Advanced Macroeconomics
4. The Zero Lower Bound and the Liquidity Trap

Karl Whelan

School of Economics, UCD

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Can Interest Rates Be Negative?

- Up to now, we have assumed that the central bank in our model economy sets its interest rate according to a specific policy rule.
- But what if the rule predicts the central bank should set interest rates equal to a negative value? Will they?
- In the Euro area today, some short-term interest rates are negative because the ECB is charging banks for depositing money with it.
- But there are limits to how negative rates can be before investors and depositors choose just to hold cash, which has an interest rate of zero.
- This means there is effectively a lower bound on the interest rates set by monetary policy, though exactly what that lower limit might be is a bit unclear.
- With these considerations in mind, we are going to adapt our model to take into account that there are times when the central bank would like to set i_t below zero but is not able to do so. For simplicity, we stick with zero rather than specifying a particular negative value for the lower bound.

The Zero Lower Bound

- Up to now, we have mainly considered a monetary policy rule of the form

$$i_t = r^* + \pi^* + \beta_\pi \left(\pi_t - \pi^*\right)$$

- The lower bound problem occurs when inflation goes below some critical value.
- We will now change the monetary policy rule to

$$i_t = \text{Maximum}\left[r^* + \pi^* + \beta_\pi \left(\pi_t - \pi^*\right), 0\right]$$

- Because the intended interest rate of the central bank declines with inflation, this means that there is a particular inflation rate, π^{ZLB}, such that if $\pi_t < \pi^{ZLB}$ then the interest rate will equal zero.
- So what determines π^{ZLB}?

Triggering the Zero Lower Bound

- We can calculate the rate of inflation that triggers the zero lower bound as the rate inflation that sees the monetary policy rule require a zero interest rate.
- Algebraically, we can write this as

$$r^* + \pi^* + \beta_\pi \left(\pi^{ZLB} - \pi^* \right) = 0$$

- This can be re-arranged as

$$\beta_\pi \pi^{ZLB} = \beta_\pi \pi^* - r^* - \pi^*$$

- Which can be solved to give

$$\pi^{ZLB} = \left(\frac{\beta_\pi - 1}{\beta_\pi} \right) \pi^* - \frac{r^*}{\beta_\pi}$$

When Will Interest Rates be Zero?

- Zero lower bound holds if inflation is below

$$\pi^{ZLB} = \left(\frac{\beta_\pi - 1}{\beta_\pi} \right) \pi^* - \frac{r^*}{\beta_\pi}$$

- Three factors determine this "trigger" value of inflation

1. **The inflation target**: The higher the inflation target π^*, the higher is the level of inflation at which a central bank will be willing to set interest rates equal to zero.
2. **The natural rate of interest**: A higher value of r^* lowers the level of inflation at which a central bank will be willing to set interest rates equal to zero. An increase in this rate makes central bank raise interest rates and so they will wait until inflation goes lower than previously to set interest rates to zero.
3. **The responsiveness of monetary policy to inflation**: Increases in β_π raise the coefficient on π^* in this formula, increasing the first term and it makes the second term (which has a negative sign) smaller. Both effects mean a higher β_π translates into a higher value for π^{ZLB}.

The IS-MP Curve and the Zero Lower Bound

- To take account of the ZLB, we need to re-formulate the IS-MP curve.
- Remember the IS curve is

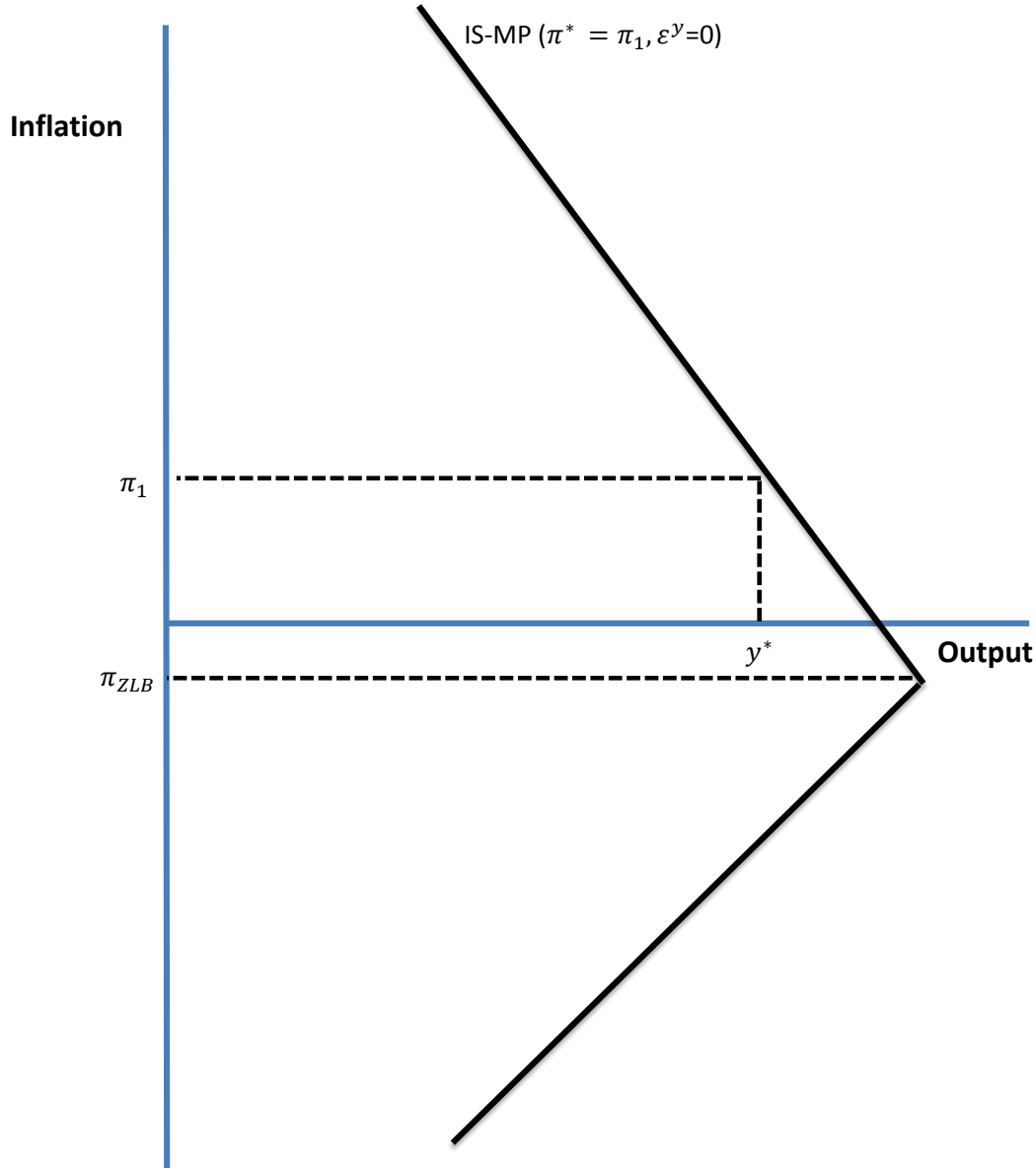
$$y_t = y_t^* - \alpha \left(i_t - \pi_t - r^* \right) + \epsilon_t^y$$

- So when nominal interest rates are zero, the IS-MP curve just set $i_t = 0$ in the above.
- So the IS-MP curve becomes

$$y_t = \begin{cases} y_t^* - \alpha \left(\beta_\pi - 1 \right) \left(\pi_t - \pi^* \right) + \epsilon_t^y & \text{when} \quad \pi_t > \pi^{ZLB} \\ y_t^* + \alpha r^* + \alpha \pi_t + \epsilon_t^y & \text{when} \quad \pi_t \leq \pi^{ZLB} \end{cases}$$

- Above π^{ZLB}, higher values of inflation are associated with lower values of output but below π^{ZLB}, higher values of inflation are associated with *higher* values of output.
- This means the IS-MP curve shifts from being downward-sloping to being upward-sloping when inflation falls below π^{ZLB}.

The IS-MP Curve with the Zero Lower Bound



Inflation Dynamics at the Zero Bound

- When inflation falls below π^{ZLB}, output is determined by

$$y_t = y_t^* + \alpha r^* + \alpha \pi_t + \epsilon_t^y$$

- Inflation is still determined by the Phillips curve

$$\pi_t = \pi_t^e + \gamma \left(y_t - y_t^* \right) + \epsilon_t^\pi$$

- So below the lower bound, inflation is given by

$$\pi_t = \pi_t^e + \gamma \left(\alpha r^* + \alpha \pi_t + \epsilon_t^y \right) + \epsilon_t^\pi$$

- This can be re-arranged to give

$$\pi_t = \frac{1}{1 - \alpha\gamma} \pi_t^e + \frac{\alpha\gamma}{1 - \alpha\gamma} r^* + \frac{\gamma}{1 - \alpha\gamma} \epsilon_t^y + \frac{1}{1 - \alpha\gamma} \epsilon_t^\pi$$

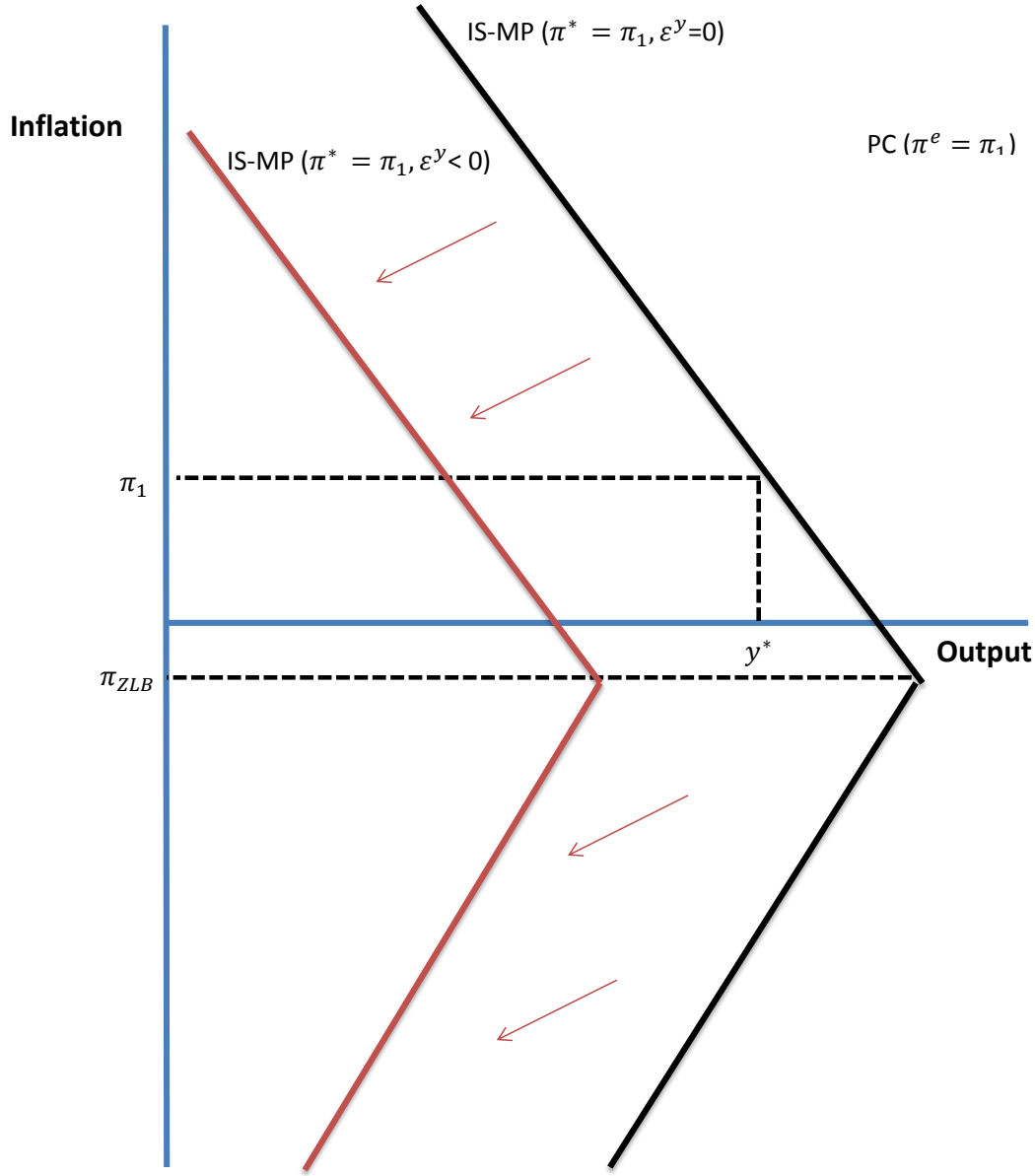
The Liquidity Trap

- Inflation dynamics at the zero lower bound are given by

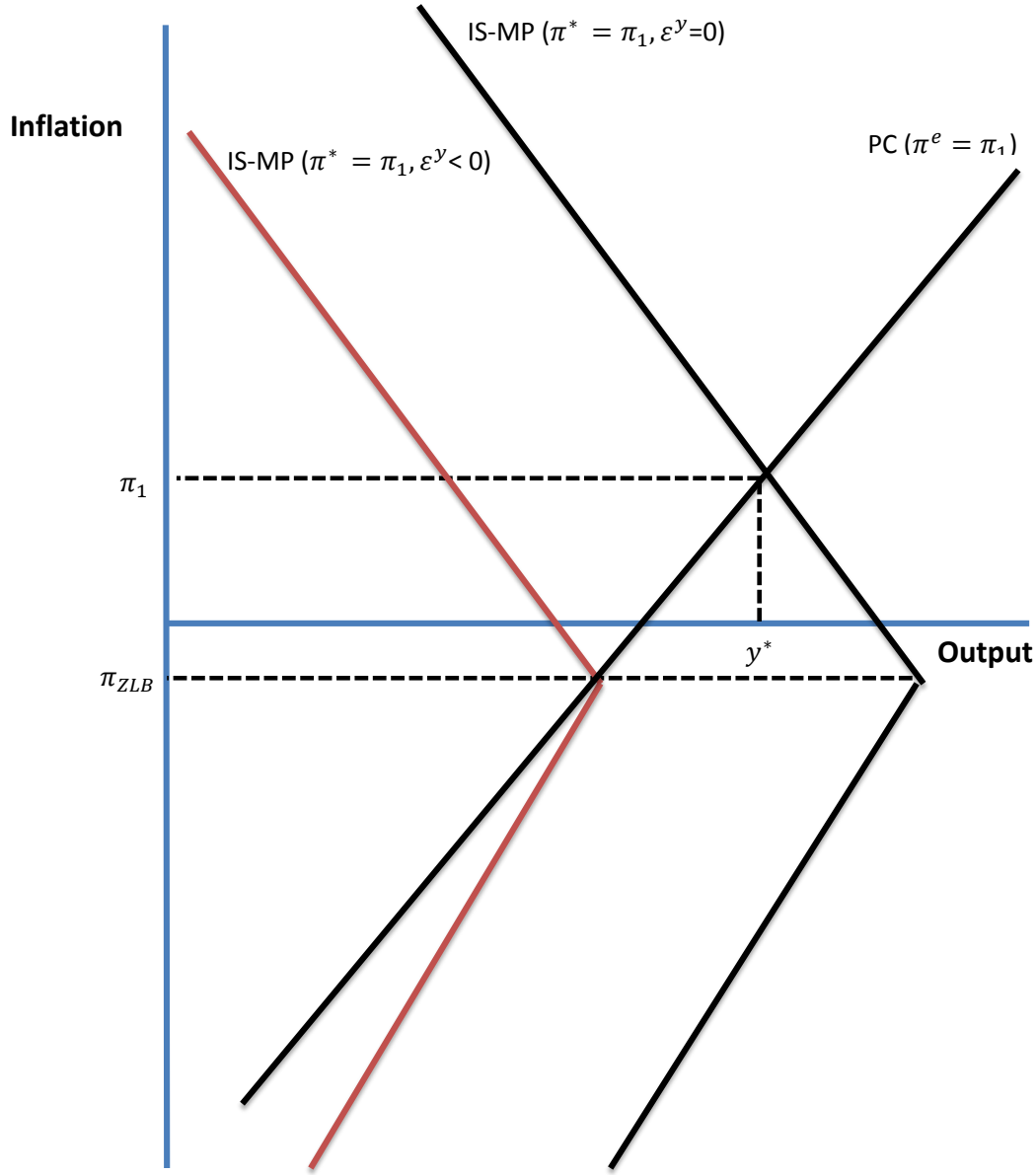
$$\pi_t = \frac{1}{1-\alpha\gamma}\pi_t^e + \frac{\alpha\gamma}{1-\alpha\gamma}r^* + \frac{\gamma}{1-\alpha\gamma}\epsilon_t^y + \frac{1}{1-\alpha\gamma}\epsilon_t^\pi$$

- The coefficient on expected inflation, $\frac{1}{1-\alpha\gamma}$ is greater than one.
- As with the Taylor principle example, changes in expected inflation translate into even bigger changes in actual inflation.
- This leads to unstable dynamics. Because these dynamics take place only when inflation has fallen below the zero lower bound, the instability here relates to falling inflation expectations, leading to further declines in inflation and further declines in inflation expectations.
- Because output depends positively on inflation when the zero-bound constraint binds, these dynamics mean falling inflation (or increasing deflation) and falling output.
- This position in which nominal interest rates are zero and the economy falls into a deflationary spiral is known as *the liquidity trap*.

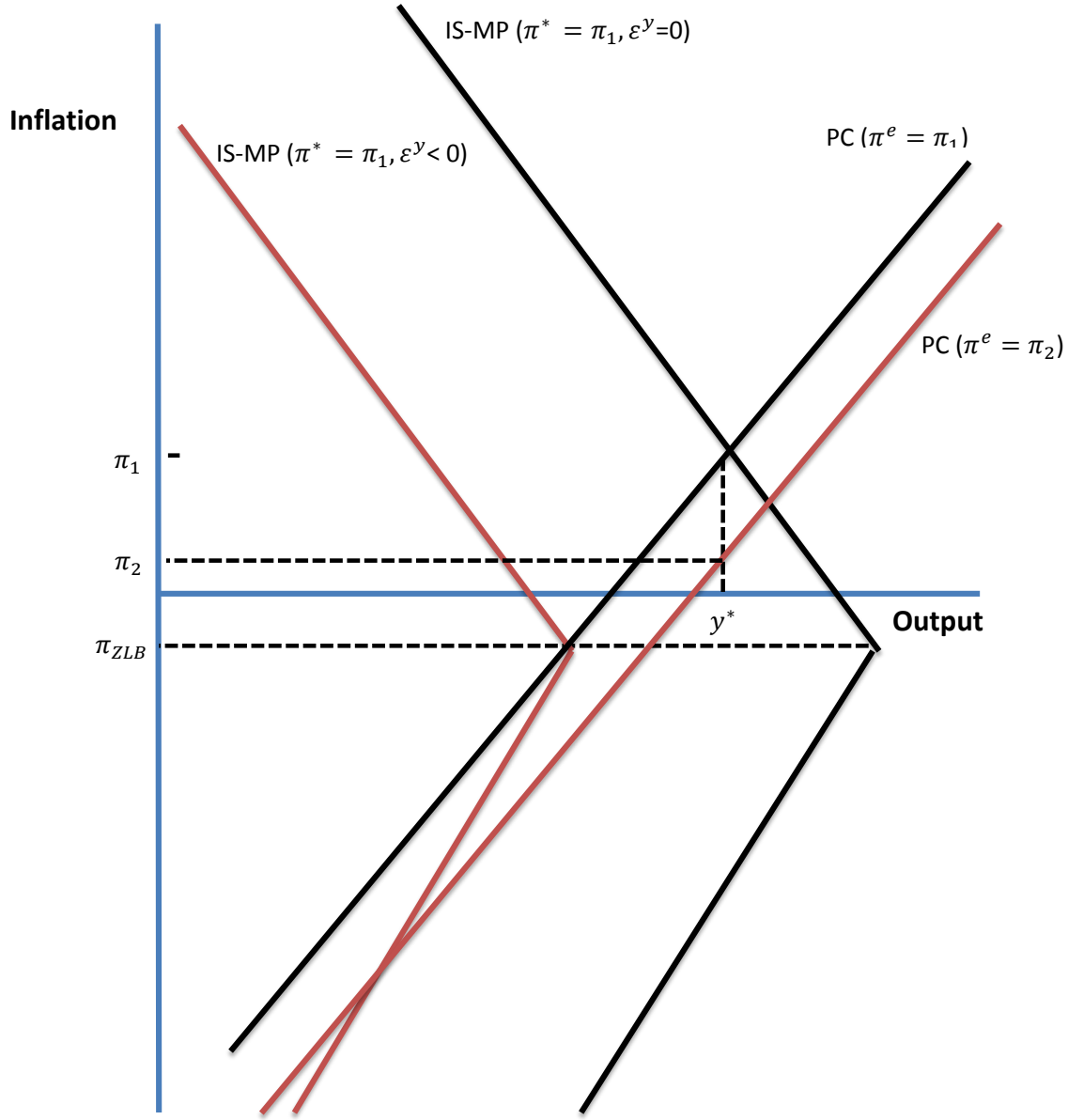
A Negative Aggregate Demand Shock



Equilibrium At the Lower Bound



Falling Expected Inflation Worsens Slump



The Liquidity Trap with a Taylor Rule

- For the monetary policy rule that we have considered, the zero lower bound is hit when inflation falls below some particular value.
- But what if policy followed the Taylor-type rule?

$$i_t = \text{Maximum}\left[r^* + \pi^* + \beta_\pi\left(\pi_t - \pi^*\right) + \beta_y\left(y_t - y_t^*\right), 0\right]$$

- Zero lower bound is hit when

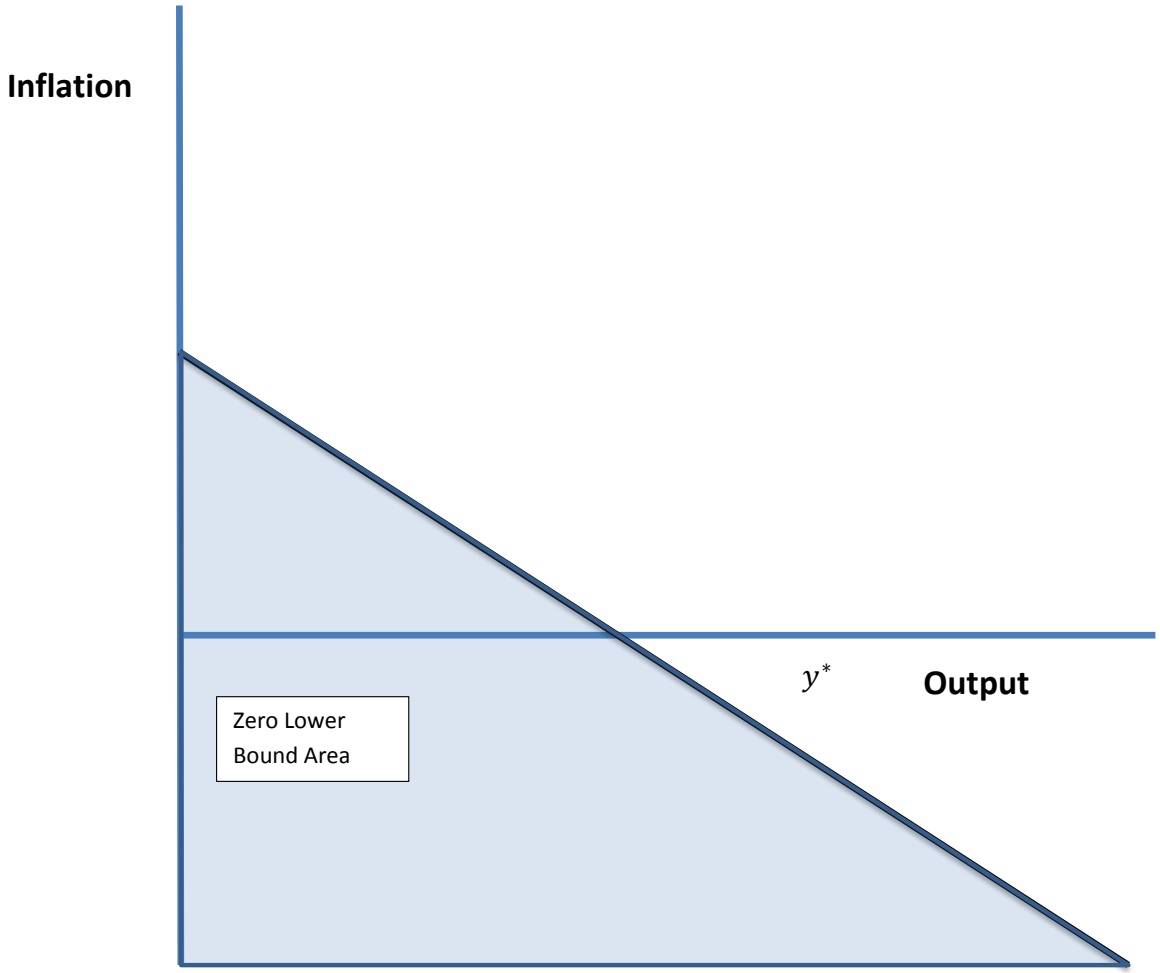
$$r^* + \pi^* + \beta_\pi\left(\pi_t - \pi^*\right) + \beta_y\left(y_t - y_t^*\right) = 0$$

- This can be re-written as

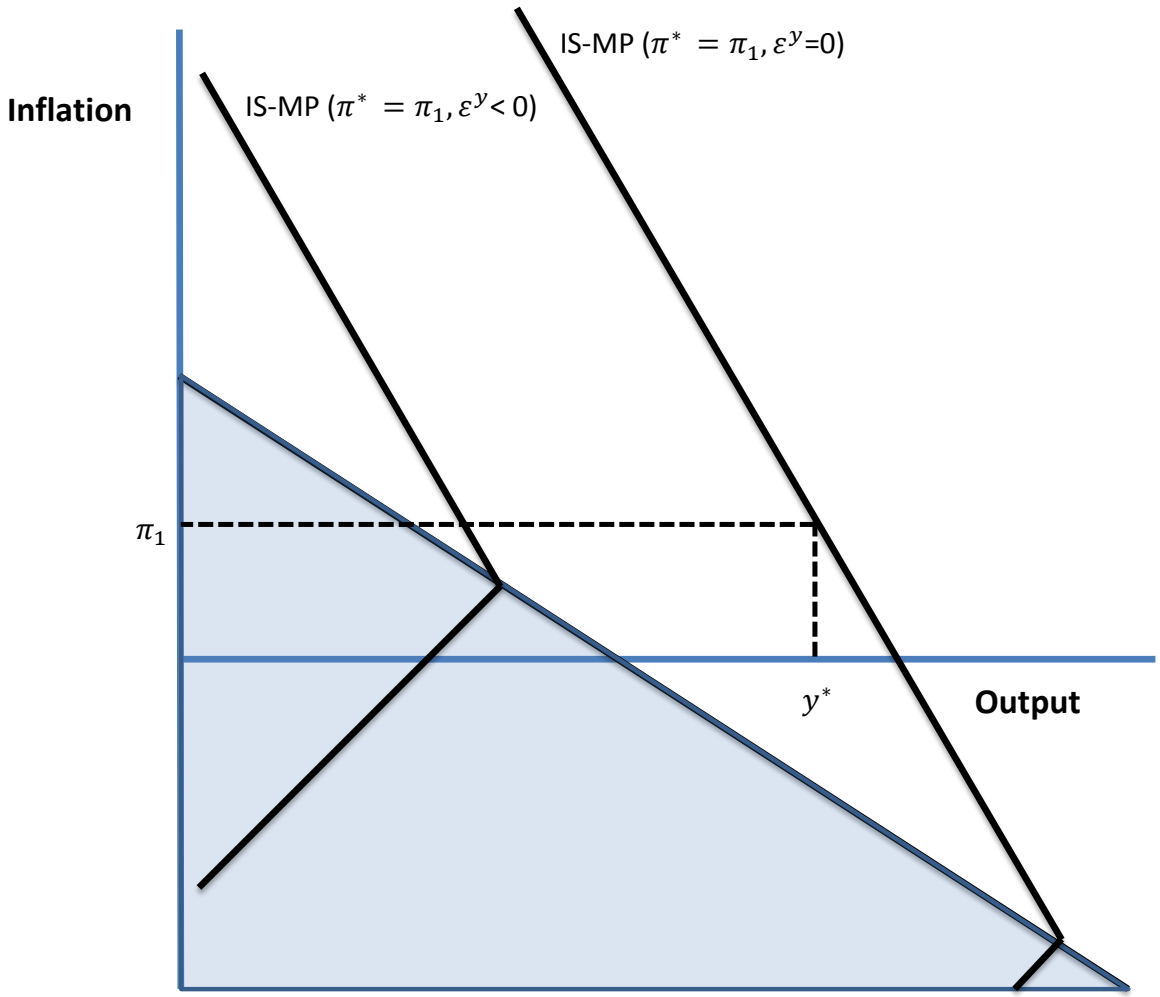
$$\beta_\pi\left(\pi_t - \pi^*\right) + \beta_y\left(y_t - y_t^*\right) = -r^* - \pi^*$$

- There are a series of different combinations of inflation gaps and output gaps that can lead to monetary policy hitting the zero lower bound.
- Can represent all the combinations of output and inflation that produce zero interest rates under the Taylor rule as the area under a downward-sloping line in Inflation-Output space.

Zero Bound is Binding in Blue Triangle Area



Zero Bound Can Be Hit With Positive Inflation



The Liquidity Trap: Reversing Conventional Wisdom

- Some predictions our model made (and which are now part of the conventional wisdom among monetary policy makers) do not hold when the economy is in a liquidity trap.
- Previously our model predicted that deviations of the public's inflation expectations from this target will be temporary and the economy will tend to converge back towards its natural level of output.
- But once interest rates have hit the zero bound, this is no longer the case. Instead, the adaptive expectations model predicts the economy can spiral into an ever-declining slump.
- Similarly, our earlier model predicted that a strong belief from the public that the central bank would keep inflation at target was helpful in stabilising the economy. However, once you reach the zero bound, convincing the public to raise its inflation expectations (perhaps by announcing a higher target for inflation) is helpful.

How to Get Out of a Liquidity Trap

- **Fiscal Policy**:
  - Increasing ϵ_t^y helps to shift the IS-MP curve back upwards.
  - However, liquidity traps such as the Japanese situation since the mid-1990s have occurred at times of very persistent weak private aggregate demand that can be hard to counteract with fiscal policy.
- **Monetary Policy**:
  - **Forward Guidance**: While the short-term interest rates that are controlled by central banks may be zero, that doesn't mean the longer-term rates that many people borrow at will equal zero. By signalling that they intend to keep short-term rates low for a long period of time they can lower longer-term rates.
  - **Quantitative Easing**: Purchasing large quantities of longer-term bonds. Reduces supply available to private sector and may push down interest rates on these bonds.
  - **Exchange Rate Targeting**: For example, the ECB could announce that it is willing to swap a euro for \$1. Currency depreciation makes imports more expensive and raises inflation. Termed the "foolproof way to escape from a liquidity trap" by monetary policy expert Lars Svensson.

Increasing Inflation Expectations

- Our model tells us that output can be boosted when the economy is in a liquidity trap by raising inflation expectations.
- Since his research on Japan in the late 1990s, Nobel prize-winner Paul Krugman has discussed the tension that central bankers feel when in a liquidity trap. When up against the zero bound, they might like to raise inflation expectations but then they are concerned that this could make inflation go higher than they would like.
- The public's awareness that the central bank will clamp down on inflation if the economy picks up then prevents there being a sufficient increase in inflation rates to get the economy out of the liquidity trap.
- Krugman thus stresses the need for central banks facing a liquidity trap to "'commit to being irresponsible" as a way out of these slumps—commit to a temporary period of inflation being higher than you would normally like.
- But central bankers are a conservative crowd and even temporary "irresponsibility" does not come easy to them.

A Higher Inflation Target to Prevent Liquidity Traps?

- In equilibrium in our model $i_t = r^* + \pi^*$ percent. If, for example, $\pi^* = 2$ (consistent with the preference of modern central bankers for a 2 percent inflation rate) and $r^* = 3$, then the nominal interest at equilibrium will be 5 percent. This gives quite a lot of room for cutting nominal interest rates before you reach zero.
- However, most central bankers think the equilibrium real interest rate (r^*) is not a fixed number and that it has declined a lot in recent years. In January 2012, Fed policy makers had a median estimate for the long-run real federal funds rate was 2.25 percent. By June 2020, this estimate was 0.4 percent.
- If the equilibrium real interest rate was only 0.4 percent, then the equilibrium nominal rate with a 2 percent inflation target will be only 2.4 percent, leaving much less room before you hit zero interest rates.
- One way to address this issue would be to target a higher inflation rate. With an inflation target of 4 percent, then the equilibrium nominal rate would be 4.4 percent and there would be an additional 200 basis points of monetary easing possible before the zero bound was hit. There has been some discussion of this idea in academic circles but most central bankers are generally very much against this idea.

Things to Understand From This Topic

1. Why there is a lower bound on interest rates
2. The factors that influence when the central bank sets zero rates in our model.
3. How the IS-MP curve changes when incorporating the zero lower bound.
4. How changes in inflation expectations affect the economy above and below the zero lower bound.
5. What is meant by the liquidity trap, i.e. why the economy doesn't automatically recover when the zero bound binds.
6. How the IS-MP-PC graphs work when we incorporate the zero bound.
7. Policy options for getting out of the liquidity trap.
8. Arguments for a higher inflation target.