ECON W3213 Spring 2014 Jón Steinsson

Monetary Policy

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This set of recitation notes introduces **the IS-MP**. This is in no way a substitute for attending lectures, but just in case you dozed off or checked your boyfriend's Facebook page while Jón was working Calculus magic on the board, this set of notes may save you.

1 Derivation

For the sake of this lesson, the next one, and your undying thirst for knowledge, let's derive the IS-MP diagram.

Investments I_t is

$$I_t = \bar{a}_i \bar{Y}_t - \bar{b}_i \bar{Y}_t (R_t - \bar{r})$$

Savings S_t is

$$S_t = Y_t - \bar{a}_s \bar{Y}_t + \bar{b}_s \bar{Y}_t (R_t - r)$$

If you don't know how either of these are derived, check the recitation notes or the lectures notes. It's really straightforward.

Combining these two (hence equating investment and savings) we get

$$\tilde{Y}_t = \bar{a} - \bar{b}(R_t - \bar{r})$$

This is the IS curve.

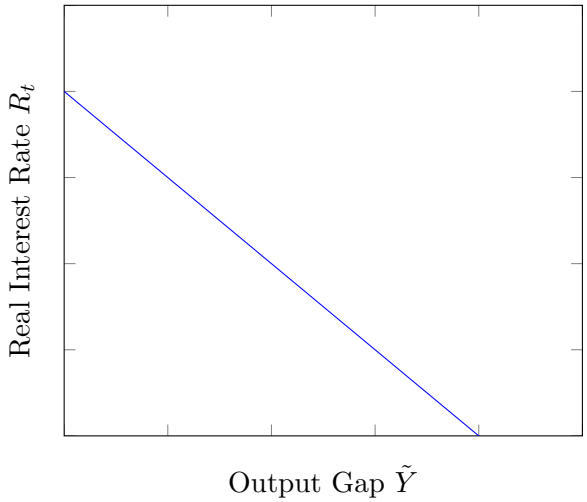


Figure 1: IS Curve

It is decreasing in real interest rate R_t

2 Money Demand and Supply

Now we go back to nominal interest rates. We first argue that the government can change nominal interest rates, then draw the link between nominal and real interest rates, then say that the government can then change real interest rates.

First let's derive money demand and supply.

On the demand side (remember the equation that we've always been using?)

$$\begin{aligned} M_t^d V_t &= P_t Y_t \\ \log M_t^d + \log V_t &= \log P_t + \log Y_t \\ \log M_t^d + \phi i_t + v_t &= \log P_t + \log Y_t \end{aligned}$$

Now we say that money velocity V_t is not constant. Instead, $\log V_t = \phi i_t + v_t$. We get

$$\log M_t + \phi i_t + v_t = \log P_t + \log Y_t$$

All this does is to say that the velocity of money is an increasing function o the nominal interest rate.

The central bank simply sets the money supply. In this case, the central bank can set the money supply to achieve any nominal interest rate.

So we can draw something like this

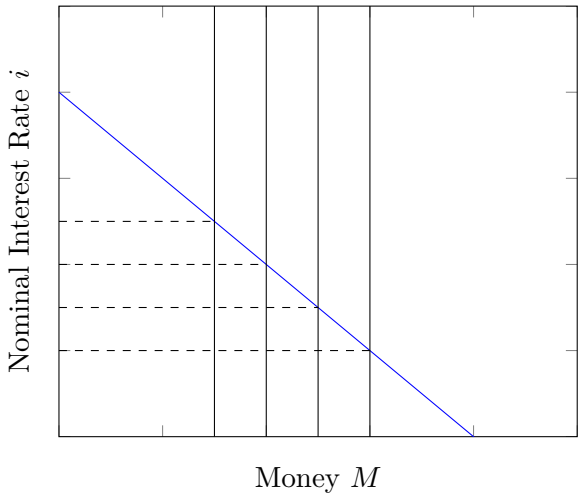


Figure 2: IS Curve

That's great. We established that **the central bank can affect the nominal interest rate**. However, how does it affect real interest rates?

3 Fisher Equation

We use the **Fisher Equation** to find the relationship between nominal and real interest rates.

$$R_t = i_t - \mathrm{E}_t \pi_{t+1}$$

where R_t is the real interest rate, i_t is the nominal interest rate, and the last term is the expected inflation of the next period at the current period.

Note that the definitions for these terms are slightly tricky:

- R_t and i_t denote the nominal and ex-ante real interest rate from time t to time $t+1$.
- However, π_{t+1} denotes the inflation between time t and $t+1$ since $\pi_t = \frac{P_{t+1} - P_t}{P_t}$

Again, using adaptive expectations,

$$R_t = i_t - \pi_t$$

Then in this case, by changing i_t, the government then sets R_t. This is due to the fact that prices (and inflation) are "sticky", so prices are set partially in advance. In other words, when the government changes i_t, π_t is still only concerned with time periods $t-1$ and t, so it is still stuck in the previous time period.

Then, the central bank, by setting the nominal interest rate i_t, can set the real interest rate R_t. We represent this decision with the Monetary Policy (MP) line in black.

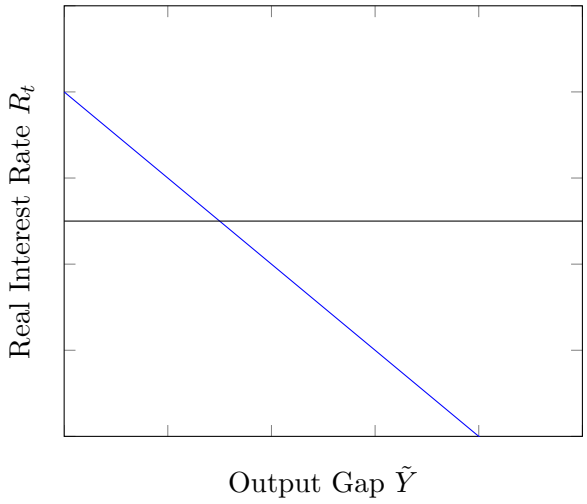


Figure 3: IS-MP Diagram

4 Examples of Shocks

This is how we derive the IS-MP diagram, useful for life and the rest of this course. Let's go over a few examples of shocks to the IS-MP. Simply because we can. You will notice that these are from your Pset. Because I made them muahaha.

Let's suppose that there's a temporary consumption boom that lasts only for one period.

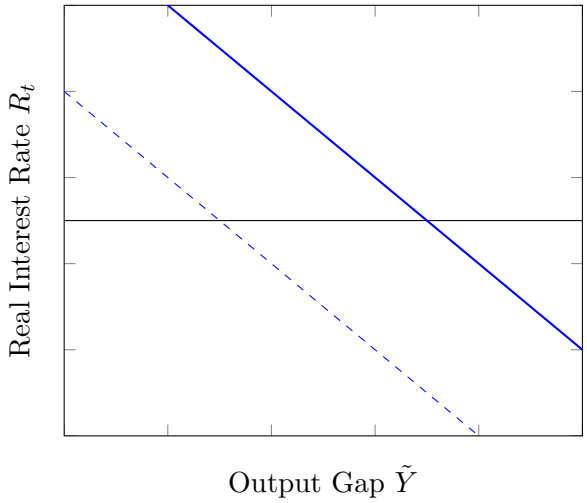


Figure 4: IS-MP Diagram

This boom means that the IS curve shifts to the right. At the same old nominal interest rate, this creates a rise in short-run output.

If you were the chair of the Fed, you'd do this.

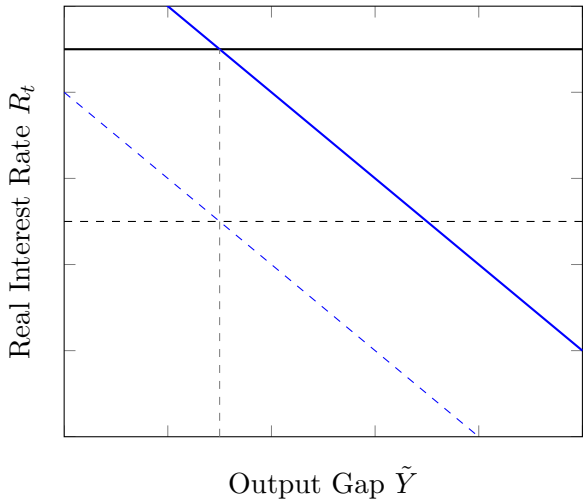


Figure 5: IS-MP Diagram

A central bank that cared about keeping short-run output right where it was before the consumption boom would immediately raise the nominal interest rate. This would raise the real interest(since inflation expectations don't change in the short run), which would hurt investment purchases. While consumers would probably consume a bit more of

GDP (due to their optimism, presumably), businesses would consume a bit less(due to the Fed's decision to raise the interest rate).

In IS-MP, this means IS shifts right and then MP shifts up just enough so that short-run output is the same as before the consumption boom.

Let's do more practices.

If consumers become pessimistic about the state of the economy and future productivity growth...

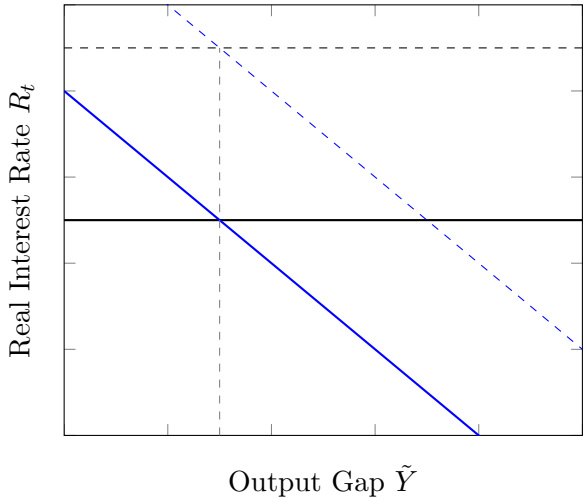


Figure 6: IS-MP Diagram

This means IS shifts left. Fed should respond by cutting rates(pushing MP down) to put output gap back to zero.

If there were improvements in productivity and hence marginal product of capital...nothing should change! An increase in productivity increases potential output only. There are minimal changes in the IS-MP diagram.

If the French suddenly wanted more of our goods, what happens?

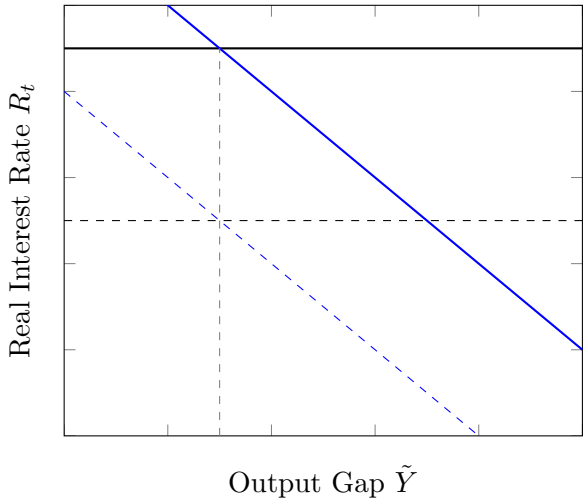


Figure 7: IS-MP Diagram

IS shifts to the right. Fed should raise MP until output gap is back to zero.

If we suddenly wanted more French goods, what happens?

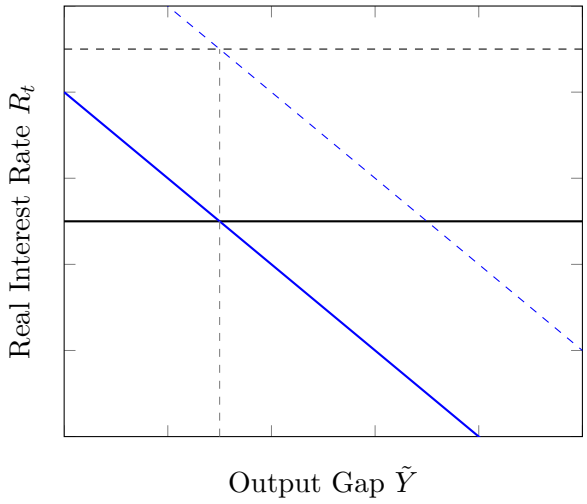


Figure 8: IS-MP Diagram

IS shifts left. This means fewer consumer goods will be made in the United States. Fed should cut MP until output gap is back to zero

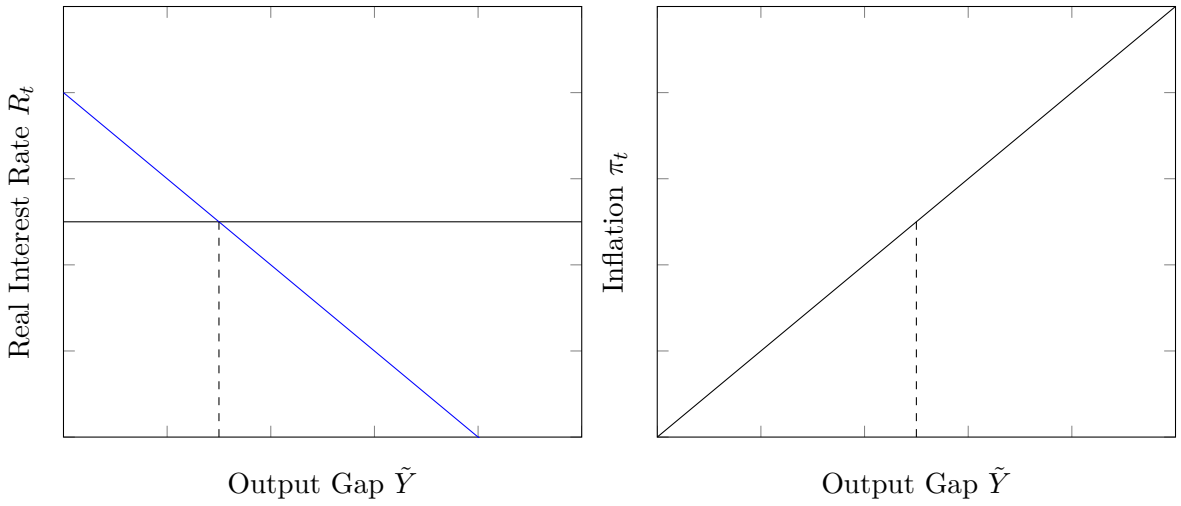
What happens during an earthquake (that destroys only potential output. Everyone is miraculously alive)? Earthquake destroys capital so potential output decreases. There are minimal changes in IS- MP diagram.

5 What So Far

So far, we know this.

- The central bank can set the nominal interest rate
- With the Fisher equation, the central bank can manipulate the real interest rate
- With the real interest rate (and the IS curve), the central bank can manipulate the output gap (and unemployment which we can find using Okun's Law)
- Accordingly, it decides the level of inflation on the Phillips Curve

So let's see how we can use this to analyze shocks. We always have two diagrams now:

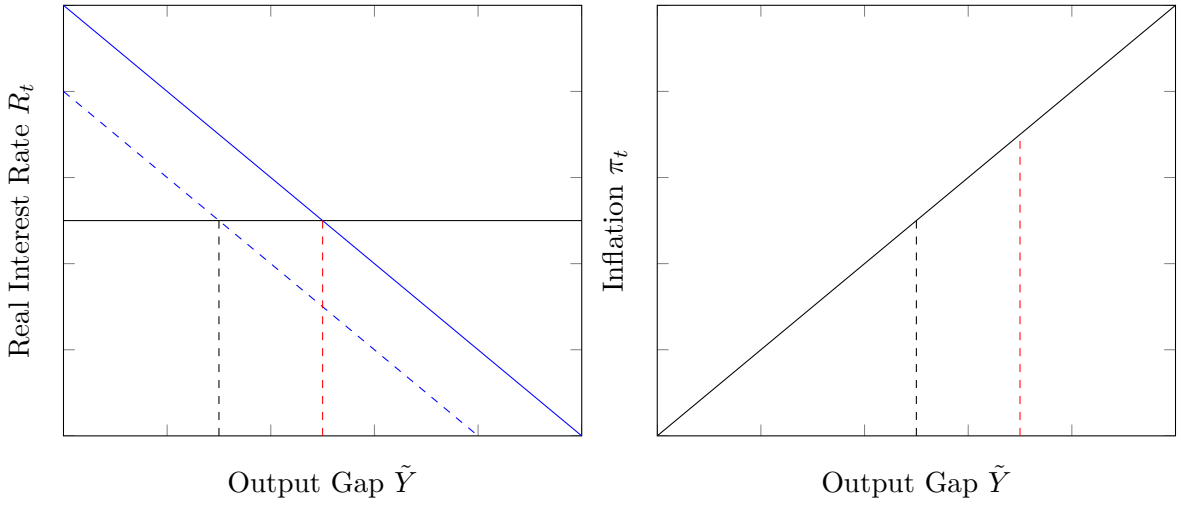


(a) IS-MP Diagram (b) Phillips Curve

Figure 9: Entire Economy

Now assume that we were originally at full employment. That's the point indicated by the dotted line.

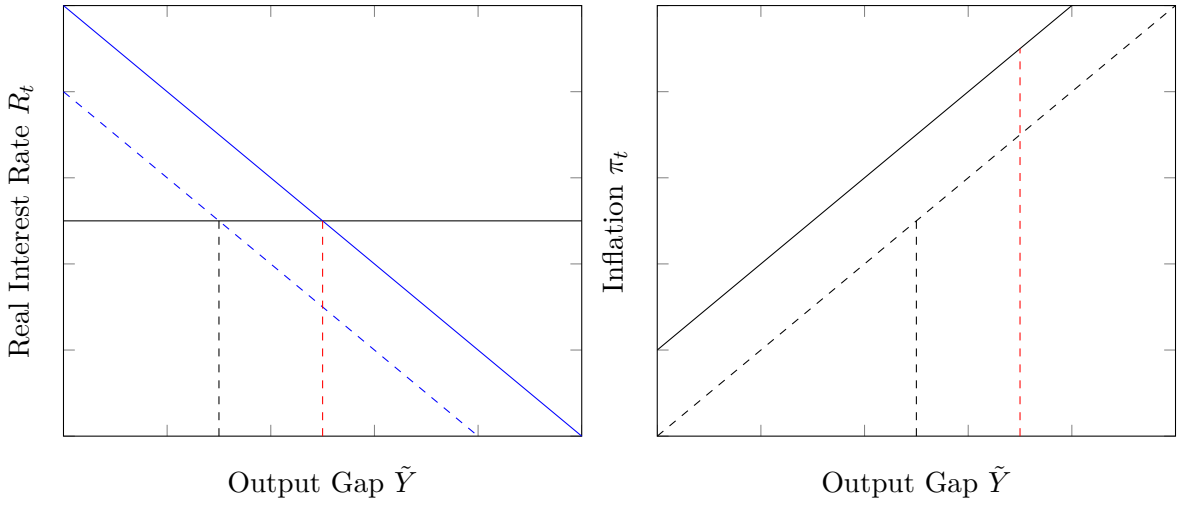
What if we had an external shock that shifted the IS curve outwards? Then, IS shifts out. And we have a positive output gap. That will be reflected in the Phillips Curve too as we shift to a higher part of the same Phillips curve. That's what happens for this time period.



(a) IS-MP Diagram (b) Phillips Curve

Figure 10: Entire Economy

Now our Phillips Curve doesn't stay constant in the next period. Nope, it shifts up because people are shmaaaaart. (or adaptive expectations. Professor Phelps please don't kill me for saying this)

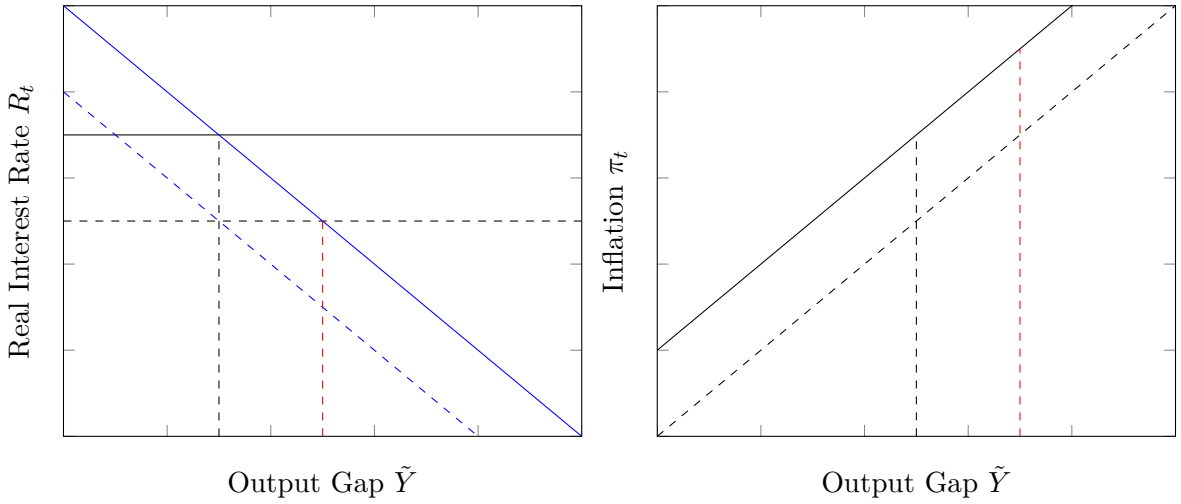


(a) IS-MP Diagram (b) Phillips Curve

Figure 11: Entire Economy

Now the central bank sees this and isn't happy. The inflation is gonna spiral out of control. So, it raises nominal interest rates, which increases real interest rates such that

output gap goes back to the full employment level.



(a) IS-MP Diagram

(b) Phillips Curve

Figure 12: Entire Economy

Then, we first get zero output gap from our IS-MP diagram with a resulting higher real interest rate. Since we're at zero output gap, inflation stops spiraling out of control. We stay with a permanently higher inflation level.

You can work out the equations for these. It's quite a handful, but it's not difficult at all.

6 Formalizing The Central Bank's Actions

So far, we think that the central bank kind of sets the MP curve using a vague set of rules. Sometimes, it aims to achieve zero output gap. Otherwise, it aims to control inflation.

Let's come up with an "ideal" central bank that aims to do one thing and one thing only: **control inflation**. Then, it will change real interest rates whenever inflation is away from its "target" level. Hence, it controls real interest rate such that

$$R_t - \bar{r} = \bar{m}(\pi_t - \bar{\pi}_t)$$

where R_t is the real interest rate, $\bar{r}$ is the "natural" interest rate (you can think of it as long run interest rate), $\bar{m}$ is how aggressive the government is with monetary policy, π_t being inflation and $\bar{\pi}_t$ being the inflation target.

7 Aggregate Demand and Supply

Then let's see what we have now

1. Monetary Policy: $R_t - \bar{r} = \bar{m}(\pi_t - \bar{\pi})$
2. Investment Saving: $\tilde{Y}_t = \bar{a}_t - \bar{b}(R_t - \bar{r})$
3. Phillips Curve: $\pi_t = \pi_{t-1} + \bar{v}\tilde{Y}_t + \bar{o}_t$
4. Okun's Law: $\tilde{Y}_t = -2(u_t - \bar{u})$

We can assume that the IS-MP will always be equilibrium. When we take that assumption, we can equate those two and come up with an **Aggregate Demand**

$$\tilde{Y}_t = \bar{a}_t - \bar{b}\bar{m}(\pi_t - \bar{\pi})$$

Our Phillips Curve acts as the **Aggregate Supply**

So together,

$$\tilde{Y}_t = \bar{a}_t - \bar{b}\bar{m}(\pi_t - \bar{\pi})$$
$$\pi_t = \pi_{t-1} + \bar{v}\tilde{Y}_t + \bar{o}_t$$

Plot them with π_t on the y-axis and $\tilde{Y}_t$ on the x-axis and we get

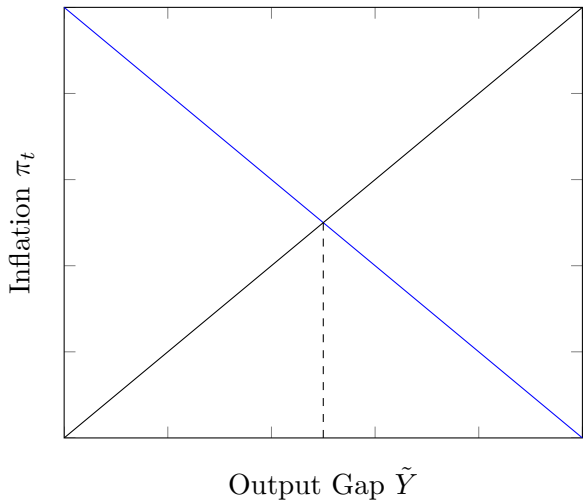


Figure 13: AD AS Diagram

The dashed line indicates the full employment level, hence where $\tilde{Y}_t = 0$. This diagram captures the whole model in one single figure. How so?

Let's suppose that an external shock moves the IS curve to the right. It's the exact same exercise as we did earlier, just that we're combining everything on one diagram.

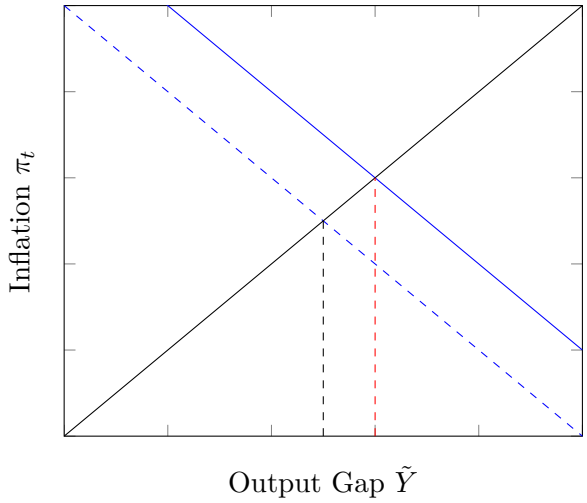


Figure 14: AD AS Diagram

Now with a higher IS due to the shock, we arrive at a higher point on our Phillips Curve.

During the next time period, our Phillips Curve (or the AS) shifts up due to them smarties.

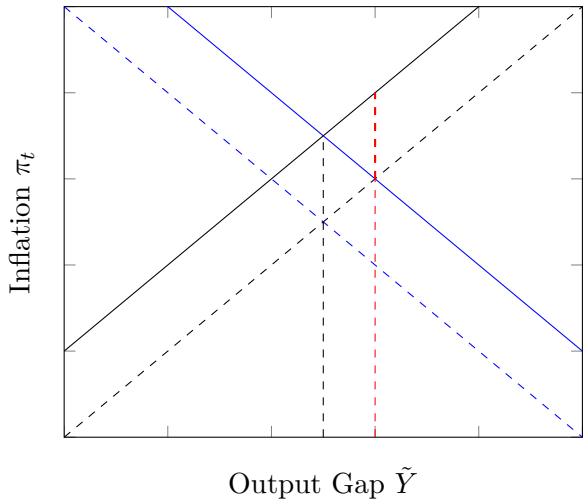


Figure 15: AD AS Diagram

Now the funny thing is as it moves up, we move back to the original output gap. How does that happen? Well remember in our original analysis, we said that the Phillips Curve shifts up, and the central bank shifts up the monetary policy curve to make output gap go back to the original level in response to increasing inflations? Well, we've simply combined this effect. Note that it is due to the effect of the central bank that inflation did not increase by the full extent of the upward shift of the Phillips Curve (as indicated by the thick red line).

We end up with a permanently higher inflation level and the original output gap, same as our previous analysis. Same shit, just a lot more convenient.