Monetary Macroeconomics

Chapter 6:

Price Surprises

Dr. Pınar Yeşin

March 26, 2021

University of Zurich

Chapter 6: Price Surprises

What happens when z is observed with a time delay?

That is, what happens when this period's money growth rate is not observed immediately?

In our previous lectures we had $M_{t+1} = zM_t$, $z > 1$ **known** to the agents.

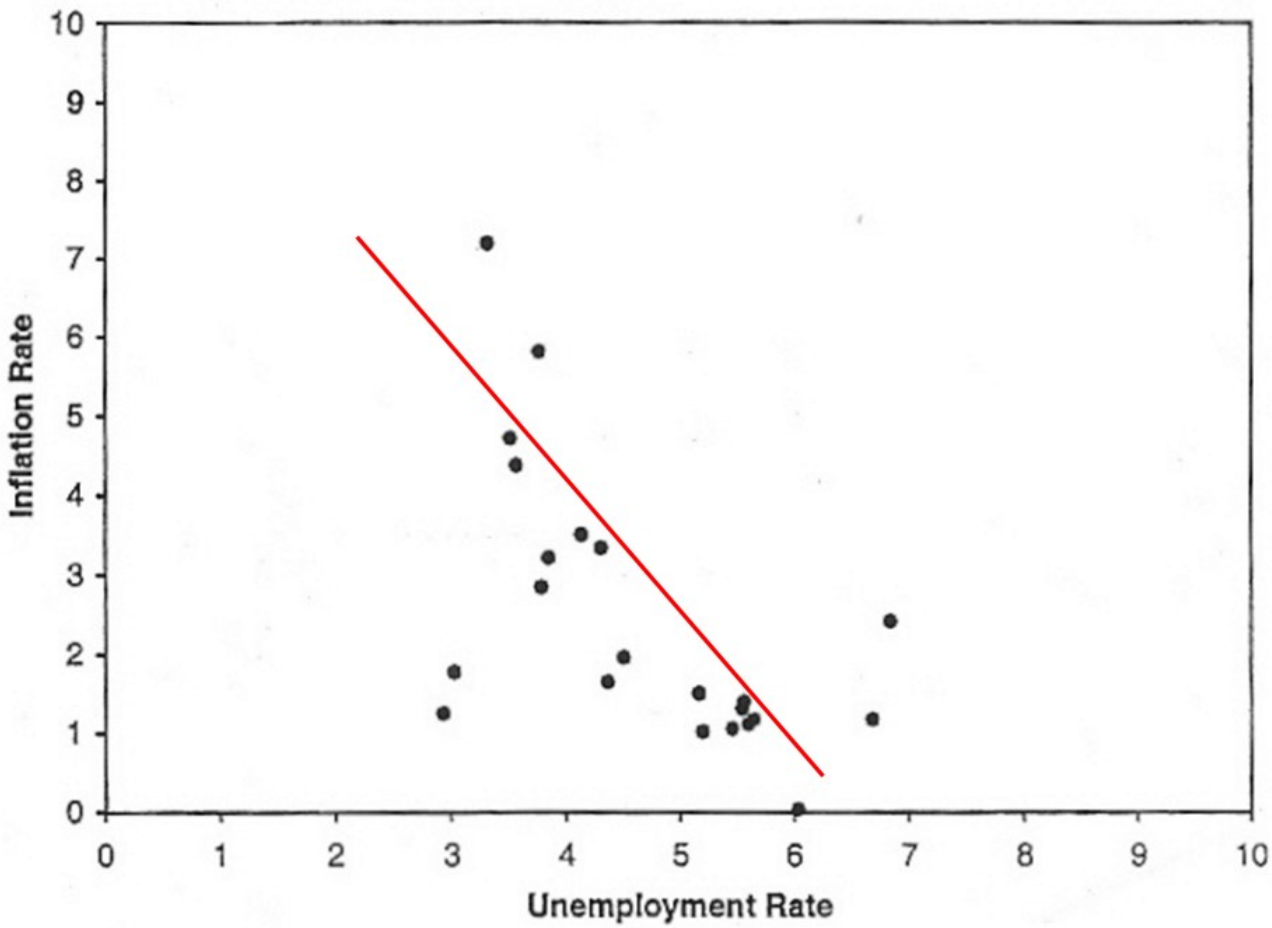
We will relax this assumption and analyze the model in this lecture.

Relationship Between Inflation and Output?

Time series data for the US during 1948-1969 shows a negative relationship between unemployment and inflation. This negative relationship is called Phillips Curve.

The Phillips Curve for the US (1948-69)

Negative relationship between annual unemployment rate and inflation rate

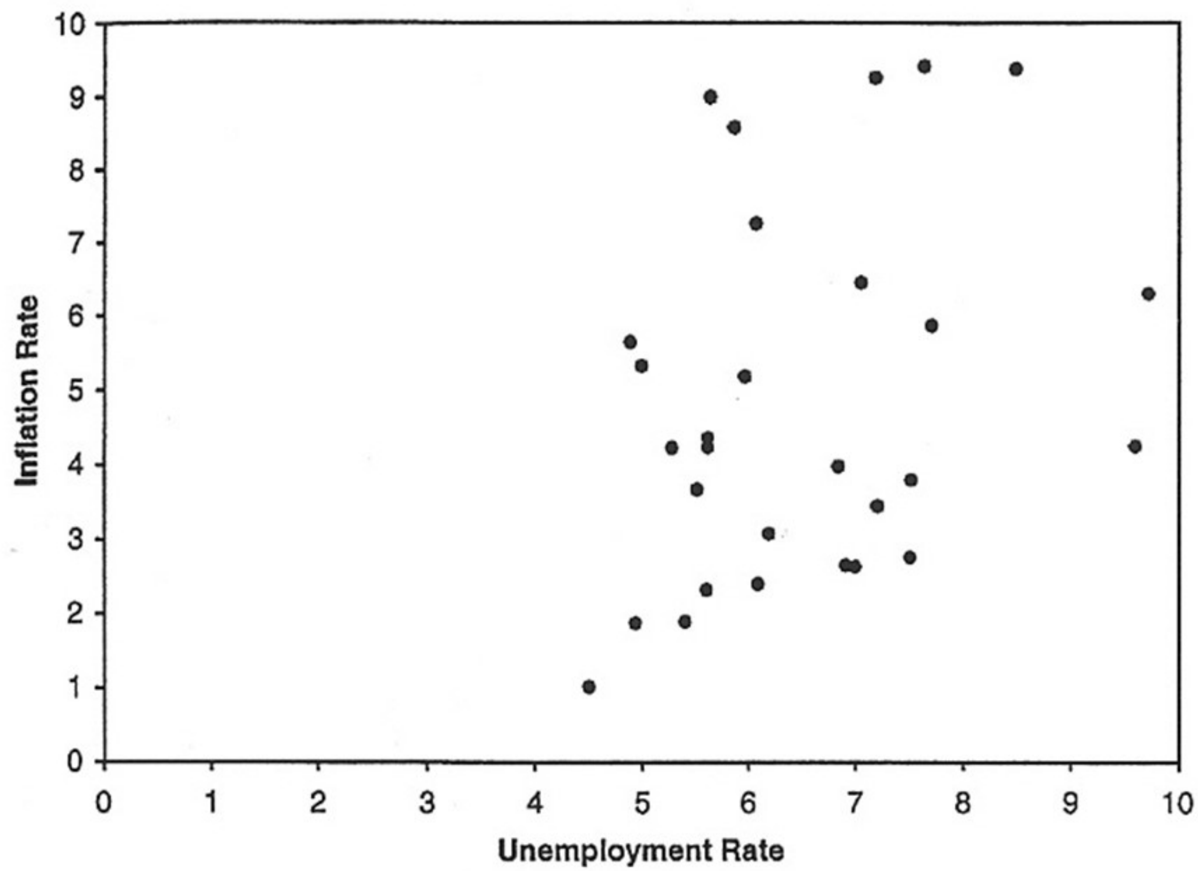


Observing this relationship policymakers thought that they can influence and stimulate employment (and hence output!) by printing money. However, this steady inflation policy did not work.

Time series data for the US between 1970-2000 shows a **positive** relationship between the same two variables!

The Phillips Curve for the US (1970-2000)

Annual unemployment rate and inflation rate suddenly have a positive relationship!



Lucas Critique

Just looking at a reduced-form correlation in the data without understanding how the economy works, and doing econometric policy evaluation is not wise, since these reduced-form correlations are subject to change when the government changes its policies and thus the rules under which decision makers operate.

Nobel Prize Lecture in 1995

Monetary Neutrality by Robert E. Lucas JR

The Lucas Model

Overlapping generations model with fiat money.

The agents live for two periods.

N young agents are born each period. The aggregate population is constant over time.

There is no government spending.

Fiat money stock grows according to the rule

$$M_t = z_t M_{t-1}, \quad z_t > 1$$

and the government gives lump-sum transfers to the old with the new printed money.

$$\left(1 - \frac{1}{z_t}\right) M_t = N p_t a_t$$

where a_t is the real value of the transfer to each old.

The country consists of 2 spatially separated islands.

$\frac{2}{3}N$ young are born on one of the islands.

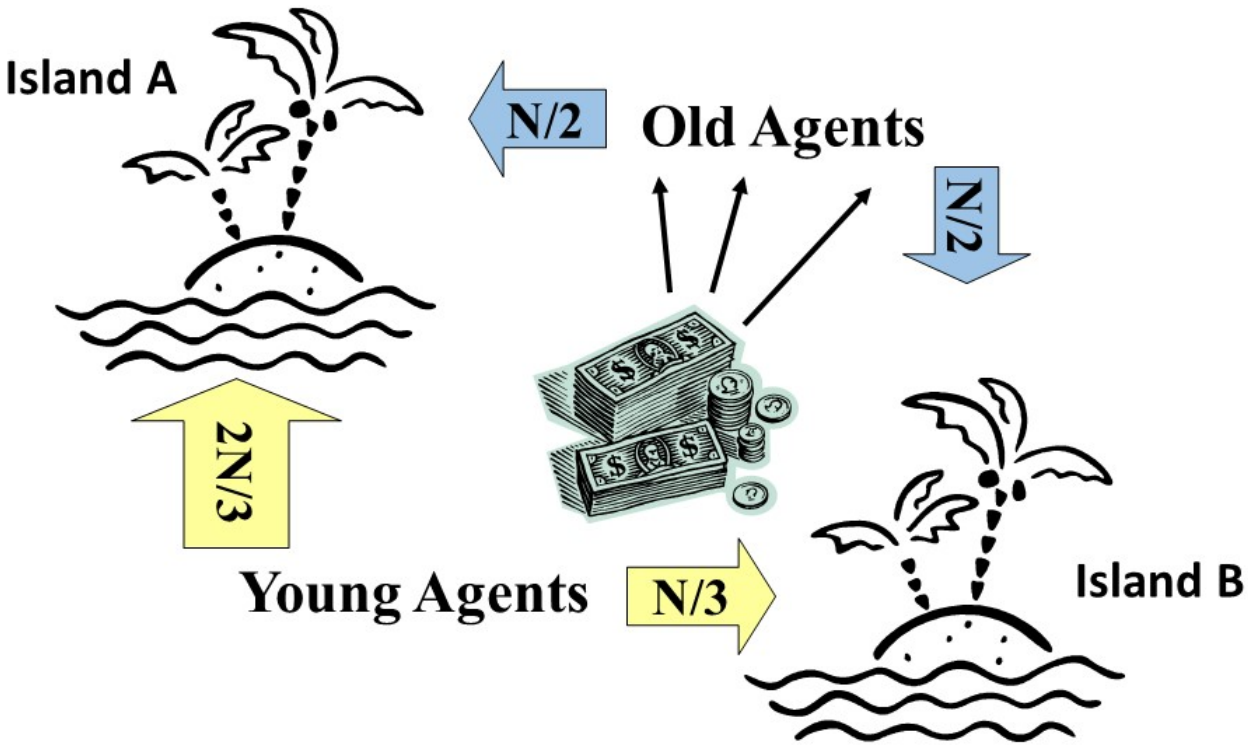
$\frac{1}{3}N$ young are born on the other island.

Which island will have more young population is random.

When agents get old, they are randomly but equally distributed across the islands.

$\frac{1}{2}N$ old are on one of the islands.

$\frac{1}{2}N$ old are on the other island.


Island A
N/2
Old Agents
N/2
2N/3
Young Agents
N/3
Island B

Informational Assumption

In any period, the young cannot observe directly the number of young people on their island and do not know the size of the transfers to the old.

That is they will not know if there are few people to produce or if there is a large transfer to the old, when they observe a high demand for their good!

But they understand the probabilities of outcomes important to their welfare. *Rational Expectations*!

Production

The young on island i are endowed with y units of time, which can be used for home production, $c^i_{1,t}$, or for market production, l^i_t (to produce goods to the old in exchange for fiat money).

l^i_t, i.e. labor, will be a function of the current price level on island i, p^i_t.

Budget Constraints

The feasibility with respect to time allocation requires

$$c_{1,t}^{t} + l_t^i = y$$

And after trade the cash balances will be

$$p_t^i l_t^i = m_t^i$$

Thus for an agent who was born on island i the budget constraint when young is

$$c_{1,t}^{i} + \frac{m_t^i}{p_t^i} = y$$

And when old the agent "moves" to island j and his budget constraint is

$$c_{2,t}^{i,j} = \frac{m_t^i}{p_{t+1}^j} + a_{t+1}$$

$$\begin{aligned} c_{2,t}^{i,j} &= \frac{p_t^i l_t^i}{p_{t+1}^j} + a_{t+1} \\ &= \left(\frac{p_t^i}{p_{t+1}^j}\right) l_t^i + a_{t+1} \end{aligned}$$

Thus consumption when old depends on where the agent was born and where he ended up when old.

Substitution vs. Income Effect

Assume that the agents' preferences are such that the optimal labor decision, l_t^i, is increasing in the rate of return on their work, $\frac{p_t^i}{p_{t+1}^j}$.

Therefore we are assuming that an increase in the current price of goods, other things being equal, will induce the young to devote more time to market production.

That is the substitution effect is larger than the income effect.

Case 1: $z_t = z$ for all t

That is consumers can easily determine the current money stock. There are no surprises!

Feasibility in the money market requires money supply equals money demand on *both* islands.

On island i the money supply is $\frac{M_t}{2}$ since half of the old are there.

$$\frac{M_t}{2} = p_t^i N_t^i l(p_t^i)$$

where $l(p_t^i)$ is the real labor supply, i.e. real demand for fiat money!

Thus the price level will be

$$p_t^i = \frac{\frac{M_t}{2}}{N_t^i l(p_t^i)}$$

Assume island A has more young population at time t. Thus

$$N_t^A = \frac{2}{3}N \quad \text{and} \quad N_t^B = \frac{1}{3}N$$

Then the price levels on the islands will be

$$p_t^A = \frac{\frac{M_t}{2}}{\frac{2}{3} N l(p_t^A)}$$

and

$$p_t^B = \frac{\frac{M_t}{2}}{\frac{1}{3} N l(p_t^B)}$$

We see that $p_t^A < p_t^B$. See the proof in the appendix pp 137-138.

That is the price level is high when young population is low, so they observe a high demand for their product.

$$\frac{p_t^i}{p_{t+1}^j} = \frac{\frac{M_t/2}{N^i l(p_t^i)}}{\frac{M_{t+1}/2}{N^j l(p_{t+1}^j)}} = \underbrace{\frac{M_t}{M_{t+1}}}_{\frac{1}{z}} \frac{N^j l(p_{t+1}^j)}{N^i l(p_t^i)}$$

As z increases, the rate of return to work falls, discouraging work, because the money balances earned from labor are "taxed" by the high expansion of the money stock.

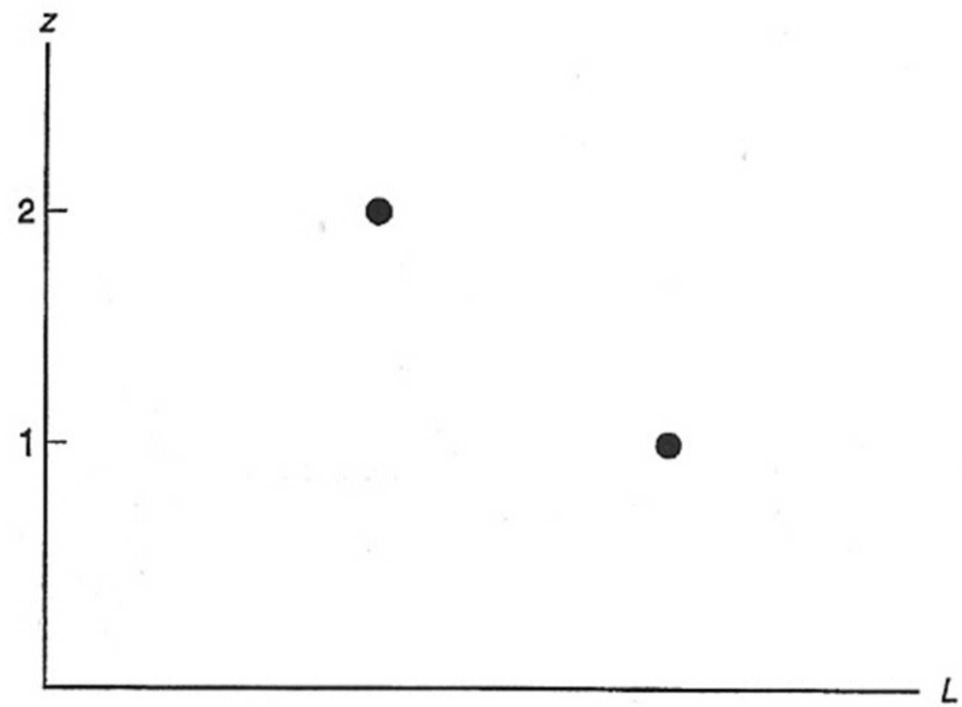
Thus we will see lower aggregate output!

We get **negative** correlation between inflation and output — contradicting the Phillips curve.

However, this is consistent with cross-sectional data of several countries!

Anticipated monetary shock

When fiat money stock is doubled every period, then labor (output) is lower compared to the case with constant money supply



Case 2: Random Monetary Policy

$$M_t = \{ \begin{array}{ll} M_{t-1} & \text{with probability } \theta \quad (z_t = 1) \\ 2M_{t-1} & \text{with probability } 1-\theta \quad (z_t = 2) \end{array} \}$$

Realization of z_t is kept secret, so that the young cannot infer the aggregate money supply in the economy.

Recall that $p_t^i = \frac{M_t/2}{N^i l(p_t^i)} = \frac{z_t M_{t-1}/2}{N^i l(p_t^i)}$

There are 4 possible states:

$N^i = \frac{1}{3}N$ or $\frac{2}{3}N$ and $M_t = 2M_{t-1}$ or M_{t-1}.

Let us find p_t^i for each state.

Growth Rate of Money Stock	Number of Young People: 2/3 N	Number of Young People: 1/3 N
$z_t = 1$	$p_t^a = \dfrac{M_{t-1}}{\frac{4}{3}Nl(p_t^a)}$	$p_t^b = \dfrac{M_{t-1}}{\frac{2}{3}Nl(p_t^b)}$
$z_t = 2$	$p_t^c = \dfrac{M_{t-1}}{\frac{2}{3}Nl(p_t^c)}$	$p_t^d = \dfrac{M_{t-1}}{\frac{1}{3}Nl(p_t^d)}$

confusion

We observe that

$p_t^b = p_t^c$ and $p_t^b > p_t^a$ and $p_t^c < p_t^d$.

So if the young face p_t^a (or p_t^d) then they know that they young population is large (or small) and that the money supply stayed unchanged (or doubled).

Therefore $l(p_t^a) < l(p_t^d)$.

However, if the young face p_t^b, then they cannot infer anything about the state of the economy. So they will all produce l^*, where

$$l_t^a = l(p_t^a) < l^* < l(p_t^d) = l_t^d$$

Aggregate Output?

The aggregate output is the sum of the outputs produced on the two islands.

When $z_t = 1$, then the aggregate output will be a weighted average of l_t^a and l^*.

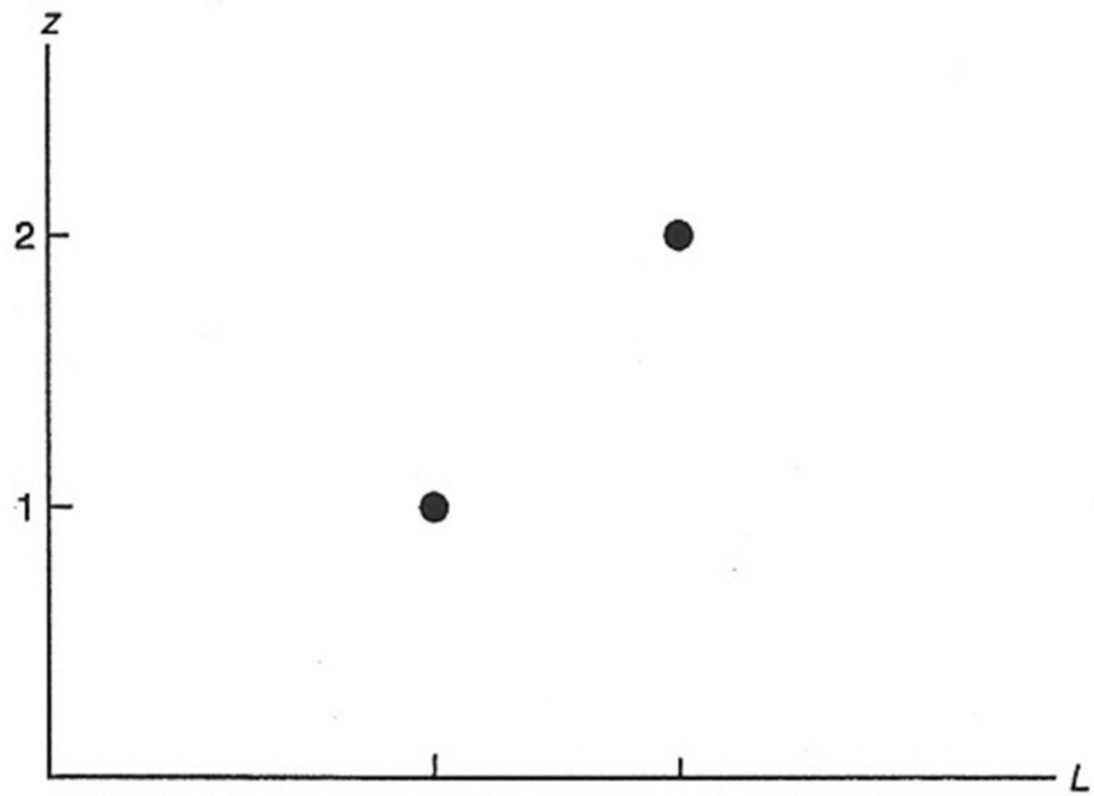
When $z_t = 2$, then the aggregate output will be a weighted average of l^* and l_t^d.

We observe that the output is higher when inflation is high. This **positive** relationship is similar to Phillips curve!

Unanticipated monetary shock

If monetary policy is random, labor (output) will be higher in periods with higher money supply growth rate.

Phillips Curve!



Policy Question

Should the governments fool their citizens to increase output?

There is a limit that the government can fool consumers. With time, consumers will learn and make decisions based on the "reputation" of the government.

Moreover, even if the output is increased through inflation there is a **welfare loss** associated with it which should never be ignored!

Conclusion

We have seen that correlations among macroeconomic variables are subject to change when economic policy changes.

Unexpected inflation can stimulate output, whereas *anticipated* high inflation will decrease incentives to work and result in lower production.

Lesson to be learned: *Correlation does not imply causality!*

Funny examples of correlation versus causality

Book by Tyler Vigen