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The Cost of the increasing Tropical Storms: Examining the Long Run Economic Implications of Climate Change

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ABSTRACT

Climate change has altered economics profoundly; it impacts major aspects of the global economy and has consequences that can be unforeseeable in the long run. Atmospheric temperatures have been increasing twice as fast since 1981 and it has caused detrimental impacts globally; one being the increase in the intensity and frequency of tropical storms. Humans have contributed about 95% to this warming of the Earth. This paper explores the long run economic impacts of a specific consequence of this pressing issue to further understand the impacts of individual actions. The warming of the Earth has caused an increase in the frequency of tropical storms as well as the intensity. Severe tropical storms destroy agriculture and demolish infrastructure and commercial buildings. This heavily impacts the economy in various ways, and this paper will focus on the impact of long run economic growth of an economy. To combat this issue, the government and central bank can take corrective actions. However, these actions come with their own economic consequences, and it is important to be aware of the outcomes to make an informed decision on critical issues. Through extensive research, it can be concluded that the best course of action is a united act amongst the central bank and the government to grow the economy while combating climate change.

Introduction

As air temperatures rise due to large carbon footprints, tropical storms are becoming an imminent threat. A carbon footprint is the average amount of carbon that is released per person. Tropical storms are becoming more frequent because warmer air tends to hold more water vapor resulting in extreme rainfall during weather events. Additionally, these tropical storms form on warmer waters and there has been a continuous rise and it is projected that it will rise 10-12 inches. These storms cause immense damage to our environment as well as our infrastructure. It is proven that an individual storm can cause damage of up to $7 billion in the United States. One of the most expensive storms was Hurricane Katrina which costed up to $129.5 billion. It has also been stated that in Northwest Europe, storm intensity can increase by 1-9% due to the extreme increase in carbon dioxide concentrations. This shows that this rise in temperatures has caused storms to increase across the globe and impacts international economies.

Prior to any economic discussion, it is essential to keep in mind that these statements are under the assumption of *Ceteris Paribus*. The typical approach to this solution is for governments to increase their spending to cover all the finances caused by this damage. Some of their spending will include repairing infrastructure, giving aid to those who have had property destructed, and funding departments that are helping to repair the damages. An increase in government spending can heavily influence the economy. Government spending is a component of a nation's gross domestic product (GDP) and in the short run can increase GDP. Gross domestic product is the dollar value of all goods and services produced in a country for one year. However, an increase in government spending does cause negative consequences, such as increasing the national debt and moving the budget balance towards a deficit. A country's budget balance primarily consists of transfer payments, tax revenues, and government expenditures. As government

expenditure increases, the country's budget will move towards a deficit, and it will be forced to borrow funds. As the government borrows money to finance spending, the demand for these funds will increase and will put pressure to increase real interest rates. It has been estimated that a 1 percent point increase in the federal debt in the United States will increase interest rates by 2 to 3 basis points. Furthermore, when more money is directed to repay this debt there is less money available to help restore the environment and recover the damaged infrastructure. The lack of funds towards benefitting the environment can result in more storms and more intensity which will put the nation in a constant loop.

Increasing real interest rates will have a great impact on the long run economic growth of an economy. This is because higher interest rates discourage investment spending on physical capital. This heavily decreases the capital formation of the economy which is the driving force for long run economic growth. Furthermore, this budget deficit can lead to a repeating loop of increasing deficits, increasing real interest rates each time. This will further slowdown long run economic growth. As capital accumulation slows, goods and services in the future will decrease and will help to solve the pressing issue of overconsumption. The production of goods and services for households is responsible for 60% of greenhouse gas emissions. Thus, a decrease in the production of final goods and services may help to reduce greenhouse gas emissions.

Economic growth is crucial for a country because this is what can reduce poverty levels. Many studies have proven that economic growth and poverty are inversely related; as economic growth rates increase, poverty levels begin to drop. For example, a one cent increase in per capita income, which is determined by long run economic growth, will reduce poverty by 1.7 cents. Additionally, those in poverty are the ones who are harder hit by the changes in climate. It is predicted that by 2050, climate change will increase those in starvation by 20%. Thus, we must take proactive action to prevent further damage to those who are in this vulnerable position. This is why it is so important to maintain high levels of economic growth.

Additionally, tropical storms are wiping out agriculture fields and reducing crop yields. Statistics have shown that crop yields are in the range of -17%-6% and livestock animal weights have been dropping by 14-16%. Food yields are important inputs in the production of many goods that are in very high demand of consumers. This decreases the supply of essential inputs and causes prices of products to rise. This also decreases the real output of the country, and when output is decreased, unemployment is directly related to this. When output decreases, less workers are required, which increases unemployment rates. High unemployment rates can bring the economy into a negative output gap, a recession. This along with inflation causes stagflation; one of the worst conditions an economy can undergo. But if no policy is taken, the economy can self-adjust back to full output. With high prices, workers may demand higher wages so their income can reflect rising prices. This will make it harder for businesses to produce, further decreasing output and causing more inflation. This will simply put the economy in a deeper recession and state of inflation.

As is evident, tropical storms impact the economy severely in the long run. Thus, corrective policy must be taken, and it is paramount to analyze the benefits and drawbacks of these actions.

Possible Solutions

For the economy to combat this decrease in long run economic growth, there are many actions that the government and central bank can take. If the government works independently, they can offer investment tax credits to businesses to promote investment. This will encourage business owners to continue investing in capital regardless of high interest rates, which will increase capital stock formation and continue economic growth.

The central bank can take two actions depending on the type of reserves the economy has: limited reserves or ample reserves. In a limited reserves economy, the central bank can increase the money supply which will cause interest rates to decrease. When the central bank increases the money supply in limited reserves, there is a larger impact compared to if there are already more than enough reserves. This is because in limited reserves, a change in the money supply will have a profound impact on interest rates. Thus, by increasing the money supply, the interest rates will decrease because there is more supply of money.

On the other hand, in ample reserves, the primary tool the central bank can use to lower interest rates to influence long run economic growth is to lower administered rates, such as the interest on reserve balances. The interest on reserve balances is what the central bank charges other banks for overnight loans. This rate will influence interest rates that banks charge, which directly impacts consumers. Lower interest rates will be charged to consumers as a result.

Limitations of Solutions

These actions can impact the economy in distinct ways depending on the long run and short run. The fiscal policy, or government action, stated above will cause increases in price levels as well as increases in real gross domestic product in the short run. This is because a decrease in taxes increases investment spending. This increase in investment spending causes gross domestic product to increase because investment is a component of it. Furthermore, increases in investment spending will increase prices of the economy, caused by demand-pull inflation. Although this may lower interest rates, this will contribute to the budget deficit. This reduction in tax revenues will move the budget balance towards a deficit and they must finance this deficit through borrowing. This will result in an increase in real interest rates. In the long run, again this will stunt long run economic growth. Thus, in the long run this action will have minimal impact on the economic growth rate. This same line of reasoning is applied to the output gap; the output gap will remain mostly the same. This is because although the increase in investment spending will increase gross domestic product, the increase in interest rates will revert that impact. Thus, it will not do much for the economy in the long run.

The purchase of bonds by the central bank in the short run will increase money supply and lower interest rates. In the short run, this will increase gross domestic product because investment spending will increase, and it is a component of GDP. However, according to the quantity theory of money when the money supply is fully expanded due to the purchase of bonds, in the long run there will be an equal increase in inflation and no increase in GDP. If you hold the velocity of money constant because people's spending habits do not fluctuate much, an increase in the money supply will only cause the price level to increase because long run equilibriums of output, or GDP, are dependent on the productivity of an economy, not on the money supply. This specific type of inflation is called demand pull inflation. Regardless, this action will still promote long run economic growth without creating a larger budget deficit in a limited reserves regime. Another action the central bank can take in a limited reserves economy to promote economic growth is to lower the required reserve requirement for banks which will further expand the money supply, causing lower interest rates. Again, these low interest rates will promote long run economic growth by increasing capital stock. This action will help bring the economy out of a recessionary gap but still steadily increase the inflation rate that was caused by the decrease in yields of essential goods.

The actions that the central bank takes in an ample reserves economy is distinctly different than in a limited reserves. In an ample reserves regime, the primary tool the central bank can utilize to lower interest rates and foster economic growth is to lower the interest on reserve balances. This is the rate that the central bank charges commercial banks for overnight loans. It is called the Federal Funds Rate in the United States of America. This rate heavily influences what rate banks charge consumers, thus impacting the whole economy. These low interest rates will help to grow the economy as well as grow the gross domestic product in the short run. This tool not only combats the issue of long run economic growth but as well as the long run decline in output from stagflation. Although this may increase inflation, it will increase real output in the long run as well. It will increase real output because it will encourage investment spending, which is a component of real gross domestic product, a measurement of output.

Conclusion

It can be concluded that the central bank and the government should work together and push the economy in a way to foster long run growth. there must be two different actions taken by the central bank in different regimes, limited reserves versus ample reserves. In limited reserves, the government can foster long run growth by promoting investment through tax breaks to businesses. Although this will cause a rise in interest rates, if the government collects more tax revenues from consumers; this can help balance the budget. This will balance the impact on the real interest rate and further help the economy grow. The action that the central bank can take is still increasing the money supply through buying bonds or lowering the reserve requirement; but in order to combat these high levels of inflation, the government can decrease its spending which will further stabilize the budget. Thus, in a limited reserves regime the best action to be taken during times like this is the government providing a tax break to businesses to promote investment as well as increasing tax revenues from consumers. The central bank must increase the money supply.

In an ample reserves economy, the same tools cannot be used because it will not influence the economy due to the excess number of reserves. Thus, the central bank must lower the interest rate on bank reserve balances and the government must increase tax revenues and decrease spending in order to cause minimal fluctuations on the real interest rate.

However, these solutions focus primarily on the economic benefits but there are ways to help promote environmental sustainability and mitigate the impacts of climate change. This will prevent future tropical storms and dampen economic consequences. The government can tax those who are degrading the environment and releasing large amounts of carbon dioxide rather than typical consumers. An example of this is taxing companies who partake in clear cutting of trees. This will disincentivize those companies and foster a cleaner environment. This will also increase tax revenues which will further allow for promoting long run economic growth. Additionally, this resulting tax revenue can be allocated towards projects that can help preserve the Earth. Moreover, the government can also influence businesses to invest in environmentally sustainable capital goods. Specifically, the government can provide tax credits to companies that produce goods that release minimal greenhouse gasses. This will put pressure on the companies to lower their prices due to lower costs to their businesses. These lower prices will encourage investors to invest in these environmentally friendly products with lower prices. This will promote capital stock formation which will drive long run economic growth. Although it will increase the number of goods and services, they will primarily be ecologically beneficial.

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References

(2023). Retrieved from https://www.epa.gov/climatechange-science/causes-climate-change#:~:text=Human%20Versus%20Natural%20Causes&text=Rather%2C%20it%20is%20extremely%20likely,dominant%20cause%20of%20that%20warming.&text=Human%20activities%20have%20contributed%20substantially,Absorption%20of%20the%20Sun%27s%20Energy

(N.d.). Retrieved from https://www.nature.org/en-us/get-involved/how-to-help/carbon-footprint-calculator/#:~:text=A%20carbon%20footprint%20is%20the,highest%20rates%20in%20the%20world.

16, R. C. |December, Cho, R., Holst, C., Georgios, Kiernan, Lai, S., Mosheim, R., Janusz, A., Sharma, S., & Roger. (2020, December 18). *How buying stuff drives climate change*. State of the Planet. https://news.climate.columbia.edu/2020/12/16/buying-stuff-drives-climate-change/#:~:text=A%202015%20study%20found%20that,the%20most%20per%20capita%20impact.

2022 sea level rise technical report. NOAA's National Ocean Service. (2022, February 15). https://oceanservice.noaa.gov/hazards/sealevelrise/sealevelrise-tech-report.html#:~:text=Sea%20level%20along%20the%20U.S.,years%20(1920%20%2D%202020).

Butt, T.A., McCarl, B.A., Angerer, J. *et al.* The economic and food security implications of climate change in mali. *Climatic Change* **68**, 355–378 (2005). https://doi.org/10.1007/s10584-005-6014-0

Colbert, A. (2022). Retrieved from https://climate.nasa.gov/news/3184/a-force-of-nature-hurricanes-in-a-changing-climate/#:~:text=Warmer%20air%20temperatures%20can%20hold,towering%20thunderstorms%20that%20surround%20it.

Dahlman, R. L. A. L. (2023). Retrieved from https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature#:~:text=January%2018%2C%202023-,Highlights,0.18%C2%B0%20C)%20per%20decade.

Dorland, C., Tol, R.S.J. & Palutikof, J.P. Vulnerability of the Netherlands and Northwest Europe to Storm Damage under Climate Change. *Climatic Change* **43**, 513–535 (1999). https://doi.org/10.1023/A:1005492126814

Hurricanes and climate change. Center for Climate and Energy Solutions. (2022, September 22). https://www.c2es.org/content/hurricanes-and-climate-change/#:~:text=Hurricanes%20are%20subject%20to%20a,damage%20if%20they%20make%20landfall.

The effect of government debt on interest rates: Working Paper 2019-01. Congressional Budget Office. (2019, March 14). https://www.cbo.gov/publication/55018#:~:text=On%20average%20over%20the%20long,3%20basis%20points%2C%20CBO%20estimates.

The facts: How climate change affects people living in poverty. Mercy Corps. (2022, October 12). https://www.mercycorps.org/blog/climate-change-poverty#:~:text=Access%20to%20clean%20water%20is,by%20as%20much%20as%2020%25.

Zhu, Y., Bashir, S. & Marie, M. Assessing the Relationship between Poverty and Economic Growth: Does Sustainable Development Goal Can be Achieved?. *Environ Sci Pollut Res* **29**, 27613–27623 (2022). https://doi.org/10.1007/s11356-021-18240-5