Ecological Indicators 141 (2022) 109025

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

Review

Estimating the Genuine Progress Indicator before and during the COVID pandemic in Australia

Alexandros Karatopouzis [a], Alexey A. Voinov [b,*], Ida Kubiszewski [c], Firouzeh Taghikhah [d], Robert Costanza [c], Daniel Kenny [a]

[a] School of Information Systems Modelling, University of Technology Sydney, Ultimo, NSW, Australia
[b] University of Twente, Netherlands
[c] Institute for Global Prosperity, University College London, London, UK
[d] Crawford School of Public Policy, Australian National University, Canberra, ACT, Australia

ARTICLE INFO

Keywords:
GPI
GDP
Lockdown
Sustainability
Well-being
Policies
Economy

ABSTRACT

In the efforts to ensure the health of the Australian population during the COVID pandemic, social, economic, and environmental aspects of people's life were impacted. In addressing the pandemic risks, a number of governments prioritized people's health and well-being over GDP growth. The Genuine Progress Indicator (GPI) is used to account for factors that influence well-being. We used the GPI to assess the pandemic's impact on well-being and we examined our results in relation to the GDP. We estimated the GPI for the first 6 months of 2019 and the same period in 2020, during which the first stages of the COVID pandemic and the first nationwide lockdown in Australia took place. We examined two scenarios, in the first we found that in Q1 the GDP growth (1.4%) was accompanied by a significant GPI growth (5.3%), showing a positive relation to the GDP; but in Q2 the significant drop (-6.3%) in the GDP was not followed by the GPI, instead the GPI growth remained almost steady with even a relatively small increase (0.33%), indicating a negative relation to the GDP growth. Whereas in the second scenario, the GPI growths (7.12%) in Q1 and (-2.60%) Q2 were positively related to the GDP growths (4.6%) in Q1 and (−0.25%) Q2.We discuss the reasons for the divergence between the two indicators and one of the limitations of the GPI as a measure of well-being. Lastly, we discuss the behavioural and policy lessons of the lockdown and their relevance to what is proposed by degrowth economists.

1. Introduction

The COVID pandemic led to a significant decline in Gross Domestic Product (GDP) in most countries. GDP is an indicator of market economic activities that is conventionally used as a measure of national success. However, there is wide recognition that GDP cannot account for national well-being (Daly and Cobb, 1994; Costanza et al., 2014; Natoli and Zuhair, 2011; Kubiszewski et al., 2013). GDP conflates costs and benefits, leaving out many benefits from non-market economic activities, without accounting for inequality. The Genuine Progress Indicator (GPI), its predecessor the Index of Sustainable Welfare (ISEW), and other measures were developed as alternative indicators of national progress. In addition to measuring economic progress, these alternative indicators also factor-in social and environmental dimensions (Talberth et al., 2006) and can therefore be used as proxies for well-being in monetary units comparable with GDP. The GPI is a composite indicator, consisting of several indices, grouped over economic, social, and environmental categories, to form a single metric (Hoskins & Mascherini, 2009). The benefits and disadvantages of composite indicators and the use of GPI as a method have been covered in the literature (OECD, 2008; Lawn, 2013; Talberth and Weisdorf, 2017; Kenny et al., 2019) . It is noteworthy that while GPI offers a more accurate indication of national progress than GDP, as with any aggregate indicator there are issues associated with the choice of indices and the underlying data for estimating them.

The GPI is calculated by adding-up the benefits and deducting the costs of economic, environmental and social externalities. It is usually compared to the GDP to identify whether additional economic growth, as measured by GDP, has actually been beneficial for people's well-being. When the GDP increases at the cost of resources that are important for the environmental and social aspects of people's well-being; and these costs are higher than the benefits of the GDP growth, this growth is called 'uneconomic' (Daly, 2005). Such a comparison provides a more

* Corresponding author.
E-mail addresses: aavoinov@gmail.com, a.a.voinov@utwente.nl (A.A. Voinov).

https://doi.org/10.1016/j.ecolind.2022.109025
Received 10 June 2021; Received in revised form 16 May 2022; Accepted 28 May 2022
Available online 29 June 2022

comprehensive view of the state of the economic, environmental and societal well-being of a country, which can help policy-makers better determine the type of interventions required. In previous studies for Australia, this comparison between the two indicators was done over a 50 year period (Lawn, 2003; Kenny et al., 2019).

Here, we use the COVID pandemic to determine whether the decline of GDP caused by the lockdown corresponds to a similar decline in GPI and the extent to which we can use the GPI to measure changes in people's subjective well-being during the crisis. Initially, we estimate the GPI for the first half of 2019 and compare it to that of 2020. We then describe the components of the GPI and analyze the results. Next, we compare the GPI to the GDP in relation to people's life satisfaction for that same period, to assess the add-value of GPI compared to the GDP. Lastly, we discuss the policy implications of the COVID pandemic and the need for a well-being metric to guide consumption behaviours.

2. Methodology

In this study, we chose to compare the GPI with the GDP during the first 6 months of 2020 and 2019. Although data is not fully available for all GPI components, we are able to track the quarterly trends of the most significant contributors such as the value of household work, the value of personal consumption and the cost of commuting and lost leisure time. When data is not fully available, we use estimates from previous years and we focus on determining the GPI trend compared to that of the GDP only for the first two quarters of 2020, in relation to those of 2019.

The GPI has been used in the past to measure well-being trends over several years or decades, but it does not usually focus on measuring well-being during short-term shocks. In this study we measure the GPI for the first 6 months of 2020; because it was during this period that (1) the WHO first announced COVID as a pandemic; (2) the first social restrictions and nationwide lockdown took place; (3) public knowledge about COVID was still limited; and (4) authorities were still adjusting their plans to the crisis.

The GPI is a monetary measure of well-being and it is used to measure both market and non-market goods and services. For example, air quality is a non-market good but the cost of preventing or treating health problems caused by air pollution is included as a positive in GDP when it should be subtracted as a negative. Healthcare is a market good and therefore the cost of air pollution can be (in-part) based on data derived from the health care market (Fig. 1). The opportunity cost is the forgone benefit of clean air, which in this case is no less than the healthcare costs incurred.

The methods and data used to estimate each GPI component are available in Table 1; and the mix of GPI indices are in accordance with GPI 1.0 (Posner and Costanza, 2011) to maintain some consistency with one of the last Australian GPI estimates (Kenny et al., 2019). However, 5 of the GPI 1.0 components (including the costs of noise pollution, net wetland change, personal pollution abatement, net forest coverage changes and services of highways and streets) were excluded from the estimation, due to inadequate data (Fig. 2).

Any variations from the valuation methods of previous GPI studies are a result of insufficient data or due to different perspectives in valuation principles. To compensate for this data inadequacy, we made assumptions that allow us to extrapolate or interpolate data, as needed. For example, we used the results of a survey (Craig and Churchill, 2021) on daily household-work-hours that involve only 3 weeks of the total 54 day national lockdown period that lasted from 23 April (ABSf, 2020) to 15 May (NSW, 2020), but we assume that their findings stay valid for the entire 54 days of Australia's first nationwide lockdown period. Additionally, for the valuation of leisure time we introduce a 'best case' scenario (Scenario 1) with an upper limit to its value equal to $23.83 WTA and a 'worst case' scenario (Scenario 2) with a lower limit to its value equal to ($0) zero. We further discuss some of these methodological challenges of GPI in section 3.1.

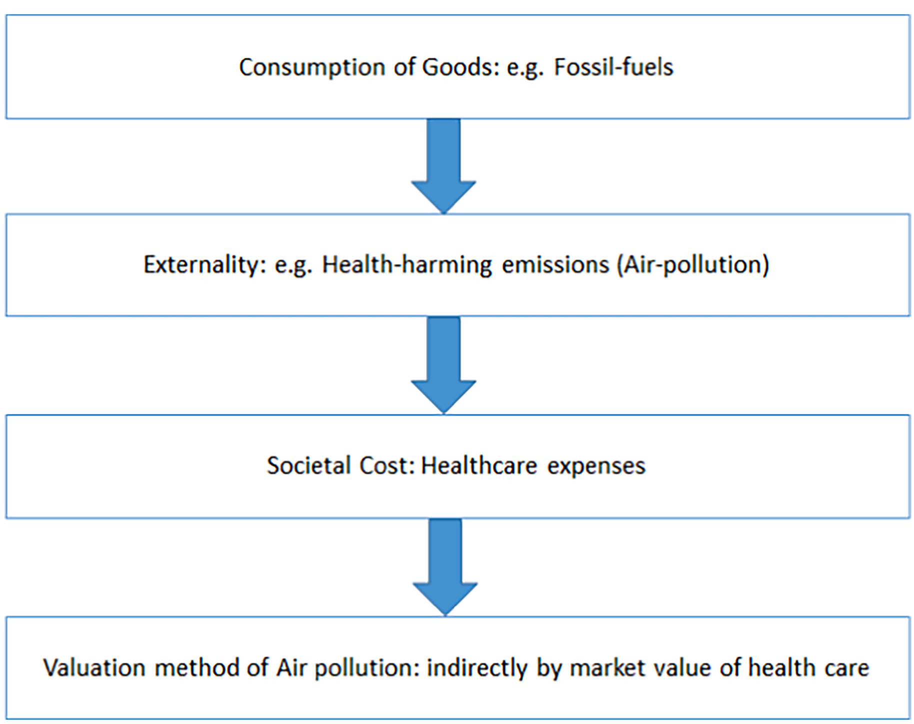


Fig. 1. Indirect valuation of Air quality cost, partially based on market value of health care costs. While the cost of air pollution decreased during the lockdown, this does not mean that people began to value clean air more than in the past, and enough to stop commuting. It mainly reflects the effect of the lockdowns; and not people's perception of the value of air.

Table 1
A list of methods used in calculation of GPI indicators and the sources for data collection. A detailed list of calculations can be found in Appendix A.

GPI Indicators	Method (Calculations / Estimations)	Reference for method	Data source
Personal Consumption Expenditures (PCE) +	ABS: 5206.0 - Australian National Accounts: National Income: TABLE 8 - Household Final Consumption Expenditure (HFCE): A2303280V	(Lawn, 2013; Bagstad et al., 2014)	(ABSa, 2021)
Income Distribution Index (INI) -	INI (2020) = G1/G0 G1: Gini (2020); G0:Base year Gini derived from What-if-Analysis (Goal-Seek) of Gini series.	INI (Lawn, 2003)	Gini series (1967–2013) (Kenny et al., 2019) Gini series (2014–2020) (ABSb, 2022)
Adjusted Personal Consumption (APCE) +	APCE = (PCE Services of Consumer Durables + Cost of Consumer Durables + Cost of Commuting + Cost of Motor Vehicle Crashes) / INI	(Lawn, 2013; Bagstad et al., 2014)	Table 1
Value from Services of Consumer Durables	ABS: 5232.0 - Australian National Accounts: Finance…: TABLE 36 - Analytical Measures of Household Income, Consumption…	(Lawn, 2013)	(ABSc, 2020)
Cost of Consumer Durables -	ABS: 5232.0 - Australian National Accounts: Finance…: TABLE 36 - Analytical Measures of Household Income, Consumption…	(Lawn, 2013)	(ABSc, 2020)
Cost of Unemployment -	ABS: 6202.0 - Labour Force, Australia…: Total Hours worked in Q1,2 of 2020 minus those of 2019 × Average hourly wage ($) (2019: considered base year, with $0 cost)	(Kenny et al., 2019; Lawn, 2013)	(Labour Force, 2020)
Value from Net Capital Investment (NCI) +	ABS: 5232.0 - Australian National Accounts: Finance…: Total Capital Formation in Q1 2019 minus that of 2020;	(Lawn, 2013)	(ABSd, 2020)
Cost of Air Pollution -	PM2.5 (tonnes) × $ cost of PM2.5 per tonne (at an urban density of people/klm2)	(O'Mahony et al., 2018a)	(Kenny et al., 2019; NPI, 2020; EPA, n.d., 2013)
Cost of Climate Change -	[Australia CO2 emissions in Megatonnes in Q1,2 of 2019 minus those in 2020] x $ Cost of C02 per metric tonne	(O'Mahony et al., 2018b)	(Department of Industry, 2020)
Cost of Net Farmland Change -	[National Agricultural Land Area (ha) in 2020 x Average value of 1 ha of agricultural land] minus the value in 2019	(Kenny et al., 2019)	(Agricultural Commodities, 2020; Rabobank. n.d., 2020)
Cost of Nonrenewable Energy Resource Depletion -	Requires estimation of $ cost for preventing the depletion of non-RES via use of RES: N/A for the COVID lockdown period	(Kenny et al., 2019)	(Teske, 2016)
Cost of Ozone Depletion -	Requires Australia CFC emissions impact from COVID: N/A × Average $ cost per tonne of CFC emissions associated to radiation levels of depleted ozone layer	(Kenny et al., 2019)	(Kenny, 2019; Lickley et al., 2020)
Cost of Crime -	$ Cost est. per type of crime in Australia for 2020 vs 2019: N/A	(Kenny et al., 2019)	(Kenny et al., 2019; ACIC, 2020) and sources in Appendix A supp. document.
Value of Leisure Time +	Based on ABS time classification [24 h - (Sleep & Hygiene Hours - Paid Work hours - Unpaid Household work hours - Commuting hours) in Q1,2 of 2020 minus those of 2019] × $ WTA hourly rate (daily est.)	(Kenny et al., 2019)	(ABS, 2006; Labour Force, 2020)
Value of Household work +	Proportionate Estimation: Total ($) value of unpaid housework for 2019 × Total hours of housework per day (in COVID)/ Total hours of housework per day (in 2016)	(PWC, 2017)	(Craig and Churchill, 2021)
Cost of Family Changes -	N/A	N/A	N/A
Value of Volunteer Work +	Volunteer work hours lost during COVID × average hourly wage ($)	(Clarke and Lawn, 2008)	(Volunteering Australia, n.d., 2018; Update on National Volunteer Week, 2020)
Cost of Motor Vehicle Crashes -	# of car crash related fatalities per Q1,2 in 2019 minus those of 2020 × average $ cost of a car crash fatality	(Kenny et al., 2019)	(BITRE, 2020; AAA, 2017)
Cost of Commuting -	Estimation: Cost of (using public transportation + car purchase & maintenance & operation + time lost commuting to work) Statistical error est.: 1% to 10%	(Clarke and Lawn, 2008)	(Australian Institute of Family Studies, 2020)(ABSe, 2017) (FCAI, 2020) (AAA, 2017) (BITRE, 2019)ABSc, 2020 (Morgan, 2020) (Denby, 2019) (ABSc, 2020)
Value of Higher Education +	Value of education in 2019 (annual revenues) minus Value of Education in 2020 (estimated revenues minus losses from drop in international student enrollments)	(Kenny et al., 2019)	(Victoria University Australia, 2020)

3. Results & analysis

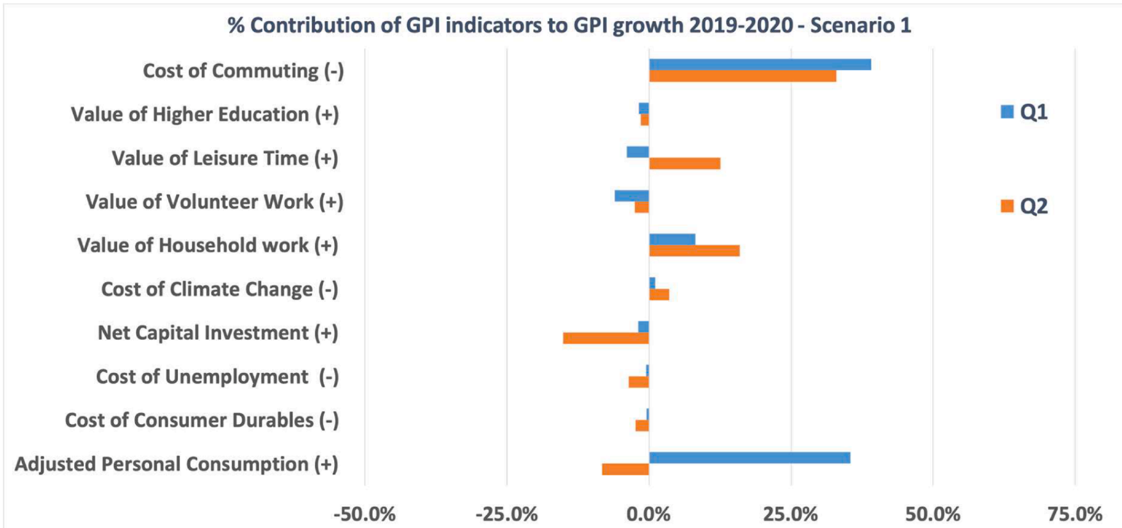
3.1. GPI estimations

The majority of the COVID measures took place in the 2nd quarter of 2020 causing a 6.3% quarterly drop in Australia's GDP "ending Australia's longest streak of continuous growth, in 28 years" (APH, 2018). The lockdown was intended as a health and safety measure but it also achieved unintended benefits in Q1, predominantly due to a -$24.3 billion drop in 'Commuting Costs' and a $5.1 billion increase in the 'Value of Household work', reflected in the increase in the GPI for that quarter. While in Q2, despite the combined drop of -$6.2 billion in APCE and -$11.4 billion in NCI contributing negatively to the GPI, these are offset by the -$24.9 billion drop in Commuting Costs and a further $12 billion increase in the Value of Household work (Table 2).

The Value of Leisure Time influences the GPI's growth level, enough to change its growth direction. In scenario (1) for Q1, the Value of Leisure time is impacted by increased hours spent on household work, leading to a -$2.4 billion drop in the balance of leisure hours, contributing negatively to the5.3% increase in GPI for that quarter; whereas in Q2, the employment hours dropped more than the increase in household work hours; and assuming the balance of those hours translates entirely into leisure time, the Value of Leisure time increased by $9.5 billion, contributing positively to the GPI's growth, enough to offset the drop in APCE and NCI, resulting in a relatively small increase of 0.33%.

In scenario (2) for Q1, any negative impact that the increase in the hours spent on household work would have had on the value of leisure time is not registered, resulting in a higher GPI growth rate of 7.2% compared to scenario (1). Whereas in Q2 with a zero Value of Leisure time, the drop in APCE and NCI has a negative effect on GPI which declines by -2.60% (Table 2b) compared to the 0.33% (Table 2a) increase in scenario (1).

a. Contribution of various indicators to GPI under scenario (1)



b. Contribution of various indicators to GPI under scenario (2)

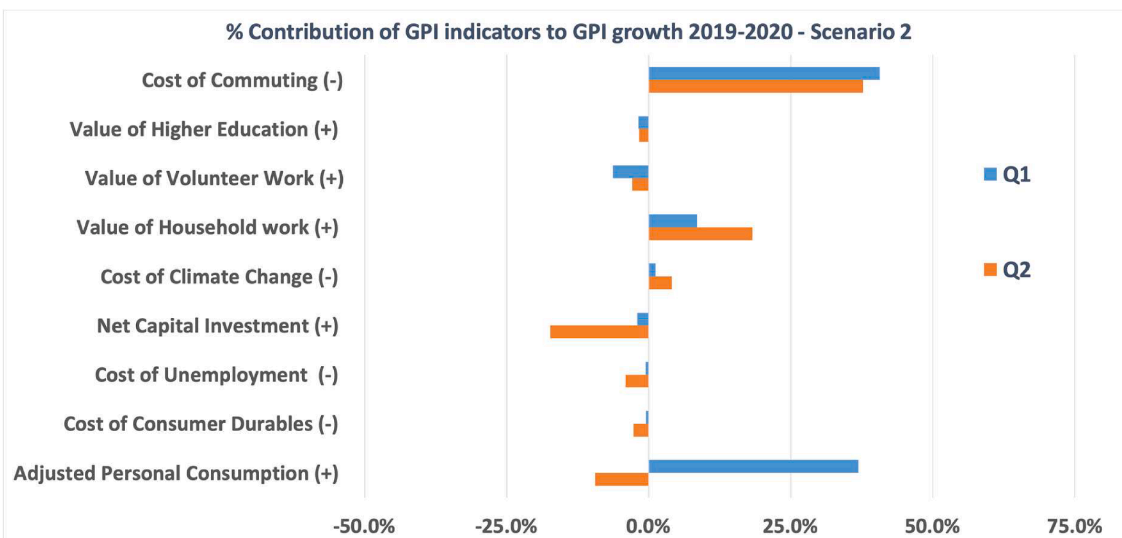


Fig. 2. The percentage quarterly impact contribution of each GPI indicator on the overall change of GPI from the Q1 (blue) and Q2 (orange) quarters of 2019 to those of 2020. The costs that increased, or values that decreased both had a negative impact on GPI; whereas the costs that decreased and values that increased had a positive impact on the GPI.

3.2. Lockdown net-benefits and driving factors

The estimation of the GPI over the first 6 months of 2020 confirmed that, in addition to the health risks driven by the pandemic, the restriction measures imposed by the government deprived Australians from enjoying their normal consumption habits, as well as the opportunity to work and earn income as normal. The lockdowns disrupted the plans of individuals and organizations, leaving many in a state of uncertainty about their future. However, during the same period, there was an overall increase in leisure time, a drop in commuting costs and an increase in the value of household work.

In response to the global pandemic and in an effort to protect public health by "flattening the curve" and controlling the spread of disease within manageable limits, most countries including Australia introduced measures that restricted all non-essential social interactions (Health, Australian Government Department of, 2022). These measures had adverse effects on the normal functioning of economies and disrupted international trade activities (OECD, 2020). Some of the most significant factors that influenced the performance of these containment measures in protecting public health, were the speed at which they were implemented, the degree to which mobility was curtailed, climatic factors, population density (Pragyan D., 2020) and the prevention of relatively rare but impactful super-spreading events (Endo, 2020).

The Australian economy can be considered a mixed economy. Similar to other countries though, its free market forces were mostly overruled by the mandatory social distancing and lockdown measures that the government imposed, which led to a reduction in economic activities. On the flip side, the Australian government introduced subsidies that helped sustain a level of economic activity necessary for the economy to survive the lockdown period.

In addition to identifying the immediate effects of the lockdown on well-being (in GPI terms), our GPI estimation helps argue that behaviours that are conscious of their environmental and social impact, may help avoid uneconomic growth and its associated negative externalities such as pandemics, allowing for more liveable environments. Modern lifestyles involve a vicious cycle of long work hours, driven by high living costs (Dawson et al, 2001), characterized by overconsumption of non-renewable resources (UNEP, 2019).

By prioritizing people's health and safety, the lockdown unintentionally forced a significant drop in consumption to arguably more sustainable levels. Although a drop in APCE does not account positively towards the GPI total; the reduced consumption in some goods such as commuting and air-travel, apart from contributing towards the surge in deposit savings (Guttmann R., et al., 2021), accounted positively towards the GPI through the reduction in the Cost of Climate Change, an increase in Leisure time and drop in motor vehicle crashes (Table 2). Next, we discuss how each indicator was affected by the pandemic, while some were affected by reasons irrelevant to the pandemic, or not found to have been impacted during this period at all.

Personal consumption. The reduced economic activity, due to the COVID restrictions, was reflected in the decline in consumption demand, with a 0.3% decline in the consumer price index (CPI) at the end of Q2-2020 over the 12-month period; and this signified a period of deflation for the first time since the Asian economic crisis in 1997 (ABSh, 2018). The CPI decline was led by price drops in automotive fuel (−19.3%), preschool, primary education (−16.2%) and child care (−95.0%) mostly due to government's subsidies (Consumer Price Index, 2020). Overall the combined decline in both consumption demand and CPI were reflected in the value of personal consumption expenditure (PCE), which was driven by a consumption decline in clothing related goods, hospitality and transportation services (Consumer Price Index, 2020).

Income inequality is considered a crucial indicator of societal wellbeing. Pandemics in the past have increased income inequality (Furceri et al., 2020); especially for those with low income jobs, women and young people. However, households in the lower half of the income distribution have benefited the most from the governmental aid packages, such as Jobkeeper and Coronavirus Supplement payments, offsetting some or all of the increase in earnings inequality from COVID and the lockdowns (ACOSS, 2020) . The drop in the Gini coefficient for 2020 showed that income inequality decreased in 2020 predominantly because of the govenrment support packages (ACOSSb, 2022).

Net capital investment, which is represented here by private fixed capital formation, declined in both quarters of 2020, led by a reduction in household investments mainly due to weak housing market demand followed by a decline in investments in machinery and equipment and reduced capital transfer transactions, as evident in the lower transfer costs. The resulting supply chain disruptions, instigated more discussions regarding the need for Australia to become more self-sufficient in its production capabilities, but also re-consider the type of production it will choose to invest in. (Dean M., et al. 2021).

Cost of unemployment. The increase in the cost of unemployment, from a market demand perspective, was a direct outcome of the reduced PCE. From a market supply perspective, however, production capacities were impacted since staff were not allowed to work due to social distancing and lockdowns. About half of the income lost from unemployment was offset by the welfare support packages that the government introduced, including Jobseeker income supplement, the Coronavirus supplement, the Economic support payments, early access to superannuation, and Temporary loan repayment deferrals (ABSj, 2020) (APRA, 2020).

Value of services of consumer durables. Compared to 2019, value from services of consumer durables increased but at a lower rate consistent with the trend of a declining rate since the 70's (Fig. 3). The driver for this trend could not be confirmed with certainty. According to the law of diminishing marginal utility as per Gossen, Menger's and Stigler (Kauder E., 1965), the satisfaction gained from consumer durables would be expected to decrease as more goods became available over the years. By examining the trend of the value of services from consumer durables in proportion to trends in the cost of durables (ABSc, 2020; Lawn P., 2019); and (Kenny et al., 2019), we observed that from 1985 to 2020 this ratio grew, but at a decreasing rate. This helps support the argument that overconsumption of many durables may be heading towards their saturation point in terms of their marginal utility.

Cost of consumer durables. The demand for durables is confirmed by the increase in the cost of consumer durables indicator, which is attributed to a consumption surge in retail products Food (24.1%); Household goods (9.1%). Furthermore, supply shortages of home office furniture and appliances were also occurring as large numbers of employees transitioned from office to home-based work to align with social distancing restrictions (ABSi, 2020).

The change in the trend of these indicators as a result of the lockdown was not significant compared to other indicators; nor could any significant insight be derived in regards to a change in consumer behaviour, except from a shift in the type of durables that were purchased compared to pre-COVID period. Even though we know the consumption of certain durables contribute to negative environmental and social externalities, the positive relationship between PCE and GDP in both quarters is misleading us to think that all types of consumption are beneficial (Coase, 2013; Cornes and Sandler, 1996).

Externality costs from production and use of durables is not reflected in the GDP, but part of it can be accounted for in the GPI's social and environmental indicators. Inversely a drop in the cost of those can be reflected in an increase of either or both the social and environmental indicators, as we observed with the drop in commuting costs and air pollution in our estimation.

Cost of climate change. The decline of CO2 emissions in Australia, can be attributed predominantly to the agriculture, energy, industrial, and transport sectors; yet, this reduction was largely offset by the growing rate of emissions in the "*stationary energy*, *fugitive*, and *land use, land use change and forestry* sectors" (Department of Industry, 2020). The decline of CO2 due to the Australian agricultural sector may not have been led by a reduction in demand for agricultural products as a result of the coronavirus lockdown, as much as it was related to drought-driven shrunken crops and declining cattle inventories, as well as a reduction in the application of fertilizers (Department of Industry, 2020).

Cost of air pollution. Consistent with literature (Jiang et al., 2020) the drop in GDP in Q2 was followed by a drop in Air pollution in Australia (NPI, 2020), which is the same result detected on a global scale (Venter et al., 2020). Primarily the reduction in production and transportation activity led to a reduction in PM 2.5 emission levels.

Cost of water pollution. The total quantity (kg) of pollutants emitted into water through industrial processes in 2020 increased slightly compared to 2019. Generally regarding water quality, a general drop in consumption can lead to a drop in industrial waste ; ocean waste from reduced seafarers; and wherever water quality is dependent on visitors (rivers, coastal waters), pollutions risks would be expected to have decreased due to less visitors (Rume and Didar-Ul Islam, 2020; Haghnazar et al., 2022). Visitors decreased in Australian coastal areas (Royal Life Saving Society - Australia, 2020), therefore we would expect a reduction in pollution in those waters. On the other hand, an increase in water pollution from plastic masks and detergents was detected globally (Rume T., and Didar-Ul Islam, 2020) and Australia would not be expected to be an exception.

Cost of net farmland change. We did not find the cost of net farmland change to have been impacted by the pandemic. We confirmed that despite global food supply chain disruptions, food demand in Australia remained steady and farmland values continued to grow at the average of the last 20 years (Ruralbank, 2021). From a market-supply perspective, the bushfires and droughts affected a significant proportion of the farmland area and farm output and incomes; but despite this, agricultural production values were forecasted to continue to rise (AWE, 2020). From a market-demand perspective, the African swine fever in Asia drove demand for Australian food exports, particularly livestock products (Rabobank. n.d., 2020). Australian producers were able to cater for more with less due to more efficient agricultural methods; hence "productivity gains and climate effects have essentially canceled

Table 2
The GPI estimation as a sum of its individual indices per quarter. The ± signs indicate either a positive or negative contribution to the GPI total summation. Except for the Income Distribution which is used for calculating the Adjusted Personal Consumptions Expenditure (Table 1). The colours distinguish the indicators into their respective categories, being economic (blue), environmental (green) and social/human-capital (pink).

a). The GPI estimation under scenario (1)

($) in billions

	Account	Q1 2019	Q2 2019	Q1 2020	Q2 2020	Function	Q1 19/20	Q2 19/20	Q1 19/20	Q2 19/20
1	Personal Consumption Expenditures (+)	$ 266.6	$ 267.5	$ 265.7	$ 233.5	Add	-0.3%	-12.7%	-$ 0.8	-$ 34.0
2	Income Distribution Index	$ 1.2	$ 1.2	$ 1.2	$ 1.2	Divide	0.1%	0.1%	$ 0.0	$ 0.0
3	Adjusted Personal Consumption (+)	$ 175.6	$ 175.8	$ 195.1	$ 167.4	Add	11.1%	-4.8%	$ 19.5	-$ 8.4
4	Services of Consumer Durables (+)	$ 17.2	$ 17.4	$ 17.7	$ 18.0	Add	2.9%	3.4%	$ 0.5	$ 0.6
5	Cost of Consumer Durables (-)	-$ 19.2	-$ 19.7	-$ 19.5	-$ 21.5	Subtract	1.6%	9.1%	-$ 0.3	-$ 1.8
6	Cost of Unemployment (-)	-$ 11.3	-$ 11.6	-$ 11.7	-$ 14.3	Subtract	2.8%	23.4%	-$ 0.3	-$ 2.7
7	Net Capital Investment (+)	$ 100.9	$ 114.4	$ 99.7	$ 103.0	Add	-1.2%	-10.0%	-$ 1.2	-$ 11.4
8	Cost of Water Pollution (-)	-$ 1.4	-$ 1.4	-$ 1.4	-$ 1.4	Subtract	0.9%	0.9%	-$ 0.0	-$ 0.0
9	Cost of Air Pollution (-)	-$ 2.9	-$ 2.9	-$ 2.8	-$ 2.8	Subtract	-2.1%	-2.1%	$ 0.1	$ 0.1
10	Cost of Net Farmland Change (-)	-$ 0.2	-$ 0.2	-$ 0.2	-$ 0.2	Subtract	0.0%	0.0%	$ -	$ -
11	Cost of Climate Change (-)	-$ 36.2	-$ 36.2	-$ 35.5	-$ 33.5	Subtract	-1.9%	-7.4%	$ 0.7	$ 2.7
12	Cost of Ozone Depletion (-)	-$ 7.4	-$ 7.4	-$ 7.4	-$ 7.4	Subtract	0.0%	0.0%	$ -	$ -
13	Cost of Nonrenewable Energy Resource Depletion (-)	-$ 22.2	-$ 22.2	-$ 22.2	-$ 22.2	Subtract	0.0%	0.0%	$ -	$ -
14	Value of Household work (+)	$ 88.3	$ 88.6	$ 93.4	$ 100.6	Add	5.7%	13.6%	$ 5.1	$ 12.0
15	Cost of Family Changes (-)	-$ 2.9	-$ 2.9	-$ 2.9	-$ 2.9	Subtract	0.0%	0.0%	$ -	$ -
16	Cost of Crime (-)	-$ 1.8	-$ 1.8	-$ 1.6	-$ 1.4	Subtract	-10.0%	-20.0%	$ 0.2	$ 0.4
17	Value of Volunteer Work (+)	$ 16.7	$ 16.7	$ 12.9	$ 14.8	Add	-22.7%	-11.4%	-$ 3.8	-$ 1.9
18	Value of Leisure Time (+)	$ 58.1	$ 57.5	$ 55.7	$ 67.0	Add	-4.2%	16.5%	-$ 2.4	$ 9.5
19	Value of Higher Education (+)	$ 8.6	$ 8.6	$ 7.5	$ 7.5	Add	-12.8%	-12.8%	-$ 1.1	-$ 1.1
20	Cost of Commuting (-)	-$ 49.8	-$ 50.4	-$ 25.5	-$ 25.5	Subtract	-48.8%	-49.4%	$ 24.3	$ 24.9
21	Cost of Motor Vehicle Crashes (-)	-$ 1.4	-$ 1.3	-$ 1.2	-$ 1.1	Subtract	-12.5%	-14.8%	$ 0.2	$ 0.2
	Genuine Progress Index (GPI)	$ 362.0	$ 375.0	$ 378.7	$ 374.1		4.6%	-0.25%	$ 16.7	-$ 1.0
	Gross Domestic Product (GDP)	$ 491.0	$ 530.2	$ 497.8	$ 496.8		1.4%	-6.3%	$ 6.9	-$ 33.4
	ECONOMIC	$ 265.2	$ 278.6	$ 283.2	$ 256.0		6.8%	-8.1%	$ 18.0	-$ 22.6
	ENVIRONMENTAL	-$ 70.2	-$ 70.2	-$ 69.4	-$ 67.4		-1.0%	-3.9%	$ 0.7	$ 2.7
	SOCIAL	$ 167.0	$ 166.6	$ 164.9	$ 185.5		-1.2%	11.3%	-$ 2.1	$ 18.9

b). The GPI estimation under scenario (2)

($) in billions

	Account	Q1 2019	Q2 2019	Q1 2020	Q2 2020	Function	Q1 19/20	Q2 19/20	Q1 19/20	Q2 19/20
1	Personal Consumption Expenditures (+)	$ 266.6	$ 267.5	$ 265.7	$ 233.5	Add	-0.3%	-12.7%	-$ 0.8	-$ 34.0
2	Income Distribution Index	$ 1.2	$ 1.2	$ 1.2	$ 1.2	Divide	0.1%	0.1%	$ 0.0	$ 0.0
3	Adjusted Personal Consumption (+)	$ 175.6	$ 175.8	$ 195.1	$ 167.4	Add	11.1%	-4.8%	$ 19.5	-$ 8.4
4	Services of Consumer Durables (+)	$ 17.2	$ 17.4	$ 17.7	$ 18.0	Add	2.9%	3.4%	$ 0.5	$ 0.6
5	Cost of Consumer Durables (-)	-$ 19.2	-$ 19.7	-$ 19.5	-$ 21.5	Subtract	1.6%	9.1%	-$ 0.3	-$ 1.8
6	Cost of Unemployment (-)	-$ 11.3	-$ 11.6	-$ 11.7	-$ 14.3	Subtract	2.8%	23.4%	-$ 0.3	-$ 2.7
7	Net Capital Investment (+)	$ 100.9	$ 114.4	$ 99.7	$ 103.0	Add	-1.2%	-10.0%	-$ 1.2	-$ 11.4
8	Cost of Water Pollution (-)	-$ 1.4	-$ 1.4	-$ 1.4	-$ 1.4	Subtract	0.9%	0.9%	-$ 0.0	-$ 0.0
9	Cost of Air Pollution (-)	-$ 2.9	-$ 2.9	-$ 2.8	-$ 2.8	Subtract	-2.1%	-2.1%	$ 0.1	$ 0.1
10	Cost of Net Farmland Change (-)	-$ 0.2	-$ 0.2	-$ 0.2	-$ 0.2	Subtract	0.0%	0.0%	$ -	$ -
11	Cost of Climate Change (-)	-$ 36.2	-$ 36.2	-$ 35.5	-$ 33.5	Subtract	-1.9%	-7.4%	$ 0.7	$ 2.7
12	Cost of Ozone Depletion (-)	-$ 7.4	-$ 7.4	-$ 7.4	-$ 7.4	Subtract	0.0%	0.0%	$ -	$ -
13	Cost of Nonrenewable Energy Resource Depletion (-)	-$ 22.2	-$ 22.2	-$ 22.2	-$ 22.2	Subtract	0.0%	0.0%	$ -	$ -
14	Value of Household work (+)	$ 88.3	$ 88.6	$ 93.4	$ 100.6	Add	5.7%	13.6%	$ 5.1	$ 12.0
15	Cost of Family Changes (-)	-$ 2.9	-$ 2.9	-$ 2.9	-$ 2.9	Subtract	0.0%	0.0%	$ -	$ -
16	Cost of Crime (-)	-$ 1.8	-$ 1.8	-$ 1.6	-$ 1.4	Subtract	-10.0%	-20.0%	$ 0.2	$ 0.4
17	Value of Volunteer Work (+)	$ 16.7	$ 16.7	$ 12.9	$ 14.8	Add	-22.7%	-11.4%	-$ 3.8	-$ 1.9
18	Value of Leisure Time (+)	$ -	$ -	$ -	$ -	Add	0.0%	0.0%	$ -	$ -
19	Value of Higher Education (+)	$ 8.6	$ 8.6	$ 7.5	$ 7.5	Add	-12.8%	-12.8%	-$ 1.1	-$ 1.1
20	Cost of Commuting (-)	-$ 49.8	-$ 50.4	-$ 25.5	-$ 25.5	Subtract	-48.8%	-49.4%	$ 24.3	$ 24.9
21	Cost of Motor Vehicle Crashes (-)	-$ 1.4	-$ 1.3	-$ 1.2	-$ 1.1	Subtract	-12.5%	-14.8%	$ 0.2	$ 0.2
	Genuine Progress Index (GPI)	$ 303.9	$ 317.6	$ 323.0	$ 307.1		6.3%	-3.29%	$ 19.1	-$ 10.4
	Gross Domestic Product (GDP)	$ 491.0	$ 530.2	$ 497.8	$ 496.8		1.4%	-6.3%	$ 6.9	-$ 33.4
	ECONOMIC	$ 265.2	$ 278.6	$ 283.2	$ 256.0		6.8%	-8.1%	$ 18.0	-$ 22.6
	ENVIRONMENTAL	-$ 70.2	-$ 70.2	-$ 69.4	-$ 67.4		-1.0%	-3.9%	$ 0.7	$ 2.7
	SOCIAL	$ 108.9	$ 109.1	$ 109.2	$ 118.5		0.3%	8.6%	$ 0.4	$ 9.4

each other out" (Chancellor et al, 2021). In consideration of the above, we decided to use the last estimated net farmland change figures available (Kenny, 2019).

Cost of nonrenewable energy resource depletion is driven by the costs associated with preventing the depletion of nonrenewable energy resources. Prevention is currently pursued through the transition to renewable energy sources (Teske, 2016). The Renewable industry supply chains have been disrupted due to the pandemic lockdown restrictions but the effect was temporary. We could not find any evidence to support the impact of the pandemic on the long-term estimation of transition costs to renewables and thus this cost was kept unchanged over 2019 and 2020. In the long-run though, if the pandemic has a more systemic impact, it would be necessary to revisit this component and its estimation.

Cost of ozone depletion. Similarly, the cost of ozone depletion for 2020 could not be estimated because there was no data found to imply that the COVID lockdowns had any effect on the chloro-fluoro-carbon (CFC) levels and the depletion or restoration of the ozone layer; as such its cost was left unchanged from previous years.

Cost of crime. Since the introduction of the social restrictions, unnecessary commuting, nightlife lockdowns and patrols, criminal activity was reported to have reduced. Specifically, NSW authorities reported more than a 20–30% drop in most criminal activities (offences, assaults, robberies), based only on cases detected by, or reported to the police (Community Relations Division and NSW Department of Justice, 2020) . An international analysis of COVID-19 lockdown restrictions on crime that includes Australia, found that crime dropped 37% on average. Considering state related crime trends showing a decline in crime, such as NSW robbery (−42%), non-domestic assault (−39%), sexual offences (−32%), break and enter-dwelling (−29%), steal from motor vehicle (−34%), car theft (−24%), shop lifting (−55%) (NSW_Crime, 2020); although VIC crime has a 6% average increase compared to 2019 (VIC_Crime, 2020); but QLD had more than a 30% drop in crime with Brisbane noting a 35% drop due to tighter movement restrictions (QUA, 2021).

Value of leisure time. The vast majority of Australians (98%) isolated primarily to protect their health and that of their friends and family (ABSi, 2020); in doing so, at least for the short-term, they were willing to relinquish some of their freedom at the cost of any social and economic goods (Manipis K., et al., 2021). We would expect those who enjoyed their time with family to value their time in isolation higher than in any other social settings that involved a risk of contracting COVID. Whereas on the other end of the scale, those who were for example victims of family violence (NPI, 2020) may value their time in isolation much lower. Details on the valuation method of Leisure time are included in the supplementary document.

Cost of commuting. Significant benefits were accounted for, due to the drop of both the cost of commuting and the cost of motor vehicle crashes. They were both a direct result of the lockdowns and interstate commuting restrictions, which reduced the need to commute to work and consequently all costs associated with public transportation, traffic risks, car ownership and maintenance and time lost traveling.

Value of tertiary education. In regards to the value of tertiary education, it is presumed that the decline in the university value is a result of reduced revenue coming from international student tuition that occurred when in-light of the COVID economic impact, many of them returned to their countries of origin.

4. Discussion

4.1. GPI methodological challenges

GPI can be further improved by considering additional factors of well-being and reconsidering the valuation methods and use of existing ones. For example, the value of leisure time is subjective because each person perceives its value in their own way, but we were not able to obtain such microdata. We attempted to address the lack of such data, by introducing a degree of uncertainty; using a lower ($0) and upper ($23.83) limit (section 2. Methodology), within which we considered the actual estimate of the average hourly rate of leisure time to reside. Also, due to diminishing returns (Harmon J., and Woosnam K., 2021), the value of each hour spent by each person can change, which adds to the challenge of valuing leisure time.

In contrast to the valuation of leisure time, for the estimation of the Value of Household work, we were able to obtain more detailed data. These involved hours spent on household work per type of household member depending on the household's family structure. Yet the quality of the data obtained would need to be further improved; such as its relevance and timeliness in relation to the lockdown period and the consistency between datasets of the different sources used. Obtaining adequate quality data is a problem that affects the broader domain of ecosystem services valuations (Kubiszewski I., et al., 2022) and consequently the GPI. As such, the extent to which the obtainable data meets the quality and cost requirements, determines whether it is beneficial to pursue and maintain more accurate GPI accounts.

The 2020 pandemic lockdown was a rare opportunity to evaluate the performance of alternative indicators such as the GPI, under critical conditions. Microdata regarding people's value perceptions are useful for the valuation of the non-market assets of the GPI; and although their collection is increasingly pursued, personal data ownership rights, privacy and safety concerns are challenging issues affecting their availability (ABSk, 2022) . More so during the lockdown when data availability was further impaired since conventional data collection methods were not as successful (ONS, 2021; ABSi, 2022); consequently, impacting GPI's performance as a well-being indicator. Further research is required, regarding improved methods (Aschwanden, 2021) for

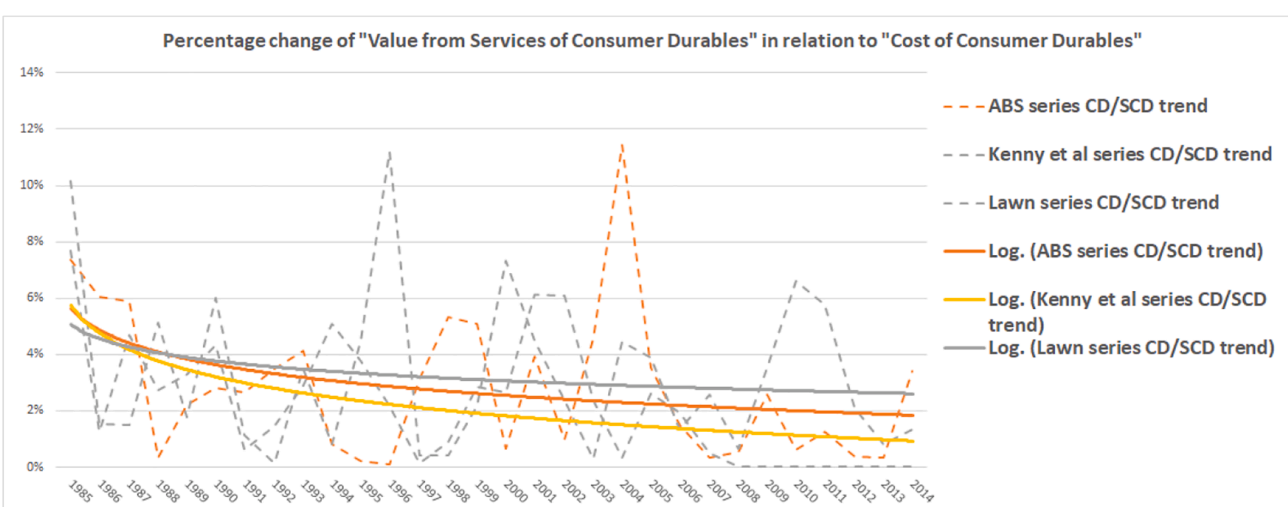


Fig. 3. From 1985 to 2020 the percentage of change in the value of services from consumer durables has been increasing in proportion to the cost of durables, at a decreasing rate.

collecting the data needed to value the more subjective components of the GPI.

4.2. Comparison: GPI and GDP

Our GPI estimation showed that, for scenario 1 in Q1, its growth was positively related to that of the GDP but negatively related in Q2. Whereas for scenarion 2, the GPI's growth was positively related to that of the GDP for both quarters (Fig. 4).

The lockdown period in Q1 covers only the last 10 days of March, with the positive effects of the lockdown registered immediately by the GPI; predominantly due to social indicators involving the reduced commuting costs and increased household work. Whereas in Q2 despite the very significant combined drop in PCE and Net Capital Investment it was offset mostly by the consecutive drop in commuting and the further increase in the value of household work. In the scenario that we accept an average value for leisure time (instead of zero), the drop in PCE and Net Capital is offset by the increase in social indicators which in this scenario also includes the value of Leisure time. Our GPI estimation is consistent with the notion that economic welfare depends on both the degree and quality of growth as expressed through environmental and social assets; and that well-being does not necessarily have to decline with a drop in GDP growth. The positive influence of the government welfare measures are captured by the GPI in Q2.

Previous studies involving the calculation of GDP and GPI for 17 countries over 50 years found that beyond a certain level of GDP per capita, the positive correlation between the GDP and GPI turned into a negative one (Kubiszewski I., et al., 2013), reinforcing the argument that GDP growth beyond a certain point does not necessarily provide further benefits, especially when it disregards its impact on the environment and society. This diversion between the two indexes occurred in the late 80′s, at which point the growth of these economies in GDP terms, accelerated at a much higher rate compared to the GPI growth rate. It was in the same decade that the need for sustainable development gained more traction at an international level , highlighting social issues (e.g. poverty) and the degradation of the environment, and advocating the need to address these urgent matters (Borowy, 2014).

Examples where GPI increased with the drop in GDP can be seen during Australia's recession in 1973 (Kilian, 2009), which led to an increase in the values of household work and personal consumption driven by an increase in wages and a drop in income inequality and the cost of crime. Similarly in 2013, "the decline in Australia's terms of trade since its peak in the September quarter 2011 has had a deflationary effect on the economy" (Dolamore R., 2013); while the GPI increased mostly because of a decline in the cost of crime, lost leisure time and motor vehicle crashes, as well as due to an increase in personal consumption expenditure and value of household work. The 1973 recession which was triggered by the international oil crisis has common denominators with the COVID pandemic, since in both cases the trigger was external, denoting the extent to which national economies have become interdependent. Another common and important characteristic of the two crises, was that in both cases the unsustainable consumption of natural resources was a causal factor. The oil crisis was a result of unsustainable oil demand that surpassed oil supply capacities. The coronavirus, similar to other zoonotic diseases, is partially the result of consumption-driven unsustainable land use practices (Institute of Medicine - National Research Council, 2009).

Compared to the GDP the GPI can help stakeholders be more aware of the trade-offs when they proceed to act on their desires. This feature makes alternative metrics like the GPI a more useful method for measuring national progress and for guiding better decision-making that is well-being centered. It is well documented that, the worse the levels of sentiment and uncertainty regarding possible future economic outcomes and the chances of them occurring; the weaker the economic conditions that occur (Nguyen and La Cava, 2020). This shows that without the broad use of more insightful metrics like the GPI and relying solely on economic metrics, especially as flawed as the GDP (Stiglitz, 2022), will propagate ill-informed decisions hindering a well-being centered progress.

4.3. Policy implications and degrowth

GDP remains the main macroeconomic indicator of choice despite providing an incorrect estimation of national progress, misleading those who decide on the world's future. All types of consumption, including the unsustainable ones (in terms of quantity and quality) that drive unsustainable growth, are accounted for as positive contributors to national progress; and the actual repercussions are not communicated to stakeholders. Pandemics, which are indirectly driven by unsustainable consumption, are expected to occur up to three times more often than in the past (Marani, et al, 2021), but there is currently no indicator to easily inform the public of the pandemic's impact on growth and national progress. More accurate metrics can help improve the way we manage risks (AIDR., 2019), for example to prevent COVID would have been 50 times less costly (Dobson P., et al, 2020) than responding to it. Instead of only anticipating and just reacting to risks, moving forward proper metrics are required to guide us in shaping futures with lower risks.

In the long-run there are two futures that we consider plausible; one in which sustainability policies underperform or fail and another in which sustainability policies thrive. In the first, we assume the root cause of policy failure is the lack of a common vision for a sustainable world; in which case the global economy continues to grow beyond the earth's biocapacity, resulting in a deterioration of the average human well-being levels in terms of mortality (Gasparrini A., et al, 2017), living costs (Kompas et al., 2019) and life quality (Beggs et al, 2021).

In this case humans are expected to adapt to a life within an increasingly hostile and volatile environment. The use of ecological indicators would have little purpose; since they are subjective and without a common vision, their estimation would not be accurate. For example, GDP is used because, as a convention, stakeholders are accustomed to agree that GDP growth is always a positive outcome, which is not true. For an ecological indicator to replace it, this may at least require the majority to first agree on the types of growth that are, or are not, beneficial.

Reflecting on the COVID pandemic may help find grounds for a more common vision, doing so would first require understanding the way the lockdown may have also influenced people's well-being perspectives. The lockdown measures may have put some of the usual over-consumption and overspending behaviours to a halt, but that does not mean that people's desires changed as well. The change was abrupt and although everyone responds differently to change (Holmes et al., 2016; Twins Research Australia, 2020), generally the lockdowns were perceived as disruptive to people's lives (Hand et al., 2020), with total satisfaction of life found to have declined (CSIRO, n.d., 2020). Would it not be more precise though, to argue that it was the abruptness of the change that was more of a disruptor, than the change itself? It is a fact that people do not like change (Ansoff et al., 2019), especially when they are told what to do (Akhtar et al., 2020), let alone when they are not prepared for it.

As such, the negative experiences may have overshadowed the environmental and socially positive outcomes of the negative GDP growth caused by the lockdown. Such as the cleaner atmosphere, the benefits of working from home, not having to travel as much for work and allowing more family time (Staton et al, 2020) and leisure time (Table 2). All of which would be worth holding-on to, for incorporating into a new living paradigm that involves a sustainable economy with less risks and improved living conditions.

In a future direction involving this new living paradigm, the world economy is considered to be more sustainable; because it assumes that the world has agreed on a common vision that requires living with sustainable consumption behaviours and compassion and respect for all life inclusive of future generations. This is called a 'degrowth economy'

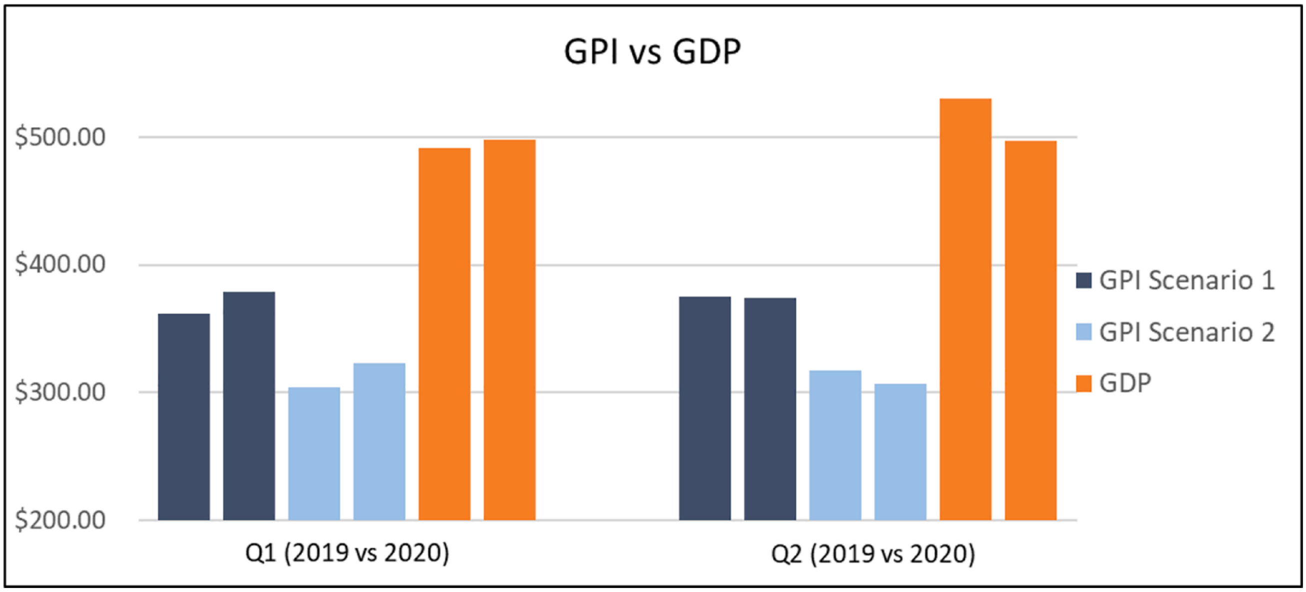


Fig. 4. GPI and GDP comparison, during the first and second quarters of 2019 and 2020 (in AUD billions) with both scenarios.

or in its ideal final phase a 'steady state' economy (Kerschner, 2010); because in order to deliver on this promise, it requires that the global economy grows only within the world's biophysical capacity to provide for all, including future generations.

A degrowth economy would involve establishing the appropriate institutions that can safeguard the social and environmental needs of its stakeholders (Kallis et al, 2012) in their transition towards a more sustainable and liveable economy. Managing the transition requires keeping accurate track of the stocks and flows of the world's resources, to ensure the sustainable management of those (Costanza et al, 2014). This calls for an ecological type of indicator like the GPI, supplemental to conventional economic indicators, that provides an insight to the environmental and social externalities of economic growth. This would help guide policy making for sustainable growth within planetary boundaries (Rockström et al., 2009) instead of economic growth at all costs; and for easily communicating policy net-benefits to the public. Australia had the Measures of Australia's Progress (MAP) which received attention and praise from the OECD, for its 'dashboard' of indicators, including education levels, population health, and community well-being data. Unfortunately, it was discontinued, as part of a scale back of ABS operations (Howard & Chambers, 2016).

The lockdown exhibited similarities with the conditions and behaviours expected in a degrowth economy. As we explain later on, some of the lockdown's benefits, captured by our GPI estimations, would be pursued in a degrowth economy too. With regards to economic growth, for the most part of the first nationwide lockdown (in Q2) the GDP dropped. Part of this GDP drop was uneconomic, in other words it was non-beneficial, whereas some other portions of it were beneficial. For example, our GPI estimation accounted for the drop in commuting as an economic benefit; which is one of the reasons the GPI did not drop in Q2 like the GDP, but instead increasesd slightly. On the other hand, the government introduced welfare policies to protect those in need, which further boosted the GPI, counteracting a large part of the economic repercussions of the lockdown; which, as opposed to the GPI, the GDP was unable to showcase to the public. In a degrowth economy there too would be a drop in growth, mainly in uneconomic GDP, relating to "matter-energy throughput" (Heikkurinen, 2021). There would also be providence for the weaker, driven by the appropriate democratic institutions that would introduce social and environmental policies such as a universal basic income, carbon emission controls, more flexible work conditions and resource and consumption-based taxes to name a few (Kallis, 2011).

Since the lockdown, urban decentralization and regionalization and localization policy suggestions (PMC, 2020; APC, 2017), may now sound even more appealing. Beyond the lockdown's primary purpose being the protection of public health through isolation, it helped showcase the benefits of 'Working From Home' WFH and it accelerated the adoption of remote working technologies, a trend which continued after the lockdown (APC, 2021). Our GPI estimation showed the benefits of this trend, in increased leisure time, drop in commuting costs and a drop in the cost of climate change and air pollution (Table 2). In pursuit of more resilient and sustainable cities, addressing WFH and pandemic risks have been added to the policy making agenda (Infrastructure Australia, n.d., 2020). Decentralization and localization policies are generally known to support more liveable and self-sufficient local economies (Olivier et al., 2018); and expected to unlock even more social benefits such as affordable housing (Gurran et al., 2021) . Similarly, the need for policies of "decentralization and relocalisation" are suggested in concepts for sustainable degrowth economies (Kallis, 2011). In a degrowth economy these policies would be used to achieve sustainability even if it eventually leads to smaller economies. Despite the alarming escalation of socio-environmental risks, an outcome involving smaller economies has not yet been considered as plausible or desirable by policy makers, nor are current urban decentralization policies designed to accommodate for such an outcome. This denotes the urgent need to speed up public deliberations on, the possibility that some form of a degrowth economy is becoming necessary; and the policies best fit to adopt it with the lowest impacts on societal wellbeing and highest net benefits.

5. Conclusion

We estimated the net of the positive and negative externalities of economic activity during the lockdown using the GPI. Overall, we found that the GPI growth for scenario 1 was positively related to that of the GDP in Q1 but negatively related in Q2, mainly because most of the government support took place in Q2. Whereas in scenario 2, the GPI's growth was positively related to that of the GDP for both quarters, although did not decline as much as the GDP in Q2. Our estimation showed that the GPI's social components benefited the most, followed by a small improvement in environmental components and a significant deterioration of its economic components. Through our analysis we confirmed that their main driving factors were the personal consumption behaviours and the government health and welfare policies, the broader impact of which was not apparent with the GDP. In comparing the GPI with the GDP, we showed that the GPI is a more realistic metric for national progress; and that its further improvement would benefit from microdata for valuing non-market assets more accurately.

We discussed that some of the policies either suggested or implemented to address the pandemic and the socio-economic externalities of the lockdown, were similar to those that have been suggested for implementing a degrowth economy. Indicating that the pandemic lockdown period offered a good opportunity to examine some of the challenges of a degrowth economy and to reflect on the need to adopt more sustainable consumption behaviours and policies, to address these challenges. As such, degrowth economy solutions are already, unintendedly and sporadically being applied. A more common vision of well-being, in the context of a more sustainable and liveable world, may entail a more systematic implementation of degrowth economics and a decoupling of well-being from GDP growth. This would also make necessary the use of ecological indicators like GPI.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ecolind.2022.109025.

References

AAA, 2017. "Australian Automobile Association. Road Safety: Australia's $29.7 Billion Car Crash". https://www.aaa.asn.au/road-safety-australias-29-7-billion-car-crash/. (Accessed 11 September 2021).

ABS, 2006. "How Australians Use Their Time, 2006 | Australian Bureau of Statistics". 2006. Accessed May 13, 2022. https://www.abs.gov.au/statistics/people/people-and-communities/how-australians-use-their-time/latest-release.

ABSa, 2021. Australian National Accounts: Finance and Wealth, December 2021 | Australian Bureau of Statistics. Accessed May 13, 2022. https://www.abs.gov.au/statistics/economy/national-accounts/australian-national-accounts-finance-and-wealth/latest-release.

ABSc, 2020. "Australian National Accounts: National Income, Expenditure and Product - Table 36 | Australian Bureau of Statistics". https://www.abs.gov.au/statistics/economy/national-accounts/australian-national-accounts-finance-and-wealth/latest-release, May 25, 2020.

ABSd, 2020. "Private New Capital Expenditure and Expected Expenditure, Australia" 2020 | Australian Bureau of Statistics, February 24, 2022. https://www.abs.gov.au/statistics/economy/business-indicators/private-new-capital-expenditure-and-expected-expenditure-australia/latest-release.

ABSf, 2020. "https://www.abs.gov.au/articles/impact-lockdowns-household-consumption-insights-alternative-data-sources".

ABSh, 2018. "70 Years of Inflation in Australia | Australian Bureau of Statistics". October 31, 2018. https://www.abs.gov.au/statistics/research/70-years-inflation-australia.

ABSi, 2020. "Measuring the Impacts of COVID-19, Mar-May 2020 | Australian Bureau of Statistics".

ABSj, 2020. Australian Bureau of Statistics. "Economic measurement during COVID-19: Selected issues in the Economic Accounts". https://www.abs.gov.au/statistics/economy/business-indicators/economic-measurement-during-covid-19-selected-issues-economic-accounts/latest-release.

ABSk, 2022. Australian Bureau of Statistics. Accessed May 13, 2022. https://www.abs.gov.au/websitedbs/D3310114.nsf/home/Australian%20Statististian%20-%20Speeches%20-%20BLADE%20Expo:%20Understanding%20what%27s%20happening%20and%20why%20-%20the%20role%20for%20microdata. 2022.

ABSe, 2017. "Household Expenditure Survey, Australia: Summary of Results, 2015-16 Financial Year | Australian Bureau of Statistics". September 13, 2017. https://www.abs.gov.au/statistics/economy/finance/household-expenditure-survey-australia-summary-results/latest-release.

ACIC, 2020. "Priority Crime Themes | Australian Criminal Intelligence Commission". 2020. Accessed May 13, 2022. https://www.acic.gov.au/about/priority-crime-themes.

ACOSSb, 2022."New ACOSS and UNSW Sydney Report shows how poverty and inequality were dramatically reduced in 2020, but have increased ever since". https://povertyandinequality.acoss.org.au/news/new-acoss-and-unsw-sydney-report-shows-how-poverty-and-inequality-were-dramatically-reduced-in-2020-but-have-increased-ever-since/.

AIDR., 2019. National Emergency Risk Assessment Guidelines. Australian Disaster Resilience Handbook Collection. https://www.aidr.org.au/media/6932/04-scenarios.pdf.

Akhtar, N., Akhtar, M.N., Usman, M., Ali, M., Siddiqi, U.I., 2020. COVID-19 restrictions and consumers' psychological reactance toward offline shopping freedom restoration. Serv. Ind. J. 40 (13–14), 891–913. https://doi.org/10.1080/02642069.2020.1790535.

Ansoff, H. Igor, Daniel Kipley, A.O. Lewis, Roxanne Helm-Stevens, and Rick Ansoff. 2019. Implanting Strategic Management. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-99599-1.

Aschwanden, Christie, 2021. How COVID Is Changing the Study of Human Behaviour. Nature 593 (7859) 331–33. https://doi.org/10.1038/d41586-021-01317-z.

APC, 2017. "Productivity Commission, Study Report – Transitioning Regional Economies". December 15, 2017. https://www.pc.gov.au/inquiries/completed/transitioning-regions/report.

APC, 2021. Australia and Productivity Commission. Working from Home: Research Paper. Working from Home – Commission Research Paper - . Productivity Commission". pc.gov.au.

APH, 2018. Commonwealth of Australia. "27 years and counting since Australia's last recession". April, 2021. https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/BriefingBook46p/LastRecession.

Australian Institute of Family Studies, 2022. Population and Households. Text. Accessed May 13, 2022. https://aifs.gov.au/facts-and-figures/population-and-households.

Agricultural Commodities, 2020. "Agricultural Commodities, Australia, 2019–20 Financial Year | Australian Bureau of Statistics". May 14, 2021. https://www.abs.gov.au/statistics/industry/agriculture/agricultural-commodities-australia/latest-release.

Australian Farmland Values, 2022. Accessed May 13, 2022. https://www.ruralbank.com.au/knowledge-and-insights/publications/farmland-values/.

Bagstad, Kenneth J., Günseli Berik, Erica J. Brown Gaddis, 2014. "Methodological Developments in US State-Level Genuine Progress Indicators: Toward GPI 2.0. Ecological Indicators 45 (October 1, 2014): 474–85. https://doi.org/10.1016/j.ecolind.2014.05.005.

APRA, 2020. APRA. Temporary Loan Repayment Deferrals Due to COVID-19 | APRA. https://www.apra.gov.au/temporary-loan-repayment-deferrals-due-to-covid-19-0.

ABSi, 2022. "Methodological News, Australian Bureau of Statistics". March 30 2022. https://www.abs.gov.au/statistics/research/methodological-news-mar-2022.

AWE, 2020. "Farm Production Value Holds despite Bushfires, Drought. n.d. DAWE." Accessed May 13, 2022. https://www.awe.gov.au/abares/news/farm-production-value-holds-despite-bushfires-drought.

Beggs, P.J., Zhang, Y., McGushin, A., Trueck, S., Linnenluecke, M.K., Bambrick, H., Berry, H.L., et al., 2021. The 2021 report of the MJA–lancet countdown on health and climate change: Australia Increasingly out on a Limb. Med. J. Aust. 215 (9), 390–392.e22. https://doi.org/10.5694/mja2.51302.

BITRE, 2019. "Progress in Australian Regions Yearbook 2019". Bureau of Infrastructure and Transport Research Economics 14, 2022. https://www.bitre.gov.au/publications/2019/regional-yearbook-2019.

BITRE, 2020. Bureau of Infrastructure and Transport Research Economics."Research Economics". Accessed May 13, 2022. https://www.bitre.gov.au/publications/2020. 2020.

Borowy, I., 2014. Defining Sustainable Development for Our Common Future: A History of the World Commission on Environment and Development (Brundtland Commission). Routledge, Abingdon, Oxon.

Consumer Price Index, 2020. "Consumer Price Index, Australia, March 2022 | Australian Bureau of Statistics". Accessed May 13, 2021. https://www.abs.gov.au/statistics/economy/price-indexes-and-inflation/consumer-price-index-australia/jun-2020.

COVID-19 Pandemic and Its Impact on the Aquatic Industry | Royal Life Saving Society - Australia. Accessed May 13, 2022. https://www.royallifesaving.com.au/research-and-policy/policy/position-statements/covid-19-pandemic-and-its-impact-on-the-aquatic-industry.

Chancellor, Will, Neal Hughes, Shiji Zhao, Wei Ying Soh, Haydn Valle, Christopher Boult. 2021. Controlling for the Effects of Climate on Total Factor Productivity: A Case Study of Australian Farms. Food Policy 102 (July 1, 2021): 102091. https://doi.org/10.1016/j.foodpol.2021.102091.

Clarke, M., Lawn, P., 2008. Is measuring genuine progress at the sub-national level useful? Ecol. Ind. 8 (5), 573–581. https://doi.org/10.1016/j.ecolind.2007.08.002.

Cornes, R., Sandler, T., 1996. The Theory of Externalities, Public Goods, and Club Goods. Cambridge Books, Cambridge University Press https://econpapers.repec.org/bookchap/cupcbooks/9780521477185.htm.

Coase, R.H., 2013. The problem of social cost. J. Law Econ. 56 (4), 837–877. https://doi.org/10.1086/674872.

Community Relations Division and NSW Department of Justice. COVID-19 Pandemic and Crime Trends in NSW. Accessed May 13, 2022. https://www.bocsar.nsw.gov.au:443/Pages/bocsar_media_releases/2020/mr-COVID-19-crime-trends-in-NSW.aspx.

Costanza, Robert, Rudolf de Groot, Paul Sutton, Sander van der Ploeg, Sharolyn J. Anderson, Ida Kubiszewski, Stephen Farber, R. Kerry Turner, 2014. Changes in the Global Value of Ecosystem Services. Global Environ. Change 26: 152–58. https://doi.org/10.1016/j.gloenvcha.2014.04.002.

Craig, Lyn, and Brendan Churchill. Dual-Earner Parent Couples' Work and Care during COVID-19. Gender, Work & Organization 28, no. S1 (2021): 66–79. https://doi.org/10.1111/gwao.12497.

CSIRO. n.d. CSIRO Study Reveals COVID-19's Impact on Weight and Emotional Wellbeing. CSIRO. Accessed May 15, 2022. https://www.csiro.au/en/news/news-releases/2020/csiro-study-reveals-covid-19s-impact-on-weight-and-emotional-wellbeing.

Daly, H. E. Economics in a Full World. IEEE Engineering Management Review Online 33, no. 4 (Fourth Quarter 2005): 21–21.

Daly, H.E., Cobb, J.B., 1994. For the Common Good: Redirecting the Economy toward Community, the Environment, and a Sustainable Future, second ed. Beacon Press, Boston.
Dawson, Drew, Kirsty McCulloch, Angela Baker. 2001. Extended Working Hours in Australia: Counting the Costs, January. Accessed May 13, 2022. https://www.researchgate.net/publication/246151595_Extended_Working_Hours_in_Australia_Counting_the_Costs.
Dean, M., Rainnie, A.l., Stanford, J., Nahum, D., 2021. Industrial policy-making after COVID-19: manufacturing, innovation and sustainability. Econ. Labour Relat. Rev. 32 (2), 283–303. https://doi.org/10.1177/10353046211014755.
Denby, Claire. 2022. "Melbourne Institute." Melbourne Institute: Applied Economic & Social Research. May 10, 2022. LivingInAus-2019.pdf (unimelb.edu.au).
Dobson, A.P., Pimm, S.L., Hannah, L., Kaufman, L., Ahumada, J.A., Ando, A.W., Bernstein, A., et al., 2020. Ecology and economics for pandemic prevention. Science 369 (6502), 379–381. https://doi.org/10.1126/science.abc3189.
Department of Industry, 2020. "Department of Industry, Science, Energy and Resources. Quarterly Update of Australia's National Greenhouse Gas Inventory". March 2020 industry.gov.au. Accessed May 14, 2022.
Dolamore, Robert, 2013, Looking Back Nominal and Real GDP Growth. Text. Australia. Accessed May 13, 2022. https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/FlagPost/2013/September/Looking_back_nominal_and_real_GDP_growth.
Data Collection Changes Due to the Pandemic and Their Impact on Estimating Personal Well-Being - Office for National Statistics. Accessed May 13, 2022. https://www.ons.gov.uk/peoplepopulationandcommunity/wellbeing/methodologies/datacollectionchangesduetothepandemicandtheirimpactonestimatingpersonalwellbeing.
Endo, Akira, Centre for the Mathematical Modelling of Infectious Diseases COVID-19 Working Group, Sam Abbott, Adam J. Kucharski, and Sebastian Funk. Estimating the Overdispersion in COVID-19 Transmission Using Outbreak Sizes Outside China. Wellcome Open Research, July 10, 2020. https://doi.org/10.12688/wellcomeopenres.15842.3.
EPA, n.d., 2013. "EPA, NSW. n.d. NSW Environment Protection Authority (EPA). NSW Environment Protection Authority". 2013. Accessed May 14, 2022. "Methodology for Valuing the Health Impacts of Changes in Particle Emissions – Final Report" 2013 https://www.epa.nsw.gov.au/~/media/EPA/Corporate%20Site/resources/air/HealthPartEmiss.ashx.
Furceri, Davide, Prakash Loungani, Jonathan D. Ostry, and Pietro Pizzuto. COVID-19 Will Raise Inequality If Past Pandemics Are a Guide. VoxEU.Org (blog), May 8, 2020. https://voxeu.org/article/covid-19-will-raise-inequality-if-past-pandemics-are-guide.
Hand, K., Baxter, J., Carroll, M., Budinski, M., 2020. Families in Australia Survey: Life during COVID-19. Text. Australian Institute of Family Studies, July 2, 2020. https://aifs.gov.au/publications/families-australia-survey-life-during-covid-19.
FCAI Releases May 2020 New Vehicle Sales Statistics. Accessed May 13, 2022. https://www.fcai.com.au/news/index/view/news/636.
Gasparrini, A., Guo, Y., Sera, F., Vicedo-Cabrera, A.M., Huber, V., Tong, S., de Sousa, M., Coelho, Z.S., et al., 2017. Projections of temperature-related excess mortality under climate change scenarios. Lancet Planet. Health 1 (9), e360–e367. https://doi.org/10.1016/S2542-5196(17)30156-0.
Gurran, Nicole, Ann Forsyth, Michael Darcy, Glen Searle, Caitlin Buckle, and Sarah Zou. Population Growth, Regional Connectivity, and City Planning — International Lessons for Australian Practice. AHURI Final Report, no. 362 (August 26, 2021). https://doi.org/10.18408/ahuri7322301.
Guttmann, Rochelle, Charissa Pavlik, Benjamin Ung, Gary Wang, 2021. Cash Demand During COVID-19, 2021, 11. Cash Demand During COVID-19 (rba.gov.au).
Haghnazar, H., Cunningham, J.A., Kumar, V., Aghayani, E., Mehraein, M., 2022. COVID-19 and urban rivers: effects of lockdown period on surface water pollution and quality – a case study of the Zarjoub River, North of Iran. Environ. Sci. Pollut. Res. 29 (18), 27382–27398. https://doi.org/10.1007/s11356-021-18286-5.
Harmon, Justin, and Kyle Maurice Woosnam. Diminishing Returns: Leisure and the Sunk Cost Effect. Annals of Leisure Research 0, no. 0 (August 19, 2021): 1–6. https://doi.org/10.1080/11745398.2021.1964993.
Health, Australian Government Department of. 2022. Australian Government Department of Health. Other. Australian Government Department of Health. Australian Government Department of Health. May 14, 2022. Issue Note 1: Evaluating the impact of COVID-19 containment measures on activity and spending | OECD Economic Outlook, Volume 2020 Issue 1 | OECD iLibrary (oecd-ilibrary.org).
Heikkurinen, Pasi, 2021. The Nature of Degrowth: Theorising the Core of Nature for the Degrowth Movement. Environ. Values 30 (3): 367–85. https://doi.org/10.3197/096327120X15973379803681.
Hoskins, B., Mascherini, M., 2009. Measuring active citizenship through the development of a composite indicator. Soc. Indic. Res. 90 (February), 459–488. https://doi.org/10.1007/s11205-008-9271-2.
Oscar IV, H., Whitman, M.V., Campbell, K.S., Johnson, D.E., 2016. Exploring the social identity threat response framework. Equality, Divers. Incl.: Int. J. 35 (3), 205–220. https://doi.org/10.1108/EDI-08-2015-006.
Household Income and Wealth, Australia, 2019-20 Financial Year | Australian Bureau of Statistics, April 28, 2022. https://www.abs.gov.au/statistics/economy/finance/household-income-and-wealth-australia/latest-release.
Howard, C., Chambers, A., 2016. The challenge of quantifying national well-being: lessons from the measures of australia's progress initiative. Policy Studies 37 (6), 551–567. https://doi.org/10.1080/01442872.2016.1144738.
Home | Infrastructure Australia. n.d. Accessed May 13, 2022. Final_COVID Impacts on Infrastructure Sectors Report_14 Dec 2020.pdf (infrastructureaustralia.gov.au).
Jiang, Min, Euijune Kim, and Youngjin Woo, 2020. "The Relationship between Economic Growth and Air Pollution—A Regional Comparison between China and South Korea". Accessed May 13, 2022. https://www.mdpi.com/1660-4601/17/8/2761.
Kallis, Giorgos. In Defence of Degrowth. Ecological Economics 70, no. 5 (March 15, 2011): 873–80. https://doi.org/10.1016/j.ecolecon.2010.12.007.
Kallis, G., Kerschner, C., Martinez-Alier, J., 2012. The economics of degrowth. *Ecol. Econ.* 84 (December), 172–180. https://doi.org/10.1016/j.ecolecon.2012.08.017.
Kauder, emil., 1965. History of Marginal Utility Theory. Princeton University Press.
Kenny et al, 2019. Kenny, Daniel C., Robert Costanza, Tom Dowsley, Nichelle Jackson, Jairus Josol, Ida Kubiszewski, Harkiran Narulla, Saioa Sese, Anna Sutanto, Jonathan Thompson. "Australia's Genuine Progress Indicator Revisited (2019). Ecological Economics 158 (April 1, 2019): 1–10. https://doi.org/10.1016/j.ecolecon.2018.11.025.
Kerschner, C., 2010. Economic de-growth vs. steady-state economy. J. Clean. Prod., Growth, Recess. Degrowth Sustainability Equity? 18 (6), 544–551. https://doi.org/10.1016/j.jclepro.2009.10.019.
Kilian, Lutz. 2009. Oil Price Shocks, Monetary Policy and Stagflation | Conference – 2009, August. https://www.rba.gov.au/publications/confs/2009/kilian.html.
Kompas, Tom, Marcia Keegan, Ellen Witte, and Melbourne Sustainable Society Institute. Australia's Clean Economy Future: Costs and Benefits, 2019. SGS-Economics-and-Planning_clean-economy.pdf (sgsep.com.au).
Kubiszewski, Ida, Kennedy Muthee, A. Rifaee Rasheed, Robert Costanza, Maya Suzuki, Stacey Noel, Mark Schauer. The Costs of Increasing Precision for Ecosystem Services Valuation Studies. Ecol. Indic. 135 (February 1, 2022): 108551. https://doi.org/10.1016/j.ecolind.2022.108551.
Kubiszewski, Ida, Robert Costanza, Carol Franco, Philip Lawn, John Talberth, Tim Jackson, Camille Aylmer, 2013. Beyond GDP: Measuring and Achieving Global Genuine Progress. Ecol. Econ. 93: 57–68. https://doi.org/10.1016/j.ecolecon.2013.04.019.
Labour Force, 2020. "Labour Force Australia, 2020 | Australian Bureau of Statistics". April 14, 2022. https://www.abs.gov.au/statistics/labour/employment-and-unemployment/labour-force-australia/latest-release.
Lawn, Philip A, 2013. A Theoretical Foundation to Support the Index of Sustainable Economic Welfare (ISEW), Genuine Progress Indicator (GPI), and Other Related Indexes. Ecol. Econ. 44 (1): 105–18. https://doi.org/10.1016/S0921-8009(02)00258-6.
Lawn, Philip. SA GPI Final Report_Wafefield Futures Group.Pdf. n.d. Dropbox. (2019). Accessed May 13, 2022. https://www.dropbox.com/s/g41nbt7tm7r53xz/SA%20GPI%20Final%20Report_Wafefield%20Futures%20Group.pdf?dl=0.
Lickley, Solomon, S., Fletcher, S., Velders, G.J., Daniel, J., Rigby, M., Montzka, S., Kuijpers, L., Stone, K., Sub Algemeen Marine & Atmospheric Res, & Marine and Atmospheric Research, et al., 2020. Quantifying contributions of chlorofluorocarbon banks to emissions and impacts on the ozone layer and climate. Nat. Commun. 11 (1), 1380–11311. https://doi.org/10.1038/s41467-020-15162-7.
Manipis, Kathleen, Deborah Street, Paula Cronin, Rosalie Viney, and Stephen Goodall. Exploring the Trade-Off Between Economic and Health Outcomes During a Pandemic: A Discrete Choice Experiment of Lockdown Policies in Australia. The Patient – Patient-Centered Outcomes Research 14, no. 3 (May 1, 2021): 359–71. https://doi.org/10.1007/s40271-021-00503-5.
Marani, Marco, Gabriel G. Katul, William K. Pan, 2021. Anthony J. Parolari. Intensity and frequency of extreme novel epidemics. Proc. Natl. Acad. Sci. 118 (35) e2105482118. https://doi.org/10.1073/pnas.2105482118.
Medicine, Institute of, and National Research Council. 2009. Sustaining Global Surveillance and Response to Emerging Zoonotic Diseases. Edited by Gerald T. Keusch, Marguerite Pappaioanou, Mila C. González, Kimberly A. Scott, and Peggy Tsai. Washington, DC: The National Academies Press. https://doi.org/10.17226/12625.
Morgan, 2020. Roy Morgan. "Hard to Switch off Work for Many Australians Working from Home". Accessed May 13, 2022. http://www.roymorgan.com/findings/8401-coronavirus-working-from-home-may-2020-202005050514.
Natoli, Riccardo, Segu Zuhair, 2011. Measuring Progress: A Comparison of the GDP, HDI, GS and the RIE. Social Indic. Res. 103 (1): 33–56. https://doi.org/10.1007/s11205-010-9695-3.
Nguyen, Kim, Gianni La Cava, 2020. News Sentiment and the Economy | Bulletin – June Quarter 2020. Bulletin, no. June (2020). https://www.rba.gov.au/publications/bulletin/2020/jun/news-sentiment-and-the-economy.html.
New Research Highlights Risk of COVID Pandemic Increasing Inequality – ACOSS. Accessed May 13, 2022. https://www.acoss.org.au/media_release/new-research-highlights-risk-of-covid-pandemic-increasing-inequality/.
NPI, 2020. "Search Results - Summary and Related Information". http://www.npi.gov.au/npidata/action/load/summary-result/criteria/substance/92/destination/ALL/source-type/ALL/substance-name/Particulate%2BMatter%2B2.5%2Bum/subthreshold-data/Yes/year/2019. 2020. Accessed May 13, 2022.
NSW, 2020. "https://www.nsw.gov.au/news/nsw-to-ease-covid-19-restrictions-from-friday-15-may".
OECD Economic Outlook, Volume 2020 Issue 1: Preliminary Version. OECD Economic Outlook. OECD, 2020. https://doi.org/10.1787/0d1d1e2e-en.
OECD, 2008. Handbook on Constructing Composite Indicators: Methodology and User Guide. Organisation for Economic Co-operation and Development, Paris.
Olivier, M.M., Howard, J.L., Wilson, B.P., Robinson, W.A., 2018. Correlating localisation and sustainability and exploring the causality of the relationship. Ecol. Econ. 146 (April), 749–765. https://doi.org/10.1016/j.ecolecon.2017.11.035.
O'Mahony, T., Escardó-Serra, P., Dufour, J., 2018a. Revisiting ISEW valuation approaches: the case of spain including the costs of energy depletion and of climate change. Ecol. Econ. 144 (February), 292–303. https://doi.org/10.1016/j.ecolecon.2017.07.024.

O'Mahony, Tadhg, Paula Escardó-Serra, Javier Dufour, 2018. Revisiting ISEW valuation approaches: the case of spain including the costs of energy depletion and of climate change. Ecol. Econ. 144 292–303. https://doi.org/10.1016/j.ecolecon.2017.07.024.

PMC, n.d., 2020. "Planning for Australia's future population".pmc.gov.au.2020.

Posner, Stephen M., Robert Costanza, 2011. A Summary of ISEW and GPI studies at multiple scales and new estimates for Baltimore City, Baltimore County, and the State of Maryland. Ecol. Econ., Special Section – Earth System Governance: Accountability and Legitimacy, 70, no. 11 (September 15, 2011): 1972–80. https://doi.org/10.1016/j.ecolecon.2011.05.004.

Pragyan Deb; Davide Furceri; Jonathan David Ostry; Nour Tawk, 2022. The Effect of Containment Measures on the COVID-19 Pandemic. IMF. Accessed May 13, 2022. https://www.imf.org/en/Publications/WP/Issues/2020/08/07/The-Effect-of-Containment-Measures-on-the-COVID-19-Pandemic-49572.

PWC , n.d. Understanding the Unpaid Economy, n.d., 8. Understanding the unpaid economy . https://www.pwc.com.au/australia-in-transition/publications/understanding-the-unpaid-economy-mar17.pdf.

QUA, 2021. "Queensland, The University of, Australia. "COVID-19 Lockdown Policies Linked to Reduction in Urban Crime." 2021, UQ News". Accessed May 13, 2022. https://www.uq.edu.au/news/article/2021/06/covid-19-lockdown-policies-linked-reduction-urban-crime.

Rabobank. n.d. African Swine Fever Dominates Global Protein Markets. Rabobank-AU. Accessed May 15, 2022. https://www.rabobank.com.au/media-releases/2020/200623-african-swine-fever-dominates-global-protein-markets-despite-covid-19/.

Rockström, J., Steffen, W., Noone, K., Åsa Persson, F., Chapin, S., Lambin, E.F., Lenton, T.M., et al., 2009. A safe operating space for humanity. Nature 461 (7263), 472–545. https://doi.org/10.1038/461472a.

Rume, Tanjena, Didar-Ul Islam, S.M., 2020. Environmental Effects of COVID-19 Pandemic and Potential Strategies of Sustainability. Heliyon 6, no. 9 (September 1, 2020): e04965. https://doi.org/10.1016/j.heliyon.2020.e04965.

Staton, Sally, Laetitia Coles, Zhaoxi Zheng, and Karen Thorpe. COVID-19: Giving the Gift of Family Time, 2020, 4. Children's experiences during COVID-19_1.pdf (uq.edu.au).

Stiglitz, Joseph E. GDP Is the Wrong Tool for Measuring What Matters. Scientific American. Accessed May 13, 2022. https://doi.org/10.1038/scientificamerican0820-24.

Talberth, Dr John, Clifford Cobb, and Noah Slattery. The Genuine Progress Indicator 2006, 2006, 33. GPI-2006-Final.pdf (sustainable-economy.org).

Talberth, John, Michael Weisdorf, 2017.. Genuine Progress Indicator 2.0: Pilot Accounts for the US, Maryland, and City of Baltimore 2012–2014. Ecological Economics 142 (December 1, 2017): 1–11. https://doi.org/10.1016/j.ecolecon.2017.06.012.

Teske et al., 2016. Teske, S., Dominish, E., Ison, N., Maras, K., 2016. "100% Renewable Energy for Australia – Decarbonising Australia's Energy Sector within one Generation. Report prepared by ISF for GetUp! and Solar Citizens". March 2016. https://www.uts.edu.au/sites/default/files/article/downloads/ISF_100%25_Australian_Renewable_Energy_Report.pdf.

Twins Research Australia (TRA). TRACKERR Study – Brief Report 1: Wave 1 Adult Twin Survey. TRA, The University of Melbourne, Melbourne, 2020. TRA_Covid_19_adult_twin_survey_1st_report.pdf (twins.org.au).

UNEP, 2019. "We're Gobbling up the Earth's Resources at an Unsustainable Rate, 2019. UNEP". April 3, 2019. http://www.unep.org/news-and-stories/story/were-gobbling-earths-resources-unsustainable-rate.

Update on National Volunteer Week 2020 – Volunteering Australia. Accessed May 13, 2022. https://www.volunteeringaustralia.org/update-on-national-volunteer-week-2020/#/.

Volunteering Australia, n.d. Accessed May 14, 2022. https://www.volunteeringaustralia.org/wp-content/uploads/FY17-18-Annual-Report-FINAL–21112018.pdf.

Venter, Z.S., Kristin, A., Sourangsu, C., Jos, L., 2020. COVID-19 lockdowns cause global air pollution declines. Proc. Natl. Acad. Sci. 117 (32), 18984–18990. https://doi.org/10.1073/pnas.2006853117.

Victoria University, Australia. (2020) n.d. Accessed May 14, 2022. Higher education finance report (vu.edu.au).