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Economic Impact of COVID-19

Introduction

The effects of a global pandemic are felt in all aspects of life. While contraction of COVID-19 has obvious physical health consequences, its reach does not end there. The ease with which the SARS-CoV-2 virus is spread from person to person has resulted in widespread fear which has social, mental, and economic consequences. Each nation has responded differently to this disease and response will ultimately dictate the lasting consequences of the pandemic on a nation's citizens. All aspects of a response including actions, timing, and duration require meticulous care in order to minimize negative long-term consequences. Thus, it is imperative that a nation's policy makers have ample information with which to make decisions.

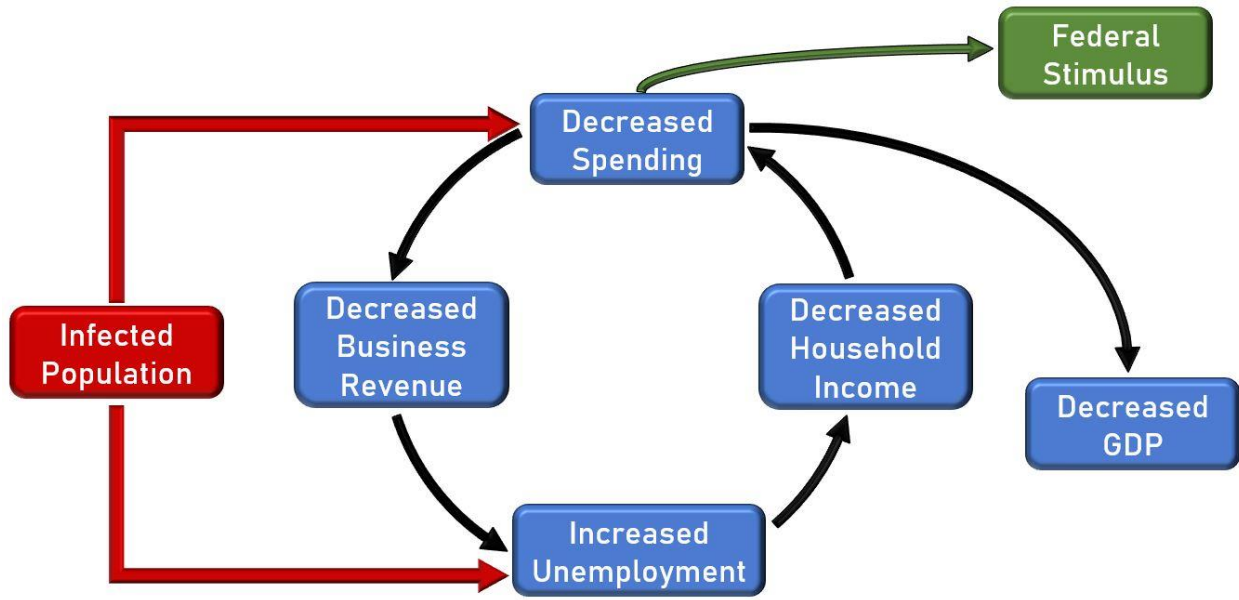
Given that COVID-19 is a novel disease, we must rely on information from other pandemics in order to use as precedent cases with which to base a model. Initial response to COVID-19 has resembled that of previous pandemics which have ultimately ended in economic recession. Developing a model involving interactions of major economic variables is important in appropriately introducing and adapting policy the United States. While avoiding a recession entirely may be impossible, informed decisions may be able to minimize the severity and duration. The present model explores scenarios of the pandemic outbreak to varying degrees and the interaction with varying federal stimulus. Specifically, we look at the effect of these interactions on annual change in gross domestic product (GDP), annual public spending, and annual unemployment rates.

Discussion

Our models involve interactions between infected population, public spending, unemployment, federal stimulus funds, and GDP. GDP is a measure of the total value of all the goods and services produced by a nation in a given time and is considered to be the strongest indicator of a country's development and progress. The GDP depends most directly on public spending. In the absence of a pandemic, the spending of the general public depends on unemployment and household income, which can be augmented through the presence of a federal stimulus package. Unemployment is dependent on consumer spending, by the fact that businesses are more likely to lay off employees if there isn't enough revenue being generated. Increased unemployment restarts the circle, as this means decreased household income and decreased consumer spending.

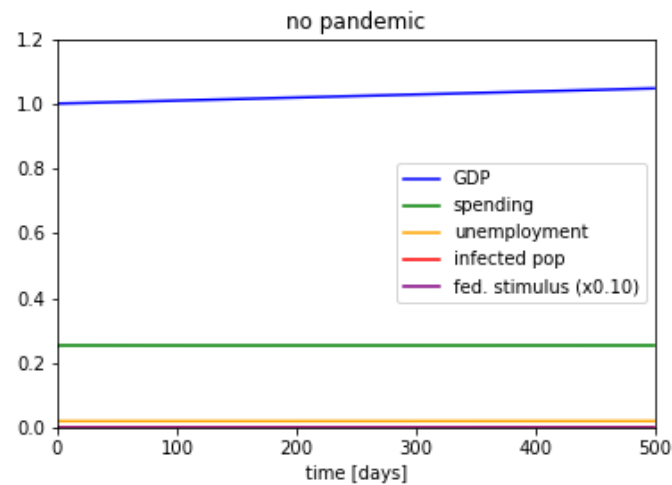
The introduction of a pandemic has drastic effects on the described cycle. Introduction of the virus into society will directly affect spending and unemployment as a consequence of the need for "social distancing" to slow the spread of the virus. As a consequence of state governments temporarily shutting down "non-essential businesses," millions are left out of work and unemployed. The government also has requested that the population stay home, except for essential activities, decreasing the spending opportunities for those still with sufficient income. Impacting these two aspects of the cycle will lead to drastic consequences in the ensuing components of the cycle, ultimately leading to continuously negative economic consequences as time goes on without change.

The following graphic illustrates this interaction.

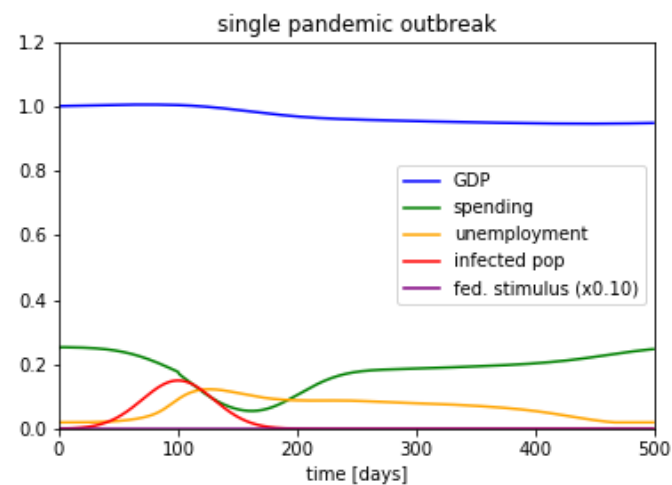


In the following case studies, we present five possible scenarios pertaining to a virus outbreak and our predicted model of the ensuing consequences on the United States' economy. The models predict the consequences of an infected population and in some cases, a federal stimulus (case 4 and 5) on GDP, unemployment, and public spending. The models are normalized for simplicity and the modelled effects (GDP, unemployment, public spending) should be compared to those in our control group, case 1, to understand the effect that the spread of infection has on the modelled economic quantities.

Data

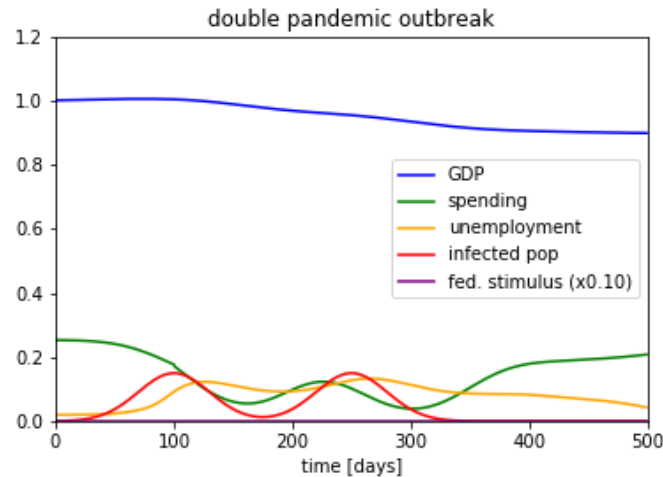


Case 1. In the case of no pandemic, the annual GDP has a 3.41% increase. The average annual unemployment of 2.02% contributes to the average annual spending and subsequently the annual GDP. Spending and unemployment level are expected to remain approximately unchanged over the course of the 500-day time span.

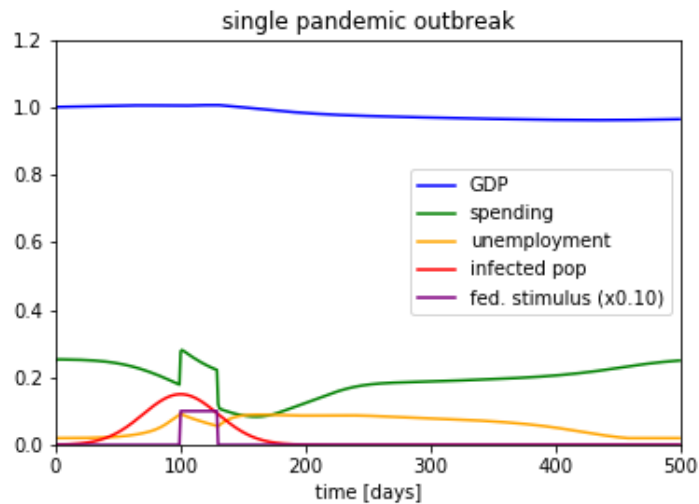


Case 2. This is a case of a single pandemic outbreak where nearly 20% of the population becomes infected. Here, we see that the GDP decreases by 5.14% over the course of a year,

compared to a 3.41% *increase* in case 1. The average annual spending is 16.72% which is 8.63% less than case 1. Unemployment has increased from 2.02% in the previous case to 7.49%, which results from both the decrease in spending and the number of those infected. Spending, unemployment, and GDP begin to gradually improve as the number of infected diminishes.

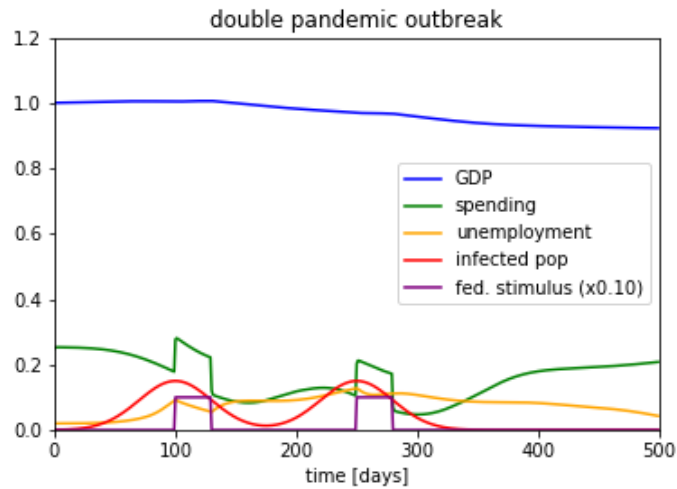


Case 3. This is a case of a double pandemic outbreak where nearly 20% of the population becomes infected at the 100-day and 250-day mark. Here, we see that the GDP decreases by 9.01% over the course of a year. The average annual spending is 12.56% which is 12.79% less than case 1. Unemployment has increased from 2.02% in case 1 to 8.74% which results from both the decrease in spending and the number of infected populations. We see that in this case the presence of a second outbreak leads to increased economic hardship. Although peaks in unemployment following both outbreaks reach similar values, spending following the second outbreak drops lower than that following the first outbreak. Spending, unemployment, and GDP begin to gradually improve as the number of infected diminishes, however, unemployment does not reach pre-outbreak numbers at the end of 500 days, as it did in case 2.



Case 4. In this case there is only one pandemic outbreak infecting nearly 20% of the population and there has been an added federal stimulus of 2 trillion dollars at the peak of the outbreak.

What we see in this case is with the added federal stimulus the average annual spending decreased to 18.32%, which is 1.6% better compared to case 2. This increased circulation of money leads to a less steep decrease in GDP. As the number of infected begins to finally tail off, we see that spending and unemployment begin to improve and the GDP begins to level off. The annual GDP decreased by 3.62%. Compared to case 2, where there was no federal stimulus, the federal stimulus was more effective at dampening the decrease in GDP. The stimulus was also effective at improving unemployment rates. The annual unemployment rate for this case is 6.74%, whereas for case 2 it was 7.49%. The federal stimulus appears to moderately improve the nation's economic scenario, compared to the circumstances modelled in case 2.



Case 5. In this last case we look at a double pandemic case, but with an added federal stimulus of 4 trillion dollars total, split between the two outbreaks. We see at the first outbreak this case behaves the same as case 4. However, when the second pandemic hits, the percent unemployed surpasses that of the first outbreak, and the spending and GDP also both drop considerably lower compared to the first outbreak.

With the second outbreak, the more extreme spending and employment deficit is unable to be offset by another 2 trillion-dollar stimulus package. This in turn leads to a 6.54% decrease in the GDP, about twice that of the single outbreak scenario, however improved over that of case 3, with the double outbreak and lack of stimulus packages. Additionally, the stimulus proved effective at improving unemployment rates, compared to case 3. The annual unemployment rate for this case is 7.78%, whereas for case 3 it was 8.74%. Spending, unemployment, and GDP begin to improve as the number of infected diminishes.

Conclusion

The models of the single and double pandemic scenarios with and without a federal stimulus suggest that a federal stimulus package may be the most effective way of avoiding long

term economic recession. By providing a federal stimulus, the public feels more comfortable spending their money in the economy. The circulation of money through spending enables businesses to continue to generate revenue, which dampens the need to lay off employees, which in turn gives the public income to spend in the economy. However, the presence of the outbreak still forces some businesses to shut down, leading to unemployment and less money for those affected to spend as a consequence of social distancing measures implemented because of the virus. From the models we see that federal stimulus is beneficial for the economy through its dampening of the GDP decrease, which should allow us to recover from recession sooner.

However, based on the double pandemic case scenarios, it is clear that the longer the number of infected cases is high, the harder the economic toll. In this model, the number of infected cases is modeled as a normal curve spread over the course of about 100 days with 20% of the population becoming infected. Should the number of infected cases remain high over a longer time span, this model would likely no longer hold true in terms of the economic consequences. Further, the effects on unemployment, consumer spending, and GDP would likely become increasingly dire with a higher percentage of the population becoming infected.