IS-MP Simulations

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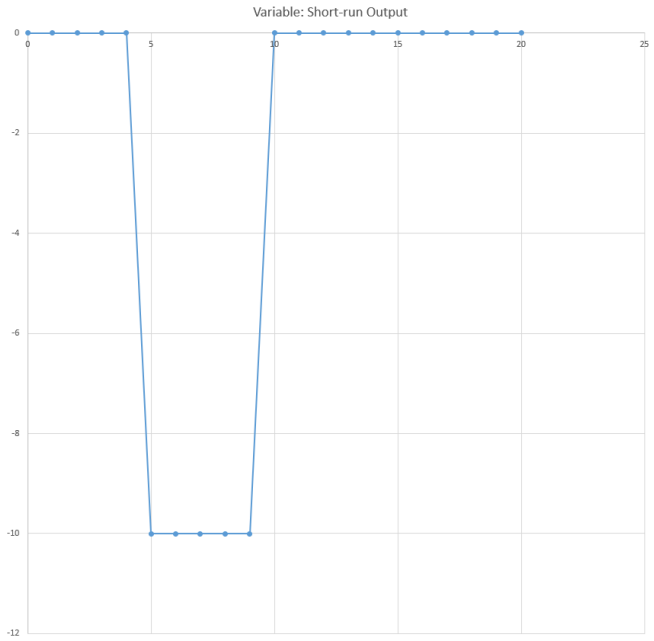
Introduction

1 IS and MP Curves experiments

The following sub-sections show what happens in the IS and MP curves, when certain parameters are changed.

1.1 Consumption Shock

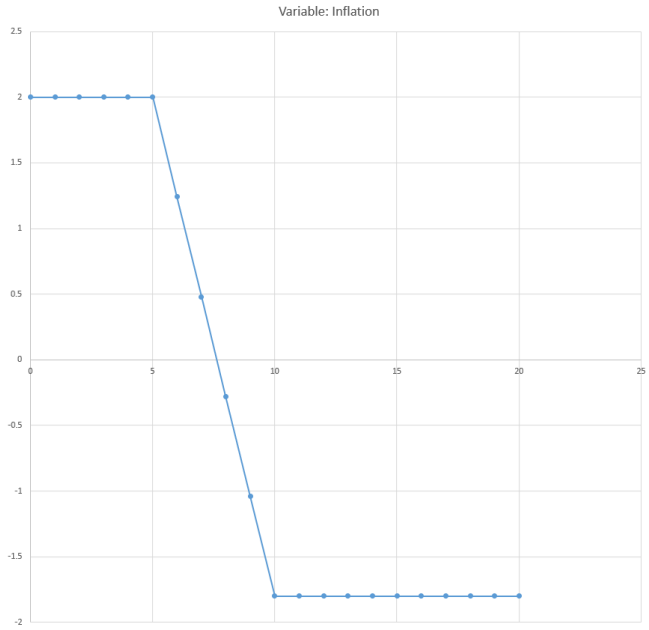
Suppose that there is a large shock to consumption. This reduces autonomous spending in the economy or a by 5.



Short run output $\tilde{Y}$ drops during this reduction. It stands to reason that without consumption there is no reason for production.

$$\tilde{Y} = a - b(R - r)$$

If a is -5 the only way for $\tilde{Y}$ to be positive, is if $-b(R - r)$ was positive. This would be rather strange behavior for an economy. The difference between the real interest rate and long run interest rate would need to be negative, or investment sensitivity would need to be positive. $-b$ coming out positive would suggest that people are risk loving and want to be a part of riskier investments. The other way to help $\tilde{Y}$ recover faster is by lowering the real interest rate.



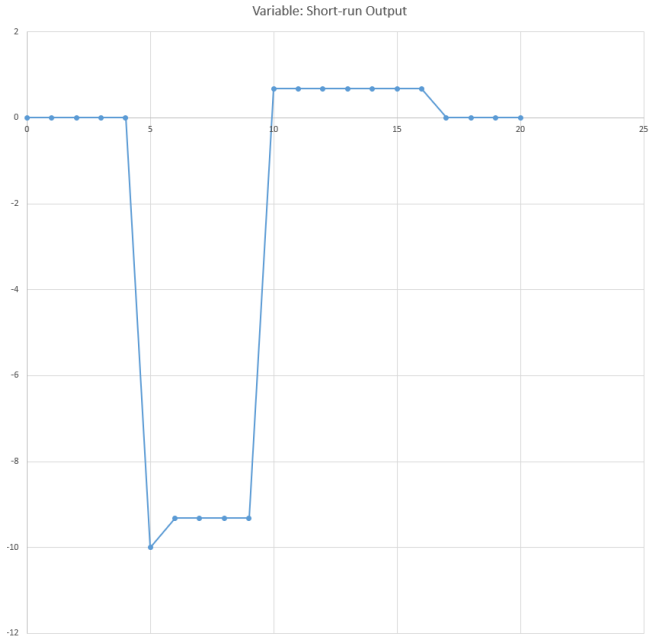
Inflation drops to match consumer preferences during this time. Since there are less consumers, producers can't price their products as aggressively. The change in inflation is represented by the equation:

$$\Delta\pi = \tilde{Y} * v + o$$

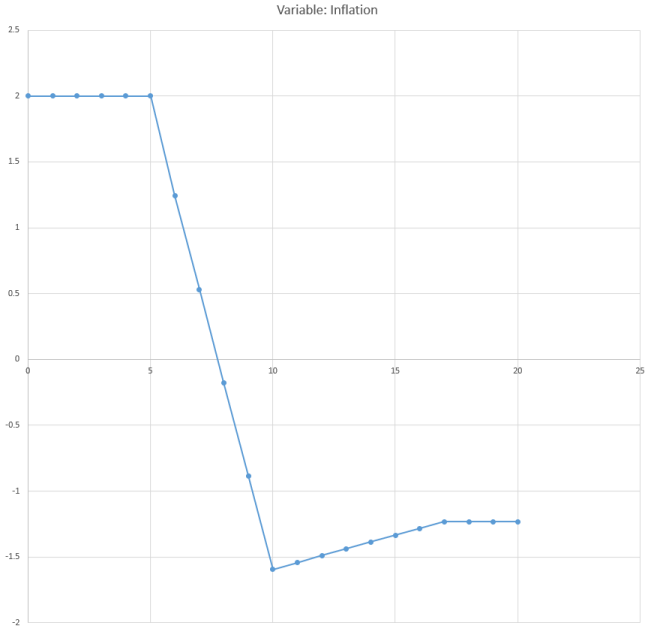
To get total inflation for a period use this equation:

$$\pi_t = \Delta\pi + \pi_{t-1}$$

In response to this shock in consumption the Fed lowers the real interest rate. This changes things. Initially $\tilde{Y}$ dropped straight to -10 then launched right back up to 0. Let's plug the numbers for that model into $\tilde{Y} = a - b(R - r)$. $-10 = -5 - 0.68(2 - 2)$ these numbers held constant for the 10 periods affected.



The Fed in response to the sharp decrease in $\tilde{Y}$ lowers the real interest rate R to 1% for periods 6 to 11. This stimulates the economy by reducing the costs of borrowing. Cheaper borrowing costs increase the number of investments. This can be seen by the small rise from -10 to -9.32. After period 10 $\tilde{Y}$ enters an inflationary period and decreases back to it's starting point.



Inflation still drops drastically with the changes in R. This is due to the drop in $\tilde{Y}$. After the shock to consumption inflation grows in response to the economy rebounding.

1.2 Stabilizing Output

These next few experiments show how the real interest rate can be changed to optimally respond to a variety of shocks in the economy.

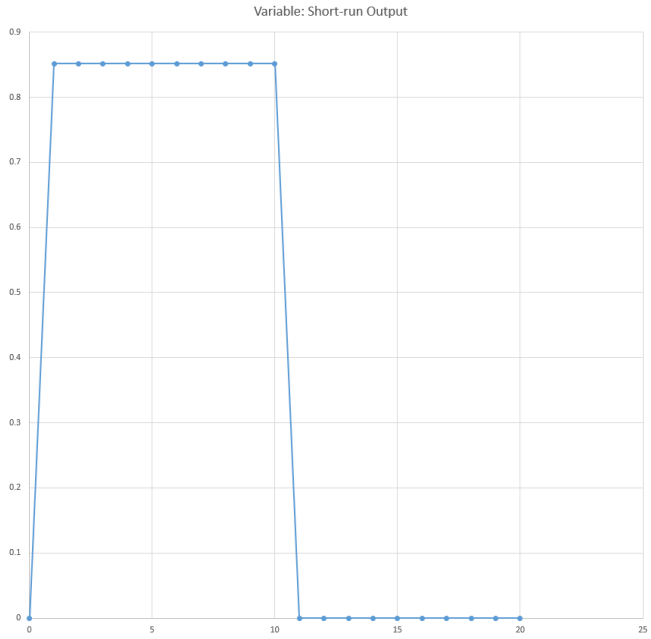
1.2.1 Consumer Behavior Change to $\Delta a_C = -0.5\%$

Consumers change their consumption behavior lowering Δa_C. To respond to the shock we will change R to offset it.

To solve for the real interest rate we can rearrange the formula for $\tilde{Y}$.

$$R = r - \frac{\tilde{Y} - a}{b}$$

Ideally we want $\tilde{Y} = 0$. After plugging in $\tilde{Y} = 0$ and $a = -0.5\%$, the ideal real interest rate turns out to be roughly 1.99% in this model. To check this we can see what $\tilde{Y}$ does when $a_C = -0.5$.

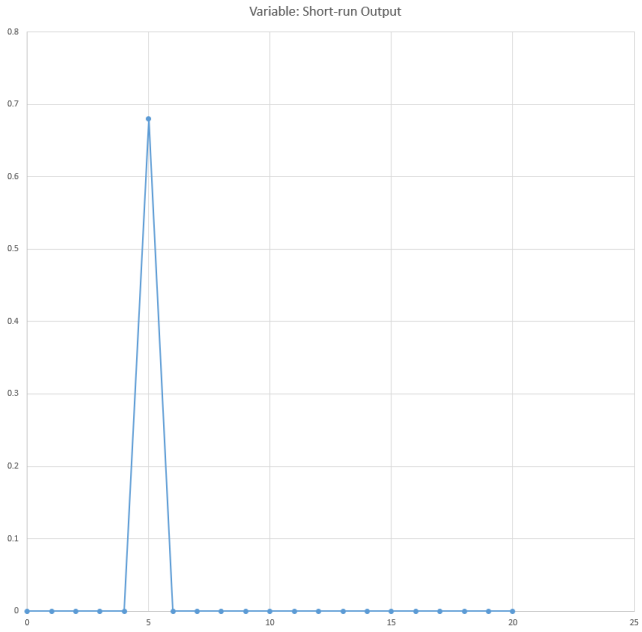


The graph shows that $\tilde{Y}$ remains fairly close to 0 jumping up to 0.85. Much of the variation in $\tilde{Y}$ is mitigated by the change in interest.

1.2.2 Improvements in MPK $\Delta r = 1\%$

Improvements in information technology makes capital more productive. This results in an increases in the long run interest rate r.

looking at $\tilde{Y} = a - b(R - r)$ its clear that to mitigate the effect of r on $\tilde{Y}$, R needs to be equal to r.



As is shown by the graph $\tilde{Y}$ is unaffected by a change in r if R responds in kind. The R response is delayed in this graphical example to show its effect on $\tilde{Y}$. The large spike is what happens to output without changing R.

1.2.3 Housing Bubble Pop

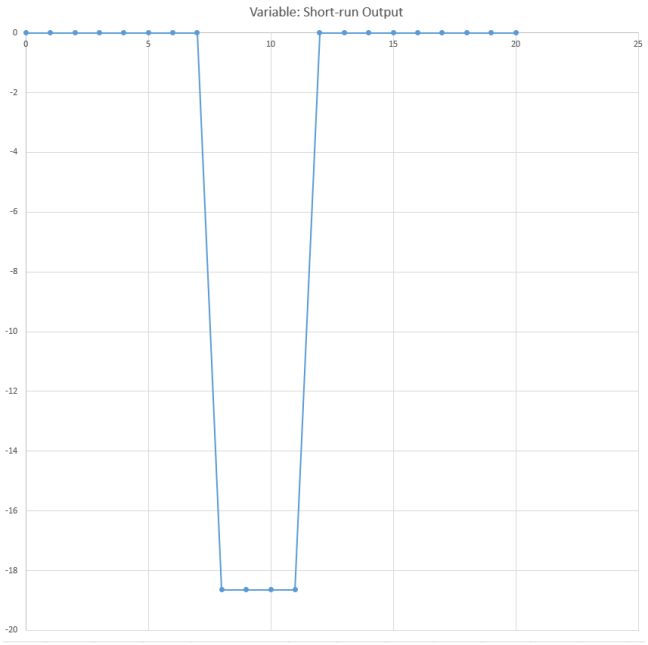
Prices decrease by 20% and the sale of new homes drops. This leads to a drop in autonomous spending or a. This economic event is akin to the consumption shock experiment in section 1.1. There is a decrease in $\tilde{Y}$ for several periods, and inflation drops to a new lower level. To help with the crisis the Fed should adjust R.

$$R = r - \frac{\tilde{Y} - a}{b}$$

Now we plug the numbers into the equation:

$$-27.4 = R = 2 - \frac{0 - (-20)}{0.68}$$

At this interest rate there would be no effect. However, an interest rate of -27% would be a devastating. Banks would pay people to take out loans. It would cost money to keep cash in savings. That's only a peek at what might happen. Instead we will drop it to 0%.



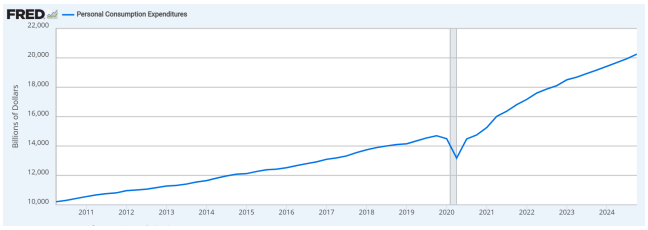
Lowering the interest rate only slightly improved the economic outlook. Taking $\tilde{Y}$ from -20 to roughly -18. Inflation drops only slightly less then it did before. Unless the interest rate drops to about -27 things are going to be hard. This seems inline with what actually happened in 2008.

2 COVID-19 simulations

This section is dedicated to seeing the effect of the COVID-19 pandemic on the IS and MP curves. There were consumer and supply shocks unlike anything seen before.

2.1 Data Selection

COVID-19 produced a shock across several areas of the economy. To properly simulate this we will find an estimate for the decrease in autonomous spending (a) during the pandemic.

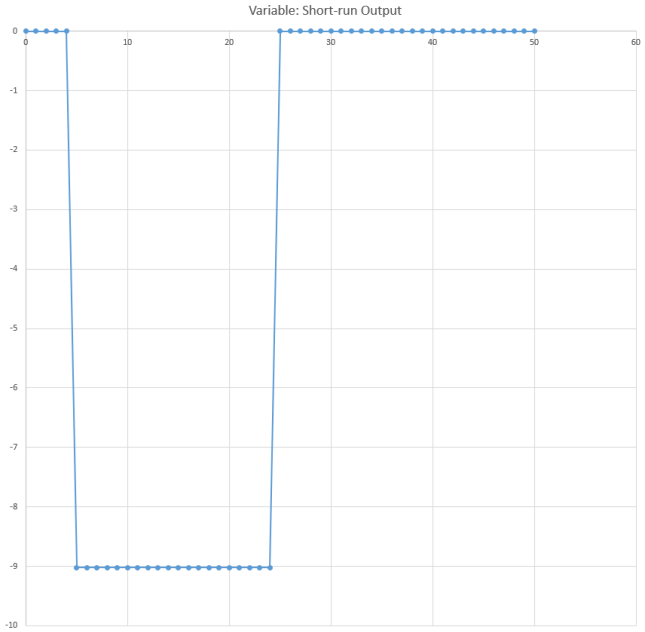


For a rough estimate of a we will use the Personal Consumption Expenditure or the PCE. The PCE captures the total goods and services purchased by the consumer. It captures consumption in a broad sense. In 2019 quarter 4 the index was at 14,701 billion dollars. This will be the starting point. then over the next two quarters it decreased to 13,175 billion dollars. This is roughly a 10.38% decrease.

This isn't by any means a perfect measure of a. It doesn't capture every aspect of autonomous spending, only the goods and services. However, it is still a good estimate of consumption.

2.1.1 Testing for COVID-19

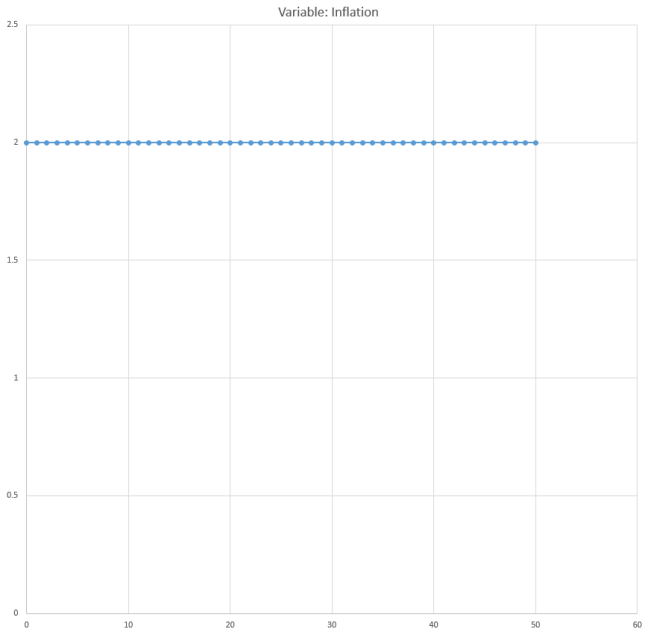
Lowering r to -13 would cancel out the effects of COVID-19. However, I don't think the government plans on paying people to take out loans and invest. The next best rate would be to drop it to 0% or next to it. This would bring $\tilde{Y}$ from -10.38 up to -9.02.



Inflation is still far bellow the target rate. One way to bring it back up to the Fed's target inflation rate at 2% is by creating artificial price shocks. The formula for the change in inflation π_c is:

$$\pi_c = (\tilde{Y} + v) + 0$$

Before COVID-19 the inflation rate was at the target, 2. We want there to be no change in inflation, or we want $\pi_c = 0$. Solving for o we get a shock of 0.67 rounded. This will make it so there is no change in inflation and that the target is met. Making inflation flat.



This would not be ideal. Creating artificial shocks like this comes with some unwanted consequences. It could erode real income without boosting spending. It is creating artificial scarcity. However, it does help us reach the target inflation rate.

2.1.2 The Future of Economic Policy

Estimating the future of an economy starts with beliefs. After a period of observation we begin to notice patterns in the economy. Like how inflation behaves in response to price shocks etc. To effectively use these beliefs they need to be modeled or described with math and statistics.

The world doesn't always behave like the models. There are events, like the pandemic, that can't be predicted. This is where the models are imperfect, and why they can't reliably tell the future.

However, Economic models help give us a framework to make policy decisions. The Fed uses their models and data to know how to use the tools of their office. They calculate the ideal rates and apply them. They use quantitative easing, and many other tactics. This report barely scratches the surface of these topic.

It is necessary for people to start becoming more involved in economic policy. When the general public understand, and the government is willing to act on behalf of the people it solves the group problem of an economy. An example of this is Argentina's new president. He has educated his people in economic policy, and is working with them to make Argentina economically stronger.

In conclusion models that reflect some of what the economy is doing, can be

very valuable during difficult times. The allow policy makers to make informed decisions, and to anticipate some of the consequences of what they are doing.

Sources

References

[1] Jones, Charles I. *Macroeconomics*. 4th ed., W.W. Norton, 2018.

[2] Federal Reserve Economic Data. *Chicago Board Options Exchange, CBOE Volatility Index: VIX [VIXCLS]*. Retrieved from FRED, Federal Reserve Bank of St. Louis, 2025. Available at: `https://fred.stlouisfed.org/series/VIXCLS`. Accessed: 2025-04-02.