

The Impact of Climate Change on GDP Growth and National Wealth

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Abstract

Addressing climate change could cost the U.S. in the trillions of dollars in the future. How the nation will finance such a costly venture is yet to be determined. The upside of these expenditures is an increase in economic activity and GDP. The downside is that the economic activity might not improve the next generation's standard of living significantly because a significant amount of human and produced capital will be devoted to fighting the effects of climate change.

Introduction

Recent changes in rules and laws have reversed legislation aimed at reducing greenhouse gases. An example; the Affordable Clean Energy rule has completed one of the bigger rollbacks of environmental rules, replacing efforts to wean the nation's electric power plants off coal and their climate damaging emissions. The rule gives states leeway in deciding whether to require efficiency upgrades at existing coal plants. The rule essentially increases emissions because it extends the life of coal plants. By investing in updating old coal plants, it makes it more economically viable to run them longer to pay off the investments.¹ These are efforts by the administration to increase short-term GDP growth, but will it add to the nation's wealth in the long-run if increasing amounts of the nations' resources will be devoted to preventing, adapting to and replacing property damaged or destroyed by the effects of climate change in the future?

GDP is the total value of all goods and services produced in a country over a year. GDP does not measure the nation's stock of assets. Growth in real GDP is used to measure the health of economic activity but does little to measure the net addition to a nation's capital stock.² Over time it will become an increasingly inadequate metric that measures the net addition to a

nation's wealth. In fact, real GDP growth will have to increase by greater amounts simply to replace fully functioning capital stock that will be damaged, destroyed or abandoned because of the effects of climate change. At the micro level, GDP corresponds to a person's income while national wealth is the person's net worth. Suppose that a hurricane damages a property and it is subsequently repaired. This GDP increasing activity would be an expenditure that does not add significantly to nation's capital stock or wealth. It simply replaces existing damaged stock although there would be some improvement because the newer materials used would meet higher wind mitigation standards.

In 1850, the French economist, Frederic Bastiat used the example of a broken window to explain why destruction doesn't benefit the economy.³ Let's say that that an assortment of windows are broken intentionally because replacing them will increase economic activity, employment and GDP. True, but it will not increase the nation's wealth because the activity will restore wealth to the level that it was prior to the breakage. It is also true that the spending on other goods, which would add to national wealth, will be curtailed because income is finite. This example illustrates that replacing something is a maintenance cost, rather than a procurement of new goods, and maintenance doesn't stimulate overall production because while it increases the production of windows, it will decrease production of other items.

Wealth measures the economy's underlying capital *stock* which includes natural capital, produced capital, and human capital that lead to future growth and consumption. Separating activities that add to wealth from activities that maintain wealth, going forward, we will find that much of the nation's resources will be expended on maintaining wealth, that is replacing produced capital and limiting the effects of climate change that it could crowd out activities and expenditures that expand national wealth.

The Many Costs of Climate Change

According to the United States Geological Survey, temperatures are rising due to greenhouse gases trapping more heat causing a greater severity in tropical storms due to warmer ocean water temperatures.⁴ Droughts are increasingly longer and more extreme, and because sea ice is melting faster, sea levels are rising which in turn is threatening coastal communities. New York City and most of the large coastal communities in Florida will experience an increase in flooding, which could eventually entail a mass migration of the coastal population to inland areas that are less prone to flooding.⁵ Major cities in population dense countries such as India, China and

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Japan will also experience substantial and persistent flooding, requiring a migration of the population.⁶

The city of Miami Beach, which experiences flooding during high-tide is spending \$500 million to raise roads and seawalls. As of September 2018, about 13% of the city streets were raised two feet. These efforts are not without unintended consequences because floodwater from raised streets ends up puddling front yards imposing costs on homeowners to shore up their properties and reduces the value of their properties. The city has a long way to go to be a sea rise ready city. In the future, all buildings would be elevated and situated on raised streets lined with water storage. It would be encircled with a sea wall and the water running off from the city's pumps would be treated so it wouldn't pollute the bay. Homeowners would pay to raise their homes and prepare for rising seas.⁷ It seems that substantial funds will have to be expended simply to keep the standard of living at levels prior to 2020.

Recent research has estimated the enormity of the cost as policymakers consider how to choose winners and losers in the race to adapt to climate change. According to the Center for Climate Integrity, simply providing basic storm-surge protection in the form of sea walls for all coastal communities will cost more than \$400 billion. The research is limited in that it considers only sea walls for minimizing flood risk. The estimates don't include the additional and costlier steps that will be required such as revamping sewers storm water and drinking water infrastructure. Still, the data provides a powerful financial measuring stick for the daunting decisions that communities are starting to confront.⁸

A substantial amount of existing housing stock and infrastructure in flood prone areas will have to be abandoned and replaced in inland areas. For example, New Orleans is protected by a system of levees that are almost obsolete. As early as 2023, the levee system may no longer protect the city and its suburbs against a so-called 100-year storm, or a hurricane with a 1% chance of happening each year.⁹ If another category five storm hits the city and overwhelms the levies, it might be prudent to move the city inland, which will cost the citizens, the state of Louisiana and the federal government hundreds of billions of dollars simply to maintain the existing standard of living. The National Oceanic and Atmospheric Administration reports that 'sunny day' flooding, or rising waters that happen without rainfall or hurricanes, is getting worse. The report predicts that annual flood records will be broken for years and decades to come from sea-level rise.¹⁰ It is evident then that increasing amounts of GDP will be devoted to repairing or replacing the nation's produced capital.

According to *The Economist*, climate change is causing environmental upheaval that destabilizes regions and raising the risk of war. The biggest danger lies in hotter and drier countries in Africa such as Mali, Niger, Chad and many others, which might require massive amounts of food and other forms of aid to these countries. Climate change models predict that as temperatures rise, dry regions of the world will get drier and wet regions will get wetter. If conditions worsen to the point that genocide and mass migration is imminent, the U.S. and other western countries might have to get involved militarily which could impose a substantial cost in blood and treasure.¹¹ The wars in Iraq and Afghanistan have cost the U.S. close to three trillion dollars.^{12,13} Refugees from drought and strife-stricken countries will try to migrate to developed countries, placing an even greater burden on the U.S. and other wealthy countries. The military leadership is aware that climate change is causing water scarcity, food insecurity, economic displacement and increased migration. Record droughts fed the instability that led to the civil war in Syria, driving farmers from their barren land to overpopulated urban centers which triggered food shortages.¹⁴

On the flip side, efforts to limit climate change will slow economic growth. The Climate Leadership Council, whose members include high ranking former government officials and several Nobel laureates in economics and finance, recommend a carbon tax be assessed on firms that pollute.¹⁵ Otherwise, profit focused firms will have little incentive to reduce their carbon emissions and the country suffers at their expense. Economic theory states that activities that generate costs borne by third parties, referred to as externalities or spillover costs, will be over-produced and underpriced. It is this distortion in the market that the carbon tax will remedy. To help gain voter acceptance, the Council proposes redistributing the revenue generated by the tax in the form of a dividend that is paid to each citizen. At \$40 per ton, the annual dividend is estimated at roughly \$2,000 per family of four. Economists Jason Furman and Larry Summers recommend spending the money on curbing climate change in addition to borrowing the necessary funds to get the job done.¹⁶

A carbon tax will spur both the private and public sectors to adopt carbon emission reducing measures. The decision to adopt such measures is akin to a capital budgeting decision in finance. The initial cost or outflow is the capital investment in the carbon reducing asset. The cost savings are inflows in the future that result from paying lower carbon taxes. Investment in these ventures make perfect economic sense if they have a positive net present value (NPV).

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Ken Rogoff has proposed creating a World Carbon Bank, which will provide a conduit for advanced economies to coordinate financial aid and technology transfer to developing economies such as India and other Asian economies to reduce their carbon emissions.¹⁷ Even if advanced economies put their own environmental house in order, it will be inadequate if developing economies, which are adding coal-fired plants at a unhealthy clip, do not follow. He estimates that it could easily cost a trillion dollars over ten years to provide the requisite incentives.

According to *The Economist* greenhouse gas emissions must fall by half by 2030 to stop global temperatures rising more than 1.5 degrees Celsius by 2030. Because this goal will be difficult to attain, scientists are recommending geoengineering which involves tinkering with climate processes to reduce global temperatures. It involves pumping sunlight reflecting chemicals such as sulphur dioxide into the upper atmosphere. This option – estimated to cost about \$20 billion annually – would cost far less than rebuilding the world's energy infrastructure. If all goes according to plan and within budget, which is usually a big if, it is projected to stop global warming in its tracks. A rich country such as the U.S. could do it alone with some contribution from other developed countries. But it would be a stopgap measure and not a solution to climate change. Efforts and expenditures to limit greenhouse gas emissions will likely continue because it would not stop other emission related problems such as the oceans becoming more acidic. Lastly, geoengineering on a global scale could have unintended consequences that could adversely impact some nations more than others and therefore invite vociferous opposition from the impacted countries.¹⁸

A study released by the National Academy of Sciences states that geoengineering is no substitute for reducing carbon emissions and adaptation efforts aimed at reducing the negative consequences of climate change. The reflection of sunlight strategies could rapidly cool the planet's surface but pose environmental and other risks that are not well understood and therefore should not be deployed at climate-altering scales until more research is done to determine if these modification approaches could be viable in the future.¹⁹

According to Swiss scientists, the most effective way to fight global warming is to plant a trillion trees. There is enough space for the new trees to cover 3.5 million square miles, an area that is roughly the size of the U.S. The study calculated that over the decades, the trees could suck up nearly 830 billion tons of heat-trapping carbon dioxide from the atmosphere, which is about as much carbon pollution as humans have spewed in the past 25 years. Much of that benefit will come quickly

because trees remove more carbon from the air when they are younger. The scientists estimate that this is by thousands of times the cheapest climate change solution” and the most effective, although they do not provide a cost estimate.²⁰

Severe weather catastrophes are possibly the costliest mishaps that humanity encounters. Although humans cannot control the weather, we can influence exposure to the risk of bad weather. We can incentivize people to build sturdier homes with stronger roofs and far from floodplains. These catastrophes are called “natural disasters,” but they are the result of a combination of natural forces and often shortsighted human decisions encouraged by dubious government policies. Unfortunately, insurance has been denied its potential role as an efficient regulator of risk. It is not allowed to give price signals regarding the cost of living in high-risk regions because it is sold at a subsidized rate. Insurance premiums are deliberately kept low thus encouraging private entities who purchase property insurance to live in high-risk areas.²¹ It allows those private parties to knowingly assume excessive risk and dump the cost of their coastal living on taxpayers. Florida’s government run Citizens Property Insurance Corporation, which provides most of the wind insurance for properties on the coast of Florida, prices its policies based on risk metrics. But there is a big difference compared to private insurance. Like the premiums charged for flood coverage by the National Flood Insurance Program (NFIP), the premiums Citizens collects from policyholders are significantly below what is necessary to cover the full risk because state law constrains them from doing so. Citizens does not face the same loss constraints that private insurers do because if the premiums are not enough to pay for the wind damage, Citizens can cover the shortfall by passing it on to Florida’s taxpayers. So, the state of Florida and the NFIP are adding fuel to the fire by encouraging the building of residential properties in high risk areas which will place a bigger financial burden on the economy not if but when natural disasters strike which are occurring more frequently and with greater intensity. If major storms strike Florida, the taxpayers of the state will likely pay huge sums of money to make coastal homeowners whole again.

Who Will, and How to Pay for Climate Change

It seems evident that addressing climate change will entail a multi-pronged approach that will have to be financed largely by the more affluent countries because they have the technology and resources to do so. It probably will take a major catastrophe or two and a change in leadership in the U.S. to address the severity of the problem and get the citizenry to buy in. Making it an issue of national prestige to save the whole world will be a

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source of pride and accomplishment similar to what was experienced with the moon shot in the 1960s.

According to economic theory, GDP is measured as:

$$GDP = \text{Consumption Expenditures} + \text{Private Investment} + \text{Government Expenditures} + (\text{Exports} - \text{Imports})$$

In 2018, U.S. GDP was 69% consumption expenditures, 18% investment spending, 17% government spending, and negative 5% (exports – imports). Investment spending includes commercial and residential real estate construction, which comprises new single-family homes, condominiums, and townhouses. Resales are not counted as investments. At its peak in 2005, combined commercial and residential construction contributed \$1.3 trillion or 9.1% of GDP. In 2010, it fell to a low of \$748.7 billion or 5.1% of GDP.²² These estimates will increase dramatically if entire cities are abandoned and rebuilt inland in the future. Government expenditures at the federal, state and local level will also increase dramatically given that the federal government has by far the deepest pockets to finance programs that will cost in some cases in the hundreds of billions of dollars. Currently, it is impossible to estimate the severity of the problem and thus the total costs to be incurred. Suffice it to say that it will be large.

State and local governments own over 90% of non-defense public infrastructure assets, and although the federal government assists in constructing these assets, state and local governments pay 75% of the cost of maintaining and improving them. They spend 85% of their capital dollars on schools, transportation, drinking water treatment and its distribution. The funding for these outlays is financed by taxpayers and by issuing bonds. States finance about 27% of their capital spending with bond issues. The federal government contributes only 28% of states' infrastructure spending towards, roads public transit projects and other capital expenditures.²³ Because deficit financing is limited in most states, taxpayers will have to bear the brunt of shifting infrastructure and housing inland, which will reduce discretionary spending on other items. So, one can expect significant tax increases in coastal states such as Florida where rising sea levels and tropical storms provide the perfect recipe for flooding and wind damage.

Nature will play a bigger role in economic planning in the future. The expenditures to combat the effects of climate change will fall into three major categories; (1) adapting to it (2) preventing it from getting worse and (3) repairing and replacing damaged property including farmland. While GDP growth and employment numbers might be of-the-charts in the future

because of these expenditures, much of it will be to maintain our existing standard of living. It is akin to riding a hamster wheel; a lot of activity but little to show for it, in that our standard of living will show meager improvement unless global markets are willing to finance a deficit that will significantly exceed one trillion dollars annually. The CBO projects the federal budget deficit to be about \$900 billion in 2019 and exceed \$1 trillion each year beginning in 2022, and that is with negligible spending on climate change.²⁴ Intergenerational well-being will increase if and only if per capita wealth increases over time.²⁵ Future generations will find that they will be burdened with copious amounts of debt and with per capita wealth that has remained stagnant.

Earlier this decade, there was some concern that the U.S. had become too indebted and that the deficit had to be reined in. Significant budget cuts in 2013 slowed the economic recovery, which in hindsight was politically motivated and shortsighted. Interest rates have remained steady in the face of deficits that will soon exceed one trillion dollars and 4% of GDP. The dollar is in the enviable position of being the world's only reserve currency and there seems to be an insatiable worldwide demand for it. This puts the U.S. in a position of being able to borrow significant sums of money at unusually low interest rates. But according to *The Economist*, economic paradigms eventually do come to an end.²⁶ The dollar's reign as the only reserve currency could be threatened causing the demand for it to drop and interest rates to rise.

As and when rates eventually rise, the U.S. will find itself under greater fiscal pressure to service the debt and might be unable to handle another crisis that requires a significant fiscal outlay. The only saving grace under such a scenario is the Federal Reserve Bank stepping in by "printing" money so to speak by buying copious amount of Treasury issues to keep interest rates low. The unknown here is the value of the dollar. A substantial infusion of money into the economy by the Federal Reserve could cause a flight from the dollar which would cause inflation to rise.

In Conclusion

Addressing climate change could easily cost in the trillions of dollars. An increasing amount of government expenditures are being spent on entitlements such as Medicare, Social Security, and Medicaid. The wars in Iraq and Afghanistan have cost close to three trillion dollars and the bills for the long-term medical care of wounded warriors will continue to add to the total cost. Adding climate change expenditures will further increase the deficit and could crowd out spending on education, and infrastructure, expenditures which are needed to advance both produced and human

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capital. The U.S. economy will experience healthy economic growth in the future, but a lot of the activity associated with that growth will be devoted to mitigating the deleterious effects of climate change. Generation Z will experience strong GDP growth and a vibrant job market but will see little improvement in their standard of living unless the U.S. has access to an endless supply of cheap capital. Produced capital replacements will incorporate newer materials and green technologies which will enhance the standard of living to a degree. But it will pale in comparison to improvements experienced by previous generations.

Author

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Endnotes

1. Walke, J. (2019, January 28). Trump's "affordable clean energy" rule: A dirty lie [Blog post]. *NRDC*.
2. AT&T Business. (2019, September 20). When to take your midsize business' IoT management to the next level. *Quartz*.
3. Beattie, A. (2019, July 14). What is the broken window fallacy? *Investopedia*.
4. U.S. Geological Survey climate and land use change [Organization website]. (n.d.). What are some of the signs of climate change? *USGS*.
5. Kulp, S., Strauss, B., Nieves, D., Bell, S., & Rizza, D. (2017, October 26). *These U.S. Cities are Most Vulnerable to Major Coastal Flooding and Sea Level Rise*. Climate Central.
6. Holahan, W.L. (2019, May 26). The Green New Deal and the carbon tax. *Tampa Bay Times*.
7. Harris, A. (2018, September 19). Keep raising roads, experts tell Miami Beach, but explain it to residents better. *Miami Herald*.
8. Flavelle, C. (2019, June 19). With more storms and rising seas, which U.S. cities should be saved first? *The New York Times*.
9. Horowitz, A. (2019, May 31). When the levees break again. *The New York Times*.
10. Smith-Schoenwalder, C. (2019, July 10). Scientists say rising seas will keep setting flood records. *U.S. News*.

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11. Climate of fear: How to think about global warming and war. (2019, May 23). *The Economist*.
12. Amadeo, K. (2019, June 25). Cost of Iraq War, its timeline, and the economic impact. *The Balance*.
13. Amadeo, K. (2019, June 15). Afghanistan war cost, timeline, and economic impact. *The Balance*.
14. Conger, J. (2019, July 5). Climate change is threatening America's national security at military bases across Florida, including MacDill Air Force Base in Tampa. *Tampa Bay Times*.
15. Economists' statement on carbon dividends: Original co-signatories. (2019, January 17). *The Wall Street Journal*.
16. Furman, J., & Summers, L.H. (2019). Who's afraid of budget deficits? *Foreign Affairs*.
17. Kenneth, R. (2019, July 8). The case for a world carbon bank. *Project Syndicate*.
18. Political economy suggests that geoengineering is likely to be used. (2019, Apr 27). *The Economist*.
19. Climate engineering. (n.d.). *Wikipedia*.
20. Borenstein, S. (2019, July 4). Best way to fight climate change? Plant a trillion trees. *AP News*.
21. Ben-Shahar, O., & Logue, K. (2015). The unintended effects of government-subsidized weather insurance. *Regulation CATO Institute*.
22. Amadeo, K. (2019, July 10). Components of GDP explained. *The Balance*.
23. McNichol, E. (2019, March 19). It's time for states to invest in infrastructure. *Center on Budget and Policy Priorities*.
24. Congressional Budget Office. *The Budget and Economic Outlook: 2019 to 2029*. (2019). Washington, D.C.: The Congressional Budget Office.
25. Dasgupta, P. (2010, January 12). Nature's role in sustaining economic development. *Philosophical Transactions of the Royal Society B*, 365(1537).
26. Many governments could bear more debt: That does not mean they should. (2019, May 16). *The Economist*.