same outcome, the expense avoided can sometimes be used to bound welfare effect. The lower bound would be based on spending patterns before the outcome became free. Reinsdorf and Schreyer (2019) use this approach to calibrate plausible bounds for the effect on the household consumption deflator of free and low-cost digital replacements. Based on weights in the average OECD consumption basket of 2005, the deflator's growth rate could be reduced by almost 0.2 percentage points

[14] Getting new models and varieties into the price index quickly so that their early price declines can be captured will help to measure the welfare gains even if quality-adjusting their prices is impossible (Quirós and Reinsdorf, 2018).

[15] Similarly, the welfare loss from a disappearing good can also be measured by assuming that the good's price rose to the reservation price.

(or by 0.1 percentage point using 2015 weights). The change in unit cost of achieving the output may also be possible to use to construct a price index. For example, Nordhaus (1996) uses the cost of producing a lumen to construct a long-run index of the price of light that compares each new lighting technology to the one it replaced (e.g. compact florescent bulbs as a replacement for incandescent bulbs). The average annual growth rate of this index over 1850–1992 is 5 percentage points lower than a standard price index that treats each new lighting technology as a different good.

C. Free Services of Online Platforms

63. Free services of online platforms, such as Google and Facebook, are a focus of the debate over measurement and digitalization. These services are sometimes said to be missing from GDP. However, if the criticism concerns nominal GDP, it is mistaken, as the services are captured indirectly.

64. Free items may be part of a bundle that also includes marked-up items that supply the funds used to subsidize the free items. Items that are free because they help to sell other, marked-up items that subsidize them are captured indirectly in GDP as part of the sales of the items that fund them (Box 3). Nevertheless, the conclusion that nominal GDP is correctly measured does not rule out underestimation of growth of real GDP and economic welfare if the deflator fails to capture the effect of the free items on the cost and quality of the bundle.

65. Platforms—service providers that facilitate interactions between two or more parties—are a major component of the digital economy. Online platforms often have a funder side and subsidized side that is free. For example, they may enable advertisers to reach an audience by supplying the free entertainment and information needed to assemble the audience. The advertisers pay mark-ups that subsidize the free entertainment and information and then recoup the cost from the platform users as part of the prices of the items sold to them. (The free services may also help to generate intangible data assets for the platform, causing the platform itself to subsidize the services as part of investment in data.)

66. The appearance of a free service in the digital economy generates welfare gains. Even if the service is free, the reservation price may be positive (Brynjolfsson et al., 2020). Because conventional methods for estimating the reservation price cannot be applied, estimates of the consumer surplus from free digital services have been based on experiments on payments that users would be willing to accept to stop using the service. Brynjolfsson *et al.*, (2019) use the consumer surplus estimates to adjust the growth rate of an expanded concept of GDP ("GDP-B") over intervals beginning just before the free services appeared. Facebook alone generates enough consumer surplus to increase the average annual growth of rate of GDP-B in the US over 2003–2017 by 0.05 percentage points. The combined median willingness-to-accept in the US for giving up Facebook, WhatsApp, online search engines, email, maps, and other free digital services totals more

than $30,000 per user annually.[16] The implied adjustment to the cumulative growth of real household consumption over the years since the free services first appeared could be 2 percentage points. Adding such a large imputation would change the character of the national accounts, making them less useful for key policy questions.

Box 3. Are Free Platforms a Problem for Measuring the Level of GDP?

A distinctive feature of the digital economy is that many of its products are free. Because free items are not explicitly included in output, the free services supplied by online platforms like Facebook and Google seem to be missing from nominal GDP. If true, imputed expenditures would have to be added to the platforms' output and to platform users' consumption.

However, the hallmark of missing output is negative net operating surplus, meaning that the amount of output being recorded is too low to cover the producer's operating costs. The fact that this does not describe most platforms offering free services (Facebook and Google have operating surpluses amounting to more than a third of output!) suggests that their output is not systematically undermeasured. The current conceptual framework for measuring the contribution of free platforms to GDP therefore remains sound.

Free items supplied by market producers are a special case of the common phenomenon of cross-subsidized pricing structures. The subsidized items help to sell other items, and the bundle as a whole generates profits. A common case of cross-subsidized prices in the digital economy is the "freemium" business model. A free version of the product is offered as an entry point for selling a premium version or add-ons. For example, free software helps to sell upgrades, support services and complementary products. Also, online video games that are free to play generate large profits from in-game purchases. Although the freemium business model causes lags in timing of the recording of output, in the long run output is not undermeasured.

A more complex case of cross-subsidization is the two-sided platform in which one side bears all the costs. The side that pays for the platform recoups this cost as part of the revenue from interactions with the other side facilitated by the platform. For example, Adobe helps the users of pdf file editing software to reach readers by making the pdf reader free. Users of the pdf editor subsidize the reader as part of the price of the editor and recoup this cost through transactions facilitated by the reader. Advertisers are a major funder of platforms' free services, and they recoup this cost as part of the prices of the advertised products. (The deflators for the advertised products may have measured the welfare gain from falling costs of online advertising that was passed on to consumers—see Mandel, 2019).

Lagged timing of the recording in GDP of the output associated with the free services is a possible minor measurement problem. The platform funder may recoup the costs of subsidizing the free platform services as part of its sales to final users with a delay. In addition, two kinds of investment of at least analytical interest are omitted from the *SNA*. First, platforms supply free services to attract more users so that they can benefit from network effects and economies of scale. Second, the platforms collect users' data. Data used for R&D and databases may also be already captured as part of these types of investment (Reinsdorf and Ribarsky, 2019), but additional intangible assets derived from data may missed.

67. Table 3 characterizes the consumer surplus from free services as unsuitable for incorporation into official estimates of GDP because of the uncertainty of the assumptions. In the case of Facebook, for example, willingness-to-pay experiments give much lower estimates of

[16] The marketers of Vitamin Water based a publicity campaign on the theme that people would need to be paid a large amount to give up their digital life. The prize for giving up smartphones for a year was $100,000.

consumer surplus than willingness-to-accept experiments (Sunstein, 2019). Also, the unmeasured losses of consumer surplus from disappearances of competing services could offset some of the gains. Finally, free digital services create opportunities for platforms to collect users' data, and loss of privacy represents a cost to users that could be worth considering.

68. Note that cross-subsidized pricing structures could affect the measurement of price and volume growth via their influence on the weights of the deflators. For example, mobile phone operators in the U.S. used to bundle subsidized phones with marked-up telecom services. Valuing the phones at market prices and valuing the telecom services at prices net of the mark-ups would change the deflator's weights. Aizcorbe, Byrne and Sichel (2019) find that corrected weights, and adjustments to the phone price index for quality change reduce the growth rate of the deflator for the bundle by 4 percentage points. Further research is needed on cost-based weights as a replacement for weights based on subsidized prices.

D. Nonmarket Production for Own Consumption Enabled by Digitalization

69. Expanded availability of information may enable improvements in household nonmarket production technology.[17] Digital information and communication have enhanced households' nonmarket production technology in ways that allow savings of time and money. Digital maps of routes and traffic jams allow better travel planning. Also, online instructions, marketing information and product reviews have improved decision-making in consumption (thereby improving outcomes). Finally, telework enabled by digital communication has saved commuters time and money, and online classes have also enabled similar savings for students. Hulten and Nakamura (2019) note that improvements in nonmarket production enabled by digital information and communication represent output-saving innovation.

E. Volunteer-Produced Software and Content

70. Digital dissemination of content (e.g., wikis, blogs, product reviews and photos) and software has amplified the value of the work of volunteers in the digital economy. Volunteer-produced content and software are outside the boundary of GDP. Complementary indicators of the use of free software (as part of investment) and free digital content produced by volunteers could improve our understanding of growth in the digital age. Estimates of their value based on the revenue that volunteer-produced content could hypothetically generate, or the time involved in creating free software tend to be relatively modest, but these approaches do not capture the welfare impact.[18]

[17] As an example from economic history, Mokyr (1993) and Mokyr and Stein (1997) argue that changes in home production in response to knowledge about diseases helped to raise life expectancy after germs were discovered.

[18] Ahmad et al. (2017) find a relatively modest value for Wikipedia based on what it could earn from selling advertising. Robbins et al. (2018) value several open source software packages (including R and Python) from the hypothetical cost of the time it took to create them at commercial pay rates for coders in the US. The implied investment is $4 billion US dollars.

F. E-Commerce and the Sharing Economy

71. Business-to-consumer (B2C) e-commerce has seen rapid growth across the globe, reaching almost 3.9 trillion US dollars in sales globally and over 1 trillion dollars in China alone (UNCTAD, 2019). The welfare gains from e-commerce come from opportunities to pay lower prices, increased choice of varieties, and the time savings from not having to visit a physical store. However, the welfare losses from lost variety and convenience caused by physical stores put out of business by online competition would offset some of the gains.

Prices May Be Lower Online

72. Lower prices online are one of the drivers of substitution from physical outlets to e-commerce. The change in the average price paid for an item caused by substitution to online sources of supply is often difficult to capture in the CPI even if the outlet sample is regularly updated to reflect changes in online purchasing patterns. However, some of the price savings from substitution to online sellers may be possible to capture in the CPI by treating the item from the online seller that is replacing an offline seller in the outlet sample as continuation of the previous item. For this to be possible, the main characteristics of the online and offline versions of the item must be the same. An alternative price index intended for research purposes could also incorporate quality-adjusted comparisons of the non-matching online and offline versions of the product.

73. Substitution to online shopping could have caused a modest overstatement of price change for items frequently bought online. If the online share of retail purchases rises at a rate of 2 percentage points per year and online sellers offer prices that are 5 percent lower (as reported by Cavallo, 2018, for Amazon), a plausible scale for this effect would be 0.1 percentage points.[19]

74. Substitution to new sources of supply in the sharing economy (e.g. ridesharing replacing taxis and home sharing replacing hotels) has also allowed consumers to pay lower prices. The CPI is unlikely to reflect the change in average price paid caused by this sort of substitution. Research on the effects of changes in the market share of ridesharing and home sharing in the local transport and overnight accommodation industries would help to fill in the picture of the welfare gains from digitalization.

Enhanced Variety and Convenience

75. Expanded choice of varieties may be the most important source of welfare gains from the emergence of e-commerce and the sharing economy. For example, ridesharing has brought local transportation services to underserved areas, and home sharing offers a wide variety of lodging options.

76. A common procedure for estimating variety gains assumes an inverse relationship between quality-adjusted prices and expenditure shares of varieties. The model's key parameter

[19] Cross-border online shopping has grown rapidly (UNCTAD, 2019), raising additional welfare measurement issues.

reflects the substitutability of different varieties of the product. The net market share of the new varieties equals the expenditure share of the new varieties that appeared in period t minus the expenditure share in period t–1 of the disappearing varieties. To approximate the adjustment to the price index for changes in variety assuming a typical substitution parameter of four, the new varieties' net market share can be divided by three. For example, Brynjolfsson, Hu and Smith (2009) estimate that in 2000 obscure titles available only after the arrival of online bookstores accounted for 2.4 percent of total book sales. The consumer surplus from the newly available obscure titles therefore reduces the cumulative growth of the price index for books over the five years since online bookstores appeared by 0.8 percentage points.

77. Dolfen et al. (2019) estimate the consumer surplus from better selections of varieties online shopping as of 2017 using data on spending patterns of US consumers at online and offline stores for items commonly purchased online. With a substitution parameter of 4.3, the variety gains from the arrival of online shopping amount to over 1 percent of overall consumption. Spreading this gain over 22 years since online shopping emerged implies additional growth of real household consumption of about 0.05 percent per year.

78. Gains from better selection of varieties could be viewed as coming from household nonmarket production and hence beyond the scope of GDP. Households use their time to search for product varieties that best fit their tastes and circumstances. Better information for finding varieties and wider choices of varieties have enabled households to improve search outcomes.

79. E-commerce has reduced the time cost of shopping by making it unnecessary to travel to physical stores and find things on shelves. In effect, households' time cost savings result from a shift of the responsibility for these tasks to the market producer side of the GDP production boundary. Even after allowing for the time cost of online search for varieties and digital ordering, households' net time savings from e-commerce could be large. The estimate of Dolfen et al. (2019) of the value of the gross time savings and money savings increases the adjustment to the growth rate of household consumption to 0.075 percentage points.

G. Recommendations

80. Data on the size and composition of the digital economy, spending on digital products, and the market shares of domestic and foreign e-commerce retailers should be disseminated in a digital economy satellite account. This satellite account will enable better understanding of the welfare effects of the digital economy by providing information on the weights of the relevant items in the consumption basket. It may also help to ensure that the digital economy is fully captured in GDP.

81. Compilation methods for price indexes and nominal GDP must incorporate new digital products promptly and price index compilers should adjust for quality changes when possible. Quality adjustments that require uncertain assumptions to estimate should be included in complementary indicators. Furthermore, CPI compilers should ensure that online and

platform-based sources of supply are properly represented in outlet samples and sample updating procedures.

82. Time use surveys should be designed to collect data needed to understand the effects of digitalization on time use and to develop complementary indicators of the significance of thee effects for economic welfare. Further research is also needed on the effects on indexes of the cost of living and of economic welfare of household nonmarket production enabled by new digital products, free digital services, and online access to information.

83. Further research is needed on measurement of the information assets generated by collection of data on platform users and other aspects of collection users' data.

FINAL CONCLUSIONS AND RECOMMENDATIONS

A. Indicators of Economic Welfare in the *SNA*

Conclusions

84. While measuring growth remains important, attention is increasingly shifting to people's welfare and well-being. Well-being encompasses dimensions such as happiness, collectively consumed environmental amenities, and trust along with economic welfare. Economic welfare is a narrower concept whose dimensions involve broadly-defined consumption, income, wealth, prices paid by domestic purchasers, and environmental sustainability.

85. The role of the welfare indicators of the *SNA* is key. They are the starting point for measuring economic welfare.

86. Complementary indicators of economic welfare are also needed to provide additional detail on how the income, consumption and wealth are distributed and to cover items beyond the GDP production boundary. These items include household time use and nonmarket activity, aspects of natural capital and environmental sustainability, and human capital. Also, many of the welfare effects digitalization will require complementary indicators because they are conceptually beyond GDP or because the assumptions required to estimate them are very uncertain. Guidelines for new complementary indicators of these items are being developed by international expert groups for inclusion in the next generation of international standards for macroeconomic statistics. Measurement of the digital economy is also being considered.

Main Recommendation

87. NSOs can make important progress on measuring economic welfare by filling data gaps on household consumption and disposable income, real income of the total economy, prices of final expenditure items, and household wealth. The data gaps may include measures of

real national and disposable income of the total economy deflated by a price index for gross final domestic expenditures.

B. Distributional Indicators

Conclusions

88. Distributional indicators of household income, consumption, and wealth as measured in national accounts would fill important information gaps on economic welfare at the household level. Policy priorities of inclusive growth require indicators of income and consumption of the bottom quintiles and data on how different kinds of people (e.g., women, the elderly, youth, and minorities) are faring. Also needed are distributional statistics that represent the experience of the typical household (such as medians) and that summarize the inequality dimension of economic welfare (such as Gini coefficients).

89. Different definitions of income and wealth can give very different pictures of inequality, and the results may also be sensitive to debatable assumptions. Comparing distributions of income based on different definitions may help to understand the redistributive effects of taxes and transfers, and sensitivity to assumptions may be worth. However, comparisons of different years or places that allow the definition of income to vary are unlikely to be meaningful. A full understanding may require consideration of the joint distribution of income and wealth.

Main Recommendation

90. NSOs should develop distributional indicators of household income, consumption and wealth. The indicators should include quintiles of the income distribution, medians, Gini coefficients, and breakdowns by demographic characteristics. To enhance the accuracy of the estimates of the income distribution and of the effect of taxes on disposable income, NSOs should have access to tax data on households. The income distribution indicators should include alternative definitions of income to allow insights into effects of taxes and transfers.

C. Digitalization

Conclusions

91. The accuracy and adequacy of the *SNA* welfare indicators has been called into question by the many free and innovative products that have appeared in the digital economy. Free online services, the capabilities of the smartphone, and digital access to information are among the things that have allowed outcomes to be achieved for free or at reduced time cost. In addition, e-commerce and the sharing economy have expanded households' access to variety and reduced their time costs. Nevertheless, estimating the money value of these effects often requires uncertain assumptions, and some the effects are conceptually beyond GDP. *Complementary indicators are therefore needed for a complete picture of the welfare effects of digitalization.*

92. The value of the free services supplied by online platforms is generally well-captured in nominal GDP as part of the prices of items sold by the funders of the platform. However, the effects on welfare growth, which are hard to measure in practice, may be missed by the price and volume indexes for household consumption. Also, further research is also needed on the measurement implications for nominal GDP of platforms' collection of users' data.

Main Recommendation

93. Estimates of the welfare growth from free and innovative products in the digital economy that depend on very uncertain assumptions should be incorporated in complementary indicators rather than in GDP. NSOs should develop complementary indicators that provide a complete, though uncertain, picture of the effects of digitalization on welfare growth through their own research capabilities and in collaboration with outside experts. This work should draw on existing academic research on welfare and digitalization. NSOs should also prioritize improvements in compilation of deflators that will allow the welfare gains from new digital products, models and suppliers to be captured in household consumption growth.

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Simplified Current Accounts for the Total Economy			
Account	**Key Resources**	**Key Uses**	**Balancing Item(s)**
Production	Market and near-market output valued at basic prices Taxes on products and imports less subsidies	Intermediate consumption *Consumption of fixed capital (depreciation)—relevant for net domestic product*	Gross (*net*) domestic product
Generation of income	Gross (*net*) domestic product	Compensation of employees Taxes on products and imports less subsidies Other taxes on production	Gross (*net*) operating surplus (of corporations/quasi-corporations) Mixed income (*Net mixed income*)
Allocation of primary income	Gross (*net*) operating surplus Gross (*net*) mixed income Compensation of employees Taxes on products and imports less subsidies Other taxes on production Property income received	Property income paid	Gross (*net*) national income
Secondary distribution of income	Net national income Current transfers received	Current transfers paid	Net disposable income
Use of Disposable Income	Net disposable income *or* Adjusted disposable income	Final consumption expenditure *or* Actual final consumption	Net saving

Changes in Wealth			
Account	**Changes in net worth/liabilities**	**Changes in assets**	**Balancing Item(s)**
Capital	Net saving Net capital transfers received	Gross (net) fixed capital formation Change in inventories Net acquisitions of valuables and non-produced assets	Net lending or borrowing
Financial	Net incurrence of financial liabilities (by type of instrument) Change in accounts payable	Net acquisition of financial assets (by type of instrument) Change in accounts receivable	Net lending or borrowing
Other changes in volume of assets		Economic appearance of assets Economic disappearance of non-produced assets Disaster losses Uncompensated seizures Reclassifications	Change in net worth due to other changes in volume of assets
Revaluations (holding gains and losses)	Financial Liabilities	Nonfinancial assets Financial assets	Change in net worth due to holding gains and losses

Wealth			
Account	**Liabilities**	**Assets**	**Balancing Item**
Balance sheet	Payables Financial liabilities	Nonfinancial assets Financial assets	Net worth

Annex II. Compiling Income Distributions in a National Accounts Framework

Compiling Household Income Distributions

1. The process of correcting for conceptual and statistical differences and constructing income quintiles in a national accounts framework can be broken into five steps (Zwijnenburg, Bournot and Giovannelli, 2017). For the distribution of household adjusted disposable income, the steps are:

a. adjust the national accounts totals to exclude income received by households who are not covered in surveys and, if necessary, nonprofit institutions serving households;

b. identify variables from household surveys and administrative records such as tax data that can be matched to household adjusted disposable income components in the national accounts;

c. correct for missing elements (e.g., income that the *SNA* imputes), allocate the gap between the micro data total and the relevant national accounts total for each income item, and combine the various income items to arrive at overall disposable income;

d. group the households into quintiles based on equivalized disposable income; and

e. derive indicators for each group, such as the income share received by each quintile.

2. Property income and social benefits often show large gaps between survey data and national accounts estimates. If available, data on taxes or other administrative records may help to reconcile the micro data with the national accounts benchmarks. Any remaining gap must then be allocated over the distribution. A Pareto distribution is often used to model the upper tail of the distribution if no information is available on the income of the rich.