GPI 2.0

Ohio's Genuine Progress Indicator

Scioto Analysis

Economics | Public Policy

Contents

1 GPI 2.0

1.1 GPI vs. GDP

The Genuine Progress Indicator (GPI) is one of the most viable alternatives to Gross Domestic Product (GDP) for measuring the strength of an economy among those who research sustainable development. It combines the raw output data of GDP with adjustments for goods with positive spillovers such as high levels of education and goods with negative spillovers such as pollution.

The result is an indicator that attempts to tell us how economically efficient an economy is rather than just how productive it is in pure market terms. In most places, the result is that GPI is often lower than GDP, meaning that in many cases the benefits of consumption are outweighed by the overall social cost they inflict.

In 2018, Scioto Analysis released its initial GPI estimate for Ohio. We then released new estimates in 2020 and 2021. This study constitutes the first estimate of GPI using the "GPI 2.0" formula, a new formula devised by John Talberth to improve on the original GPI calculation. We follow his formulation as laid out in "Genuine progress indicator 2.0: pilot accounts for the US, Maryland, and City of Baltimore 2012–2014."[1]

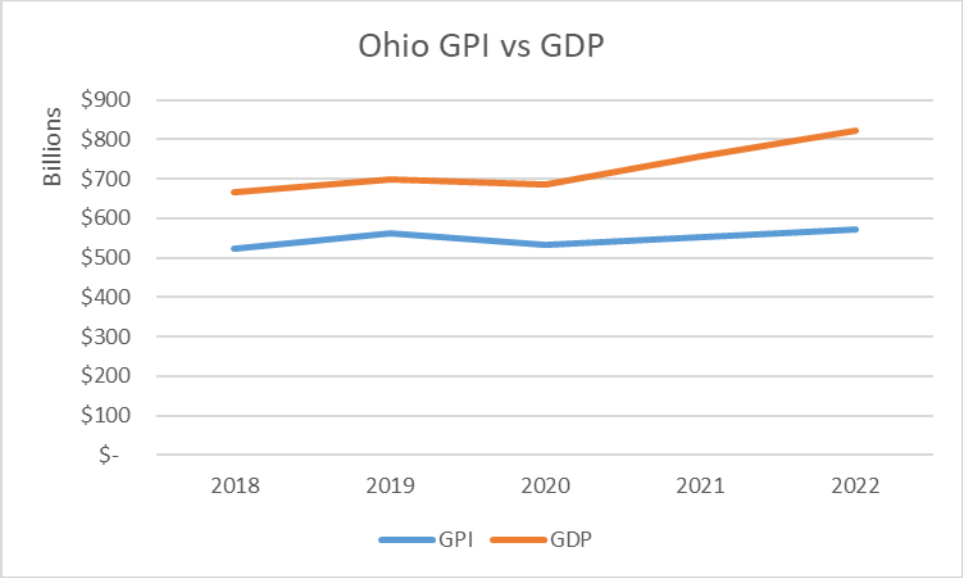

Figure 1: The gap between GPI and GDP has grown over the past five years

1. John Talberth and Michael Weisdorf, "Genuine progress indicator 2.0: pilot accounts for the US, Maryland, and City of Baltimore 2012–2014," *Ecological Economics* 142 (2017): 1–11.

In Ohio, GPI has been much more stagnant when compared to GDP over the past five years. It still has increased, though by not nearly as much. GDP rose by almost 23% over this time compared to only 8% for GPI.

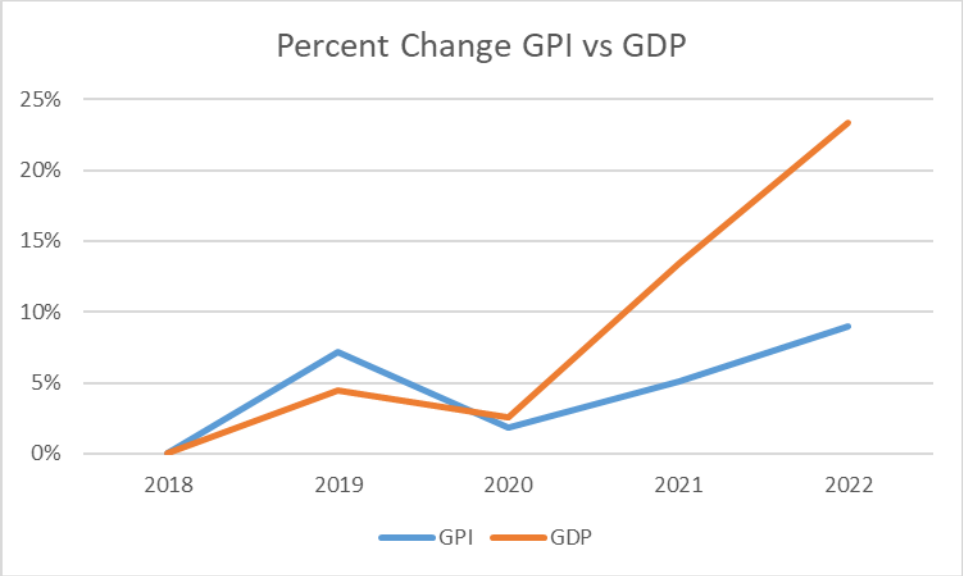

Figure 2: GPI suggests that economic growth has been less robust than GDP growth

1.2 What GPI Does Differently

GPI is broken into three main indicators: the value of **market based well-being**, the value of **non-market based well-being**, and the **social costs of economic activity**. Each of these indicators is then broken down into multiple sub-indicators which are usually composed of a few monetized components.

Market based well-being is the part of GPI that most closely resembles GDP, thanks to the fact that it measures the consumption of goods and in the economy. However, it differs from GDP quite significantly by subtracting the amount people spend consuming undesirable goods and it adjusts consumption downward to adjust for income inequality.

Non-market based well-being attempts to measure the value of goods that are not acquired through monetary transactions. Examples of goods included in this indicator are the value of ecosystem services we freely use and the value of non-market labor such as volunteering and unpaid childcare.

The social costs of economic activity are the costs of undesirable economic conditions such as pollution and crime. GPI adjusts downward for these, adjusting for a key double-counting problem with GDP.

In each of the following sections, we go into greater detail about each sub-indicator and the calculations that compose it.

2 Market Based Well-being

2.1 Household Budget Expenditures

Household budget expenditures are the largest component of GPI in Ohio. This data comes from the Bureau of Economic Analysis.[2] Data was not available for 2022, so that number is linearly extrapolated using the past four years of data.

This indicator includes personal spending on utility generating consumption items. This differs from GDP by limiting what we measure to strictly expenditures we assume generate some utility. The categories that we exclude from this calculation are covered in the Defensive Expenditures section.

Additionally, we exclude consumption of consumer durables. This is because spending on things like appliances and cars represent not just one time consumption, but investments with future utility. These are accounted for in the Household Investment account and their long term gains are measured in the Services from Built Capital account.

Household Budget in Ohio has steadily increased over the past five years, except in 2020 when the pandemic kept people in their homes and reduced consumption of goods and services. Recovery from the initial stages of the pandemic was fairly swift, and as of 2021 it appears that Ohio is on the same pre-pandemic trend line as household budget continues to increase.

2.2 Defensive Expenditures

One major difference GPI has from GDP is that calculation of GPI includes a subtraction of spending on defensive or utility-neutral goods from the final total. Items included in this calculation are things like medical expenses, tobacco, 25% of spending on alcohol, and 25% of food consumed at home and 19% of food consumed away from home to represent waste among others.[3] These values come from BEA data about personal consumption in Ohio.[4]

2. "Personal consumption expenditures by type of product," BEA, https://www.bea.gov/data/consumer-spending/state.

3. Defensive expenditures like medical expenses and tobacco are removed in full while percentages of expenditures are removed to account for categories that have waste.

4. "Personal consumption expenditures by type of product."

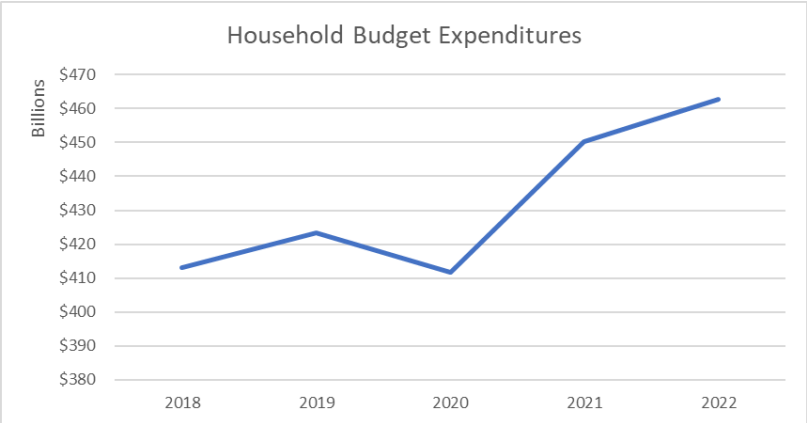

Figure 3: Ohioans spent over $460 billion on goods and services last year

In Ohio, defensive expenditures have cost the economy between about $85 and $100 billion over the past five years. The trend over this period largely mirrors the spending on utility-generating consumption at a lower level.

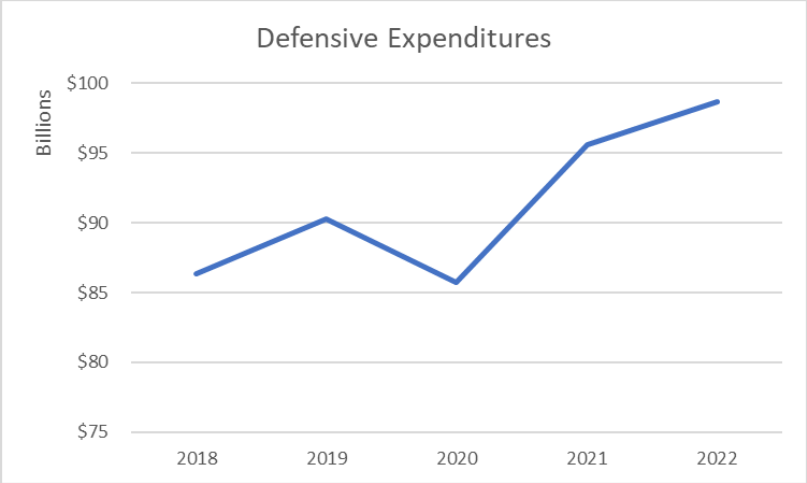

Figure 4: Defensive expenditures closely follows the same trend as household budget expenditures

2.3 Household Investment

Household investment is separated from the personal consumption indicator in GPI because we later factor it into the Services from Built Capital indicator. This

indicator includes line items from BEA including consumer durables, in addition to other forms of household investment such as education spending.[5]

Ohioans have spent between $60 and $90 billion on household investment over the past five years. Interestingly, investment did not appear to suffer the same dip during the pandemic that other types of consumption did. This may have been due to the fact that stay-at-home orders led to more consumption of consumer durable goods that are used at home versus experience goods like eating out and travel.

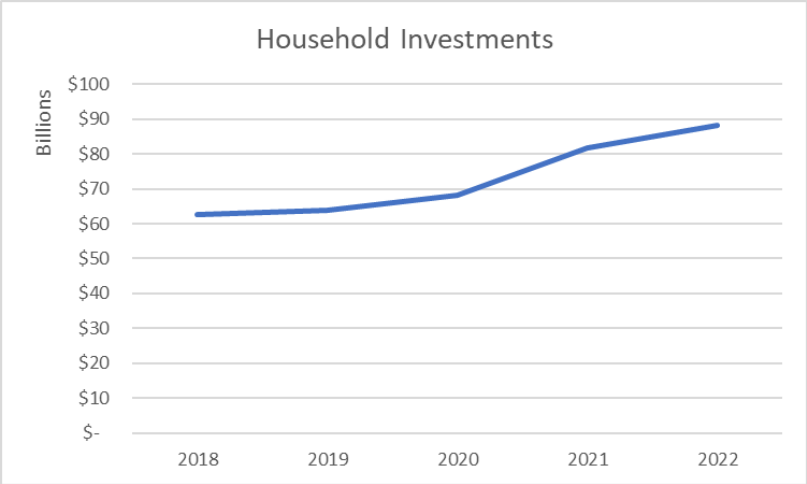

Figure 5: Household investment did not decline during the pandemic in Ohio

2.4 Inequality Adjustment

One major difference between GPI and GDP is that GPI incorporates an adjustment to personal consumption expenditures for inequality. This is calculated based on estimates of the declining marginal utility of income. From a theoretical perspective, marginal dollars spent by low-income households result in higher utility than dollars being spent by high income households. Making this adjustment thus converts dollars to their average value for people in the economy.[6]

We use tax data made available by the Ohio Department of Taxation to construct adjusted income brackets following the method outlined by Talberth and Weisdorf (2017):[7]

5. Ibid.

6. Daniel Acland and David H Greenberg, "Principles and Practices For Distributional Weighting: A New Approach," *Available at SSRN 4067472*, 2022,

7. Talberth and Weisdorf, "Genuine progress indicator 2.0: pilot accounts for the US, Maryland, and City of Baltimore 2012–2014."

- Group tax returns into brackets of $5,000, with the upper bracket being people earning more than $250,000
- Sum up the total income in each bracket
- Adjust brackets above median income according to their distance from the median income
- Sum up the total adjusted income
- Divide adjusted income by total income to get the inequality adjustment value.

Below are values for inequality adjustment for each of the years included in this study.

Table 1: Percentage of Consumption Counted by GPI

Year	Income Inequality Adjustment
2018	77%
2019	76%
2020	74%
2021	69%
2022	68%

Tax data for 2022 is not available at the time of writing, so we create a line of best fit based on trends over the past five years to extrapolate data for 2022.

Since 2018, income inequality has slowly been on the rise in Ohio. Most notably, there was a big spike between 2020 and 2021, when the inequality adjustment fell from 74% to 69%. This drop was likely influenced by the pandemic.

Income inequality has cost Ohio over $100 billion since 2020. This is a combination of the fact that Ohio has high levels of consumer spending (5th in the country) and slightly higher than average income inequality.

2.5 Public Provision

The final indicator in the market-based well-being section of GPI is the addition of goods and services consumed by the private sector but produced by the public sector. This includes spending on things like safety net programs or public parks. We exclude this spending from the inequality adjustment because the consumption of many of these items is skewed to those less well off.

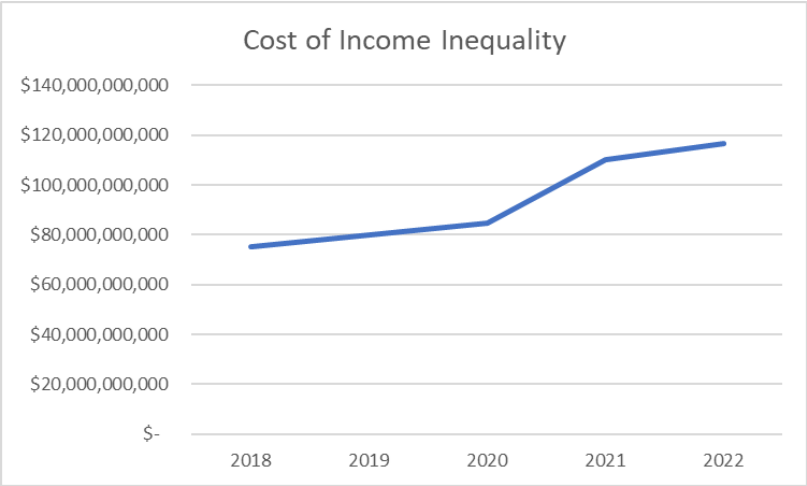

Figure 6: Income inequality rose during the pandemic

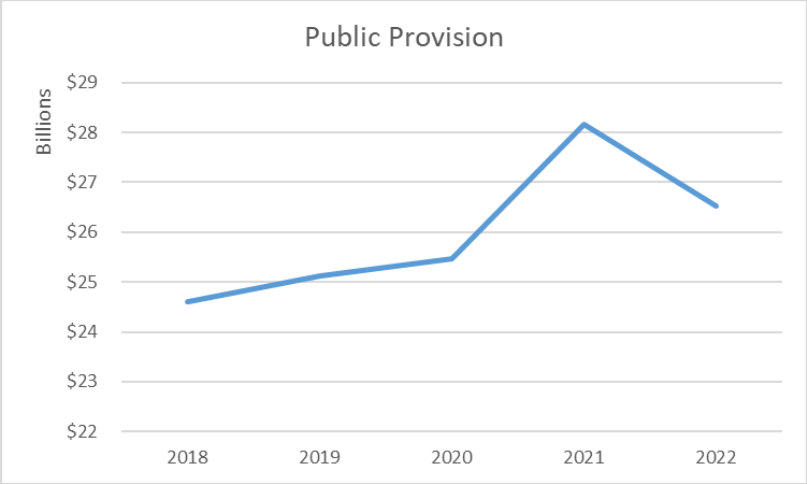

Figure 7: Public provision has been on an upward trend for the last five years

3 Non-Market Based Well-being

3.1 Services from Human Capital

3.1.1 Higher Education

Data for Ohio's annual population over 25 years old and the percentage of those adults who have earned at least a bachelor's degree are made available by the Census

Bureau.[8,9] For all of our calculations, we use ACS 5-year estimates to minimize the risk of sampling error by year.

Following the standards set by other GPI studies, the positive economic spillover value generated by an individual with a college degree is $19,447 (2012 dollars).[10] Over the past five years, Ohio has received an average of $45.1 billion worth of benefits from higher education.

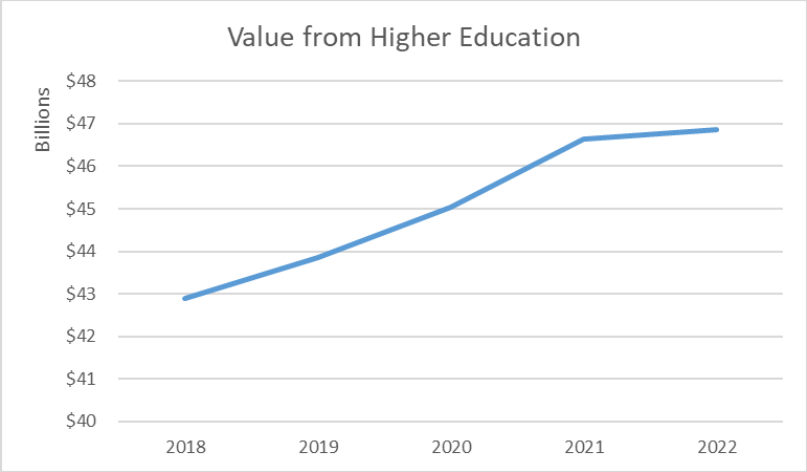

Figure 8: The number of adults with college degrees in Ohio has increased over the last five years

3.1.2 Manufacturing Jobs

Data for the number of people with jobs in manufacturing is made available by the Bureau of Labor Statistics.[11] Over the past five years, the number of manufacturing jobs in Ohio has been growing at a fairly constant rate of about 25,000 additional jobs each year. The notable exception was in 2020 when the pandemic caused the loss of 120,000 manufacturing jobs.

The standard value for each manufacturing job is assumed to be $10,000. Talberth calculates this based on subsidy and incentive programs from across the country, which imply a nationwide willingness to pay for manufacturing jobs.

8. "Age and Sex," Census Bureau, https://data.census.gov/table?q=population+age+ohio&tid=ACSST5Y2018.S0101.

9. "Educational Attainment," Census Bureau, https://data.census.gov/table?q=college+degree+ohio&tid=ACSST5Y2018.S1501.

10. Talberth and Weisdorf, "Genuine progress indicator 2.0: pilot accounts for the US, Maryland, and City of Baltimore 2012–2014."

11. "Economy at a Glance," BEA, https://www.bls.gov/eag/eag.oh.htm.

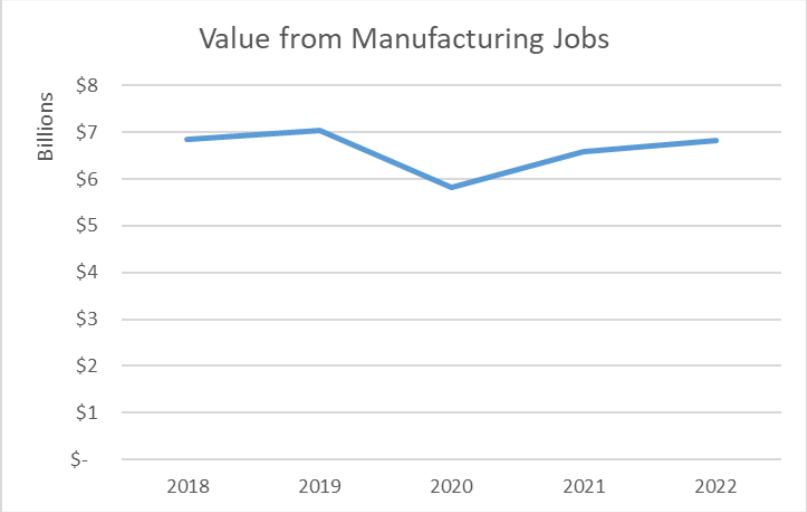

Figure 9: Ohio has received an average of about $6.5 billion of value from manufacturing jobs over the last five years

3.1.3 Green Jobs

Between 2009 and 2011, the Bureau of Labor Statistics kept detailed data on the number of green jobs, jobs associated with firms that are responsible for producing green goods or services.[12]

In order to determine the number of jobs that qualified as green, BLS surveyed approximately 120,000 businesses that they identified as being potentially associated with green goods and services. These businesses reported what percentage of their revenue and employment was used in the production of green goods and services.

Because we don't have more recent data than 2011 for measuring the number of green jobs, we make the assumption that the share of all employment that is associated with green goods and services has remained constant since 2011. For Ohio, we assume that 2.6% of all jobs are in green goods and services. This can be thought of as a lower bound on the value from green jobs, since the share of total jobs in green goods and services has likely increased over the last decade with growth in adoption of new technologies.

According to Talberth, the range of estimates for the value of green jobs to the economy has much higher variance than estimates for other industries. Because of this, we adopt the standard set by previous GPI 2.0 studies and set the value of each green job at $100,000.

12. "Employment in Green Goods and Services," BLS, https://www.bls.gov/news.release/pdf/ggqcew.pdf.

In Ohio, the value added by the number of green jobs was $13.9 billion on average over the last five years. There was a decline in 2020, when the pandemic lowered the total working population.

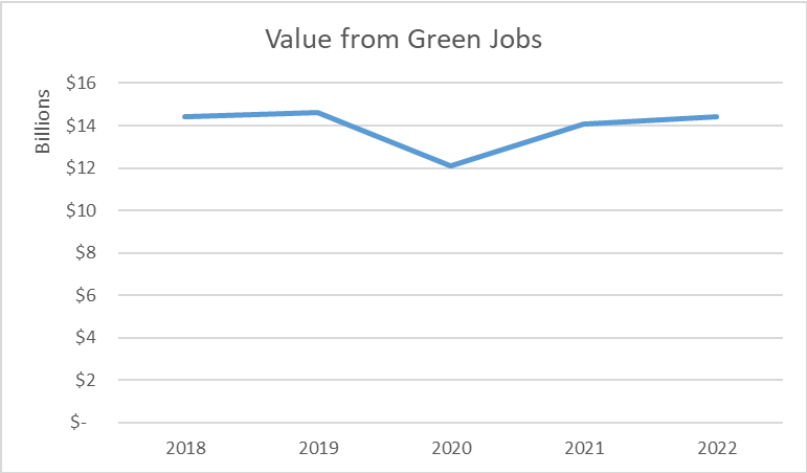

Figure 10: Ohio's value from green jobs has increased each year except in 2020

3.2 Services from Built Capital

Built capital refers to the services we receive from investment in previous years. For example, purchasing a car only gets counted by GDP in the first year as spending on that car, but cars usually last a long time and provide lots of value to their owners.

Similarly, government investment on things like roads continue to provide value after the concrete has been poured. In this section, we estimate how large the total stock is for different categories of built capital, then estimate how much value that produces each year.

3.2.1 Services from Consumer Durables

Another way GPI differs from GDP is that we estimate the value consumers receive from past spending on durable goods. The logic is that major household investments don't just provide value to the economy in the year they are purchased, but instead continue to provide value for many years after. So while GDP will grow if a household purchases a new car every year, GPI estimates the value of a car maintained over multiple years.

We calculate the stock of consumer durables in a given year by adding up all of the spending on durable goods over the past eight years. We then assume that the value of annual services is 20% of the stock value.

Over the past five years, the services generated by consumer durables have increased in Ohio. Because we assume the stock of consumer durables exists for multiple years, this indicator is much less sensitive to single year shocks like we saw in 2020 than a measure like personal consumption expenditures

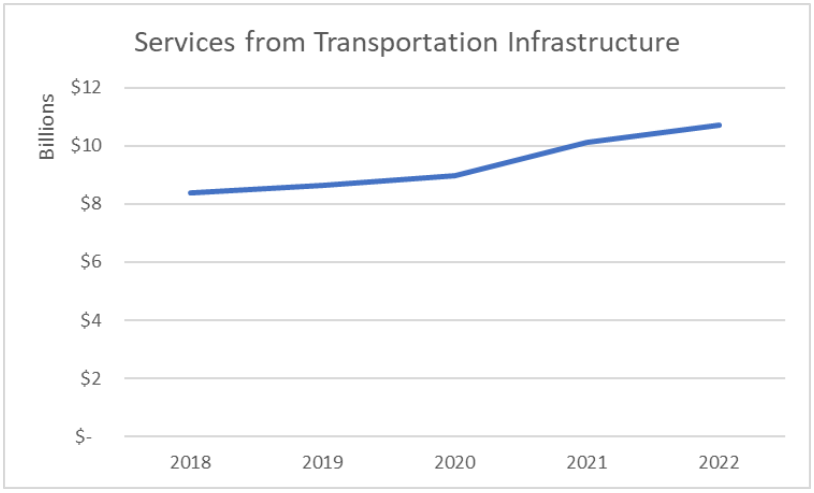

Figure 11: Services from transportation infrastructure increased through the pandemic

3.2.2 Services from Water Infrastructure

Like transportation infrastructure, we measure the value of water infrastructure as 7.5% of the current stock value of water infrastructure across the state. Future GPI accounts could do more research into the value of services provided by water infrastructure to provide a more detailed estimate.

Over the past five years, the value of water infrastructure in Ohio has increased from roughly $1.4 billion to just over $1.8 billion. This spending very closely mirrors the trend in the value of transportation infrastructure, though at a much smaller value.

3.3 Services from Social Capital

Social capital refers to non-market conditions that have economic value. This includes goods like education and non-market time. A new addition in GPI 2.0 is the value of free internet services. The logic is that people with internet access get massive benefits from having access to free websites.

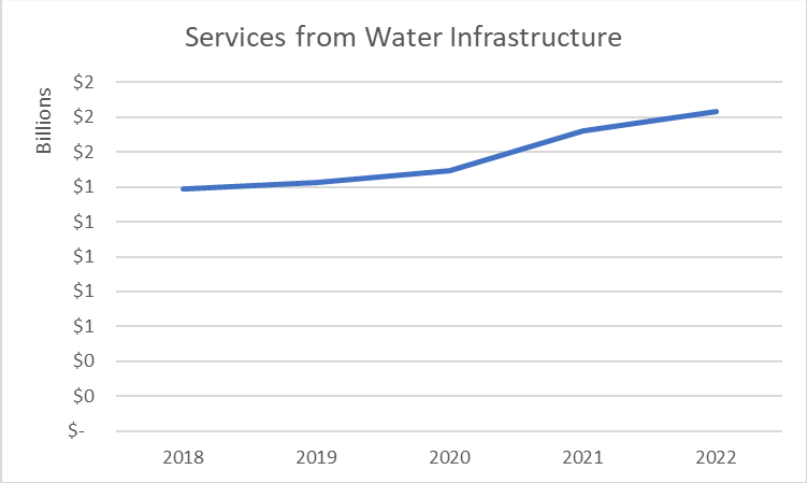

Figure 12: Water infrastructure very closely follows the trend of other built capital indicators

3.3.1 Value of Non-Market Labor

Non-market labor is one of the most significant missing pieces of GDP. People spend significant portions of their days performing household chores like cooking and childcare without getting paid. The value of these services is crucial to our society function properly, but because no money ever exchanges hands it gets missed by GDP. Because of this problem, when houses outsource these tasks through purchasing services like food prep at a restaurant or formal child care, GDP grows more than the value created.

To correct for this in GPI, we use American Time Use Survey data to measure the amount of time people over the age of 15 spend on different activities.[13] In particular, we focus on the categories of volunteering, housework, and caregiving. We then use data from BLS to estimate the wages these jobs would earn on the open market.[14] We use the Independent Sector's estimate for the average value of volunteer hours.[15]

3.3.2 Value of Leisure Time

To estimate the value of leisure time, we assume that the alternative to taking time for leisure would be to work for pay. To calculate it, we take the amount of time

13. "American Time Use Survey," BLS, https://www.bls.gov/tus/.
14. "Occupation Employment, and Wage Statistics," BLS, https://www.bls.gov/oes/current/oes_oh.htm#00-0000/.
15. "The Value of Volunteer Time / State and Historical Data," The Independent Sector, https://independentsector.org/resource/the-value-of-volunteer-time-state-and-historical-data/.

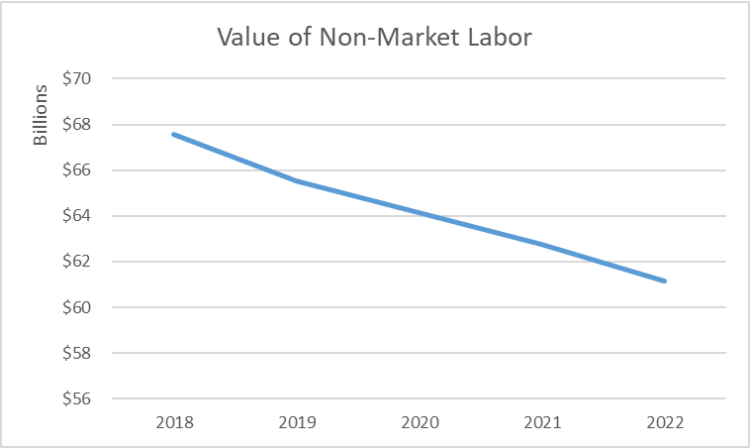

Figure 13: Ohioans are spending less time on non-market labor

people 15 and older spend on leisure during work days from the American Time Use Survey and multiply that by the average wage rate in Ohio.[16,17]

We find that over the past five years, the value of leisure time has overall remained constant in Ohio. It increased fairly significantly between 2018 and 2019, but has since decreased to roughly the same level as in 2018.

As with the value of non-market labor, data for the American Time Use Survey was not collected in 2020, so our estimates may be higher or lower than the actual value in that year.

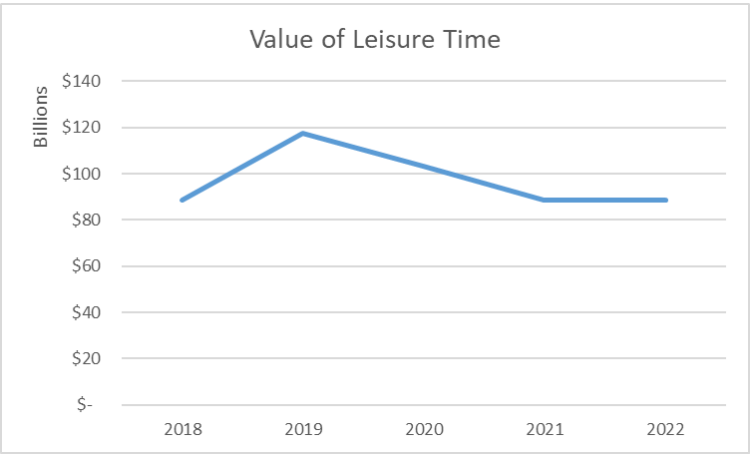

Figure 14: Leisure time has been constant in Ohio over the last five years

16. "American Time Use Survey."
17. "Occupation Employment, and Wage Statistics."

3.3.3 Value of Internet Services

One new indicator included in GPI 2.0 is the value of free internet services such as search engines. The logic behind this is that people with internet access benefit greatly from access to free tools available on the internet.

To calculate this, we use data from the Census Bureau to figure out the number of Ohioans with access to the internet. We then follow Talberth and assume that each person with internet access enjoys $591 of free internet services annually.[18]

The number of Ohioans with access to the internet has steadily increased over the past five years. This has resulted in over $5 billion worth of free internet services being consumed across the state per year.

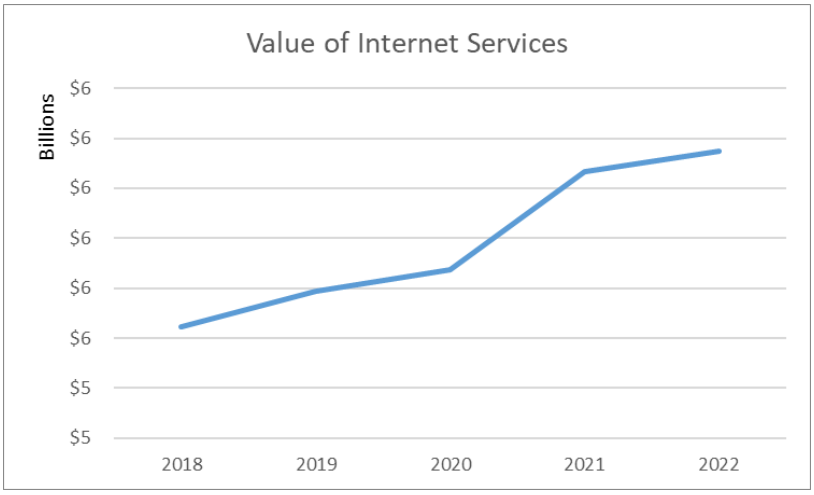

Figure 15: More Ohioans are getting access to the internet

3.4 Services from Natural Capital

The adjustment for services from natural capital relies on two main data sources, the USGS National Land Cover Database (NLCD) and the USGS National Gap Analysis Program's protected area database.[19,20] The combination of these two data sources allows us to measure what types of land cover (e.g. forest, wetland, farmland, etc) make up the protected regions in Ohio. Following Talberth's GPI study,

18. Talberth and Weisdorf, "Genuine progress indicator 2.0: pilot accounts for the US, Maryland, and City of Baltimore 2012–2014."

19. "National Land Cover Database," USGS, https://www.usgs.gov/centers/eros/science/national-land-cover-database/.

20. "Protected Areas," USGS, https://www.usgs.gov/programs/gap-analysis-project/science/protected-areas/.

we assume that only protected areas that exclude extractive use provide ecosystem services.[21] For the years where the NLCD was not reported (2018, 2020, 2021, 2022), we assume that changes in land cover are linear, and extrapolate into the future.

The values for different ecosystem services also come from multiple sources. For forests, wetlands, and freshwater, we use values found in other GPI studies. For the value of cropland and pasture, we use the most estimates provided by the Department of Agriculture specifically for Ohio.[22] The value of these ecosystem services represent things like the sequestration of carbon dioxide, the provision of clean water, and the provision of habitat for wild animals.

Ohio has relatively small benefits from natural capital, less than $100 million for the last five years. Since the amount of protected land increased between 2016 and 2019, we extrapolate that there was a small linear increase over the last four years.

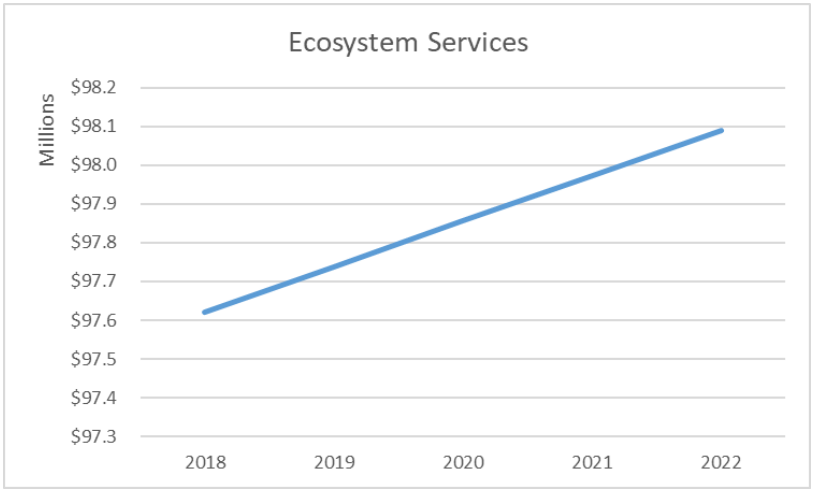

Figure 16: Ohio's ecosystem services are orders of magnitude lower than most other indicators

21. Talberth and Weisdorf, "Genuine progress indicator 2.0: pilot accounts for the US, Maryland, and City of Baltimore 2012–2014."

22. "Land Values, 2022 Summary," USGS, https://www.nass.usda.gov/Publications/Todays_Reports/reports/land0822.pdf/.

4 Environmental and Social Costs

4.1 Depletion of Natural Capital

4.1.1 Change in Productive Lands

The indicator for change in productive lands also uses the NLCD data to measure the acreage of different types of land cover across the state.[23] The valuations for these land types are identical to the section on values of ecosystem services.

The two main assumptions we use in this calculation are that our baseline year is 2012 and instead of just using the yearly differences in productive lands, we calculate the net present value of the land over a 50-year time horizon. This means that we are not measuring the current lost value from potential ecosystems, but rather the economic tradeoff associated with land conversion activities.

In the past five years, Ohio has seen a steady increase in the costs associated with the loss of productive lands. Much of this is driven by the decreased amount of open pasture, which is more valuable to a state like Ohio that has a very productive agriculture industry.

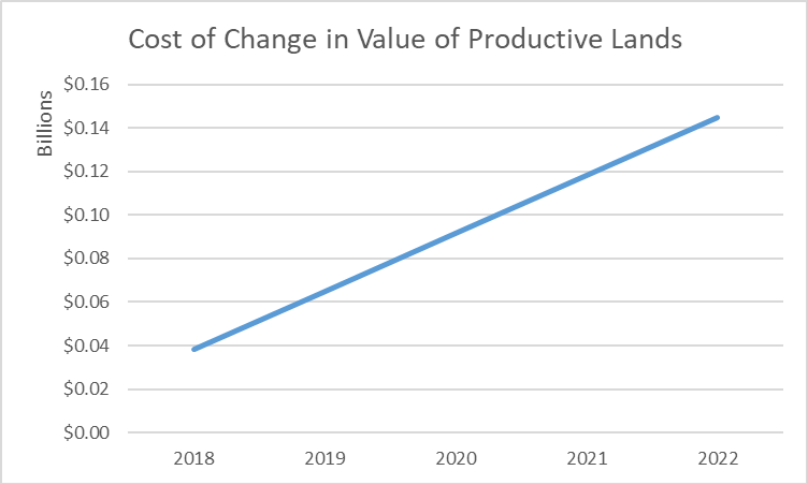

Figure 17: Figure XX: Ohio's cost of land conversion has tripled over the past five years

23. "National Land Cover Database."

4.1.2 Cost of Non-Renewable Energy Depletion

For this GPI calculation, we measure the cost of non-renewable energy depletion as the replacement cost for producing the same amount of energy from renewable resources in Ohio. This is one indicator that may require more research to determine the most appropriate way of valuing these limited resources.

Data for Ohio's energy consumption is available through the Energy Information Administration.[24] We estimate the replacement cost of non-renewables used to produce electricity at $0.13 per kilowatt hour and the cost of replacement for each barrel of petroleum based liquid at $116.[25]

In Ohio, the depletion of natural resources cost just below $10 billion in 2022. There was reduced consumption of energy during 2019 and 2020, but the last two years have seen a fairly substantial upward trend. This could potentially be associated with efforts to dig the economy out of the pandemic recession.

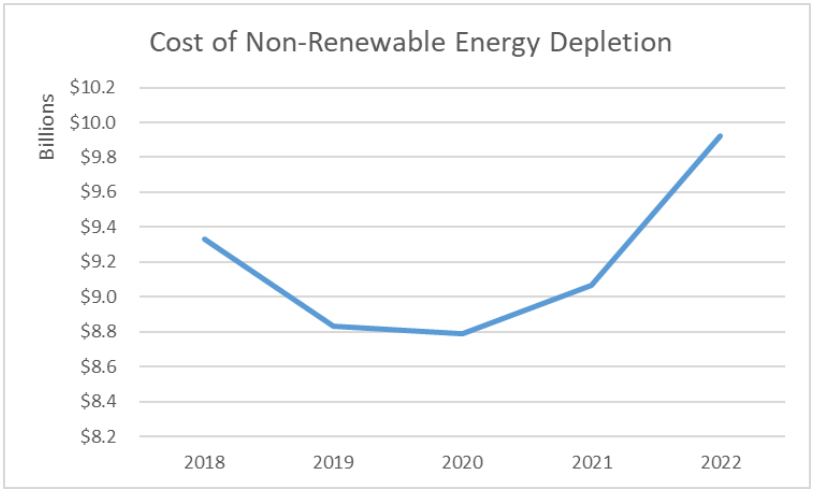

Figure 18: Non-renewable energy use has been increasing in recent years

4.2 Costs of Pollution

4.2.1 Air Pollution

Air pollution is responsible for a wide variety of damages such as negative health impacts. We use estimates for the costs associated with six major air pollutants

24. "Profile Overview," EIA, https://www.eia.gov/state/?sid=OH.

25. "MD GPI 1.0: Cost of Nonrenewable Energy," State of Maryland, https://dnr.maryland.gov/mdgpi/Pages/GPI%5C%201.0/Cost-of-Calculating-Non-renewable-Energy-Source-Depletion.aspx/.

(ammonia, NOx, PM 10, PM 2.5, SO2, and VOC) in this account. Data on the amount of air pollution is available through the EPA's Emission Inventory System.[26]

Air pollution has cost Ohio over $1.5 billion the last three years. There was a slight dip in air pollution in 2019, but pollution increased sharply the next year. The next two years saw slight decreases but costs are still above where they were in 2018.

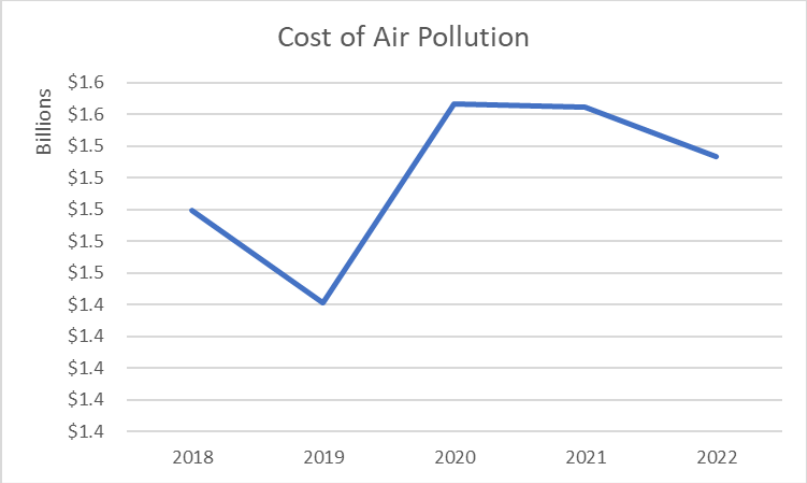

Figure 19: The cost of air pollution increased sharply in 2020

4.2.2 Greenhouse Gas Emissions

Data for Ohio's greenhouse gas emissions are made available by the U.S. Energy Information Administration.[27] The monetized cost of greenhouse gas emissions comes from the EPA's current estimate for the Social Cost of Carbon (SCC).[28] More precisely, we follow Talberth and estimate the cost per ton of emissions at $120.50, which is the average between the current SCC and the most recent proposed change to the SCC.

In Ohio, the costs associated with greenhouse gas emissions have been steadily falling over the last five years. Costs have gone down by over $5 billion over this time. This is driven by reductions in carbon emissions within the state. Relative to the rest of the country, Ohio still has relatively high levels of greenhouse gas emissions.

26. "Emission Inventory System," EPA, https://www.epa.gov/air-emissions-inventories/emissions-inventory-system-eis-gateway.

27. "Energy-Related CO2 Emission Data Tables," EIA, https://www.eia.gov/environment/emissions/state.

28. "EPA Draft "Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances," EPA, https://www.epa.gov/environmental-economics/scghg.

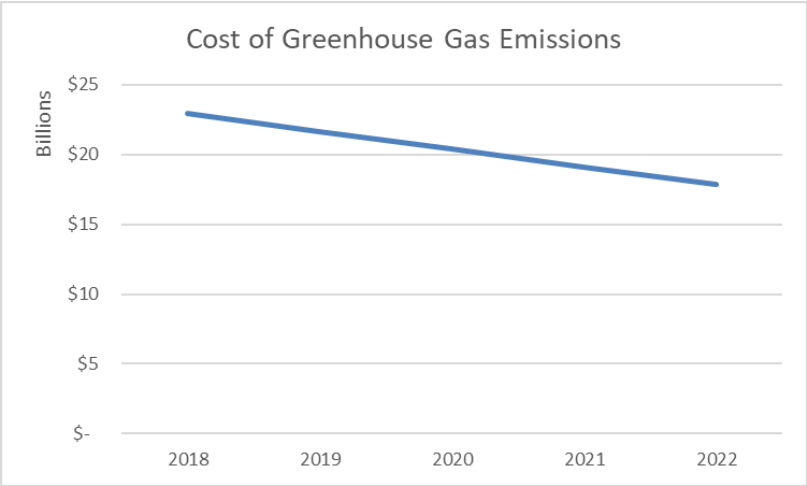

Figure 20: Ohio's costs from greenhouse gas emissions have steadily decreased over the last five years

4.3 Social Costs of Economic Activity

4.3.1 Costs of Underemployment

To calculate the costs of underemployment in Ohio, we take the population over the age of 16 and apply the U-6 unemployment rate to estimate how many people are unemployed and underemployed.[29,30] We then use estimates for the number of hours of employment lost each year per person multiplied by the average hourly wage in Ohio to get an estimate for the total cost of underemployment.

In Ohio, underemployment has cost the state between $15 to 25$ billion over the last five years. Overall, there is a downward trend with the exception being a spike in 2020 because of the pandemic.

4.3.2 Cost of Homelessness

In order to calculate the cost that homelessness exacts on society, we need estimates for the number of homeless people and the annual cost incurred per person. Data on homelessness is notoriously difficult to collect, especially during 2020. Because of this, the counts for homeless people in 2020 and 2022 are extrapolated using data from the National Alliance to End Homelessness.[31]

29. "Age and Sex."
30. "Occupation Employment, and Wage Statistics."
31. "State of Homelessness 2020 Edition," NAEH, https://endhomelessness.org/homelessness-in-america/homelessness-statistics/state-of-homelessness/.

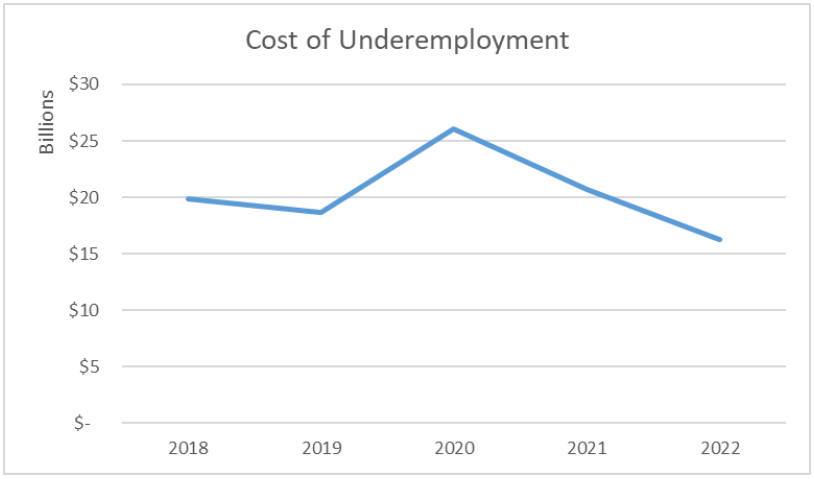

Figure 21: Overall underemployment is on a downward trend over the last five years

Following Talberth, we estimate the social cost of each homeless person is $40,000 annually. This represents the average amount of social services these people utilize.

Each year for the past five years, Ohio has had between 10,000 and 11,000 homeless people annually. This has meant that homelessness has cost the state over $400 million annually over the past five years.

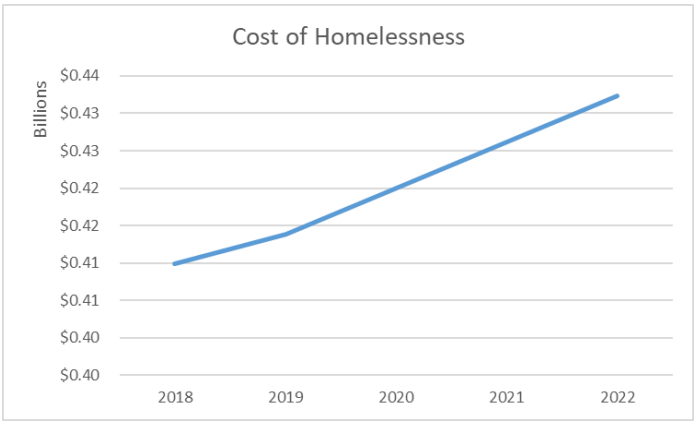

Figure 22: Homelessness costs Ohio over $400 million annually

4.3.3 Cost of Motor Vehicle Crashes

The costs for motor vehicle crashes are split up into costs for fatalities, injuries, and damages. Estimates for these costs come from the National Safety Council.[32] The associated costs are $1,024,000 per death, $36,000 per injury, and $6,400 per damage incident.

In Ohio, the costs associated with motor vehicle crashes have decreased slightly over the last five years. This has largely been due to a decrease in the number of injuries and accidents that cause damage, but is countered by an increase in fatalities.

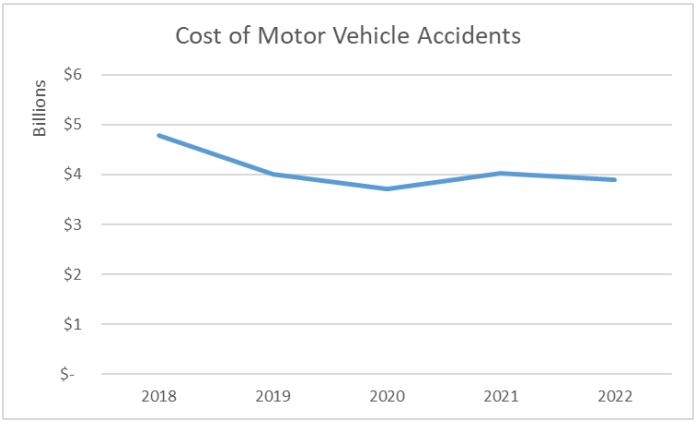

Figure 23: The cost of motor vehicle accidents has decreased in recent years

4.3.4 Cost of Commuting

Commuting to and from work is an extra cost that many people have to face that goes unnoticed in measures of GDP. To account for this, we use data from the American Community Survey about how much time people spend daily commuting to work and multiply that by the average wage in Ohio to get an estimate for the lost value of time associated with commuting.[33]

In Ohio, the cost of commuting has sharply decreased over the past three years. As the pandemic forced more people to work from home, fewer and fewer people were forced to commute for their jobs. Still, Ohio loses over $26 billion annually from lost time associated with commuting.

32. "Motor Vehicle Injury Facts," NSC, https://injuryfacts.nsc.org/motor-vehicle/overview/introduction/.

33. "Commuting Characteristics by Sex," Census Bureau, https://data.census.gov/table?q=commuting+ohio&tid=ACSST1Y2021.S0801.

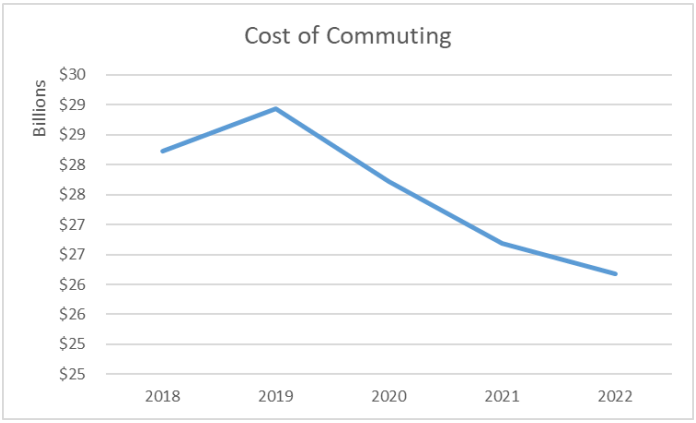

Figure 24: Following the pandemic Ohioans have spent much less time commuting

4.3.5 Cost of Crime

Crime is an inherently undesirable social condition and GPI accounts for this by subtracting amounts for different types of serious crimes. GDP can overestimate the value of crime by counting deployment of resources for fighting crime when a better society would be one where those resources are not needed. Crime data is made by the FBI's crime data explorer.[34]

We monetize the losses associated with some of the most severe forms of crime, including murder, rape, aggravated assault, robbery, burglary, motor vehicle theft, and larceny. In Ohio, the cost of crime has risen slightly over the past five years, from just below $4 billion to just below $5 billion.

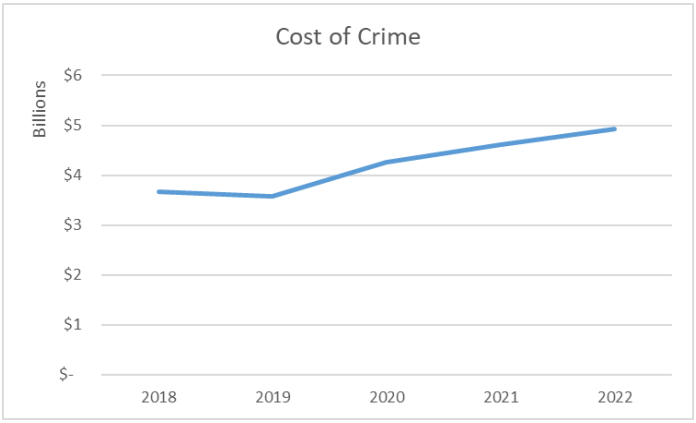

Figure 25: Crime cost Ohio almost $5 billion in 2022

34. "Crime Data Explorer," FBI, https://cde.ucr.cjis.gov/LATEST/webapp/#/pages/home.

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