ECN 106 Macroeconomics 1

Lecture 5

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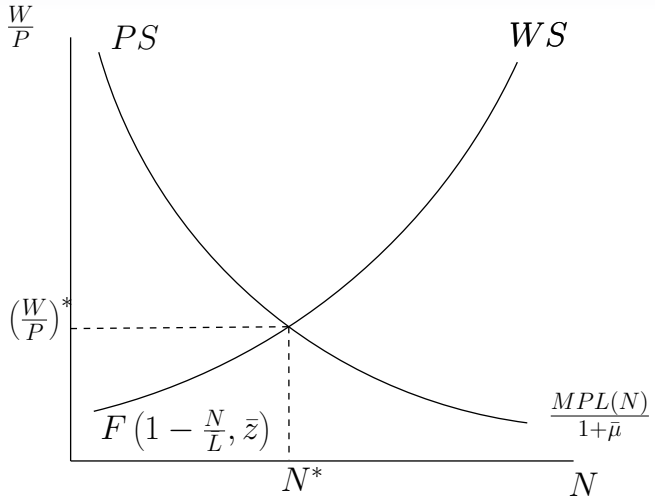
Roadmap for this lecture

- Long-run general equilibrium: putting it all together.
- Fiscal and monetary policy in the long run.
- Long-run money neutrality.
- The aggregate demand (AD) and long-run aggregate supply (LRAS) curves.
- Mankiw Ch. 4-2, 4-8, 9-3, 11-2(Section 1)

Recapping

- Three markets: (1) labour market; (2) goods market; (3) money market
- Markets are interdependent $\rightarrow$ general equilibrium
- Labour market equilibrium determines **real** output
- Labour market + goods market equilibrium determines the **real** interest rate.
- To determine nominal variables we need money market.

Recapping: LR labour market equilibrium

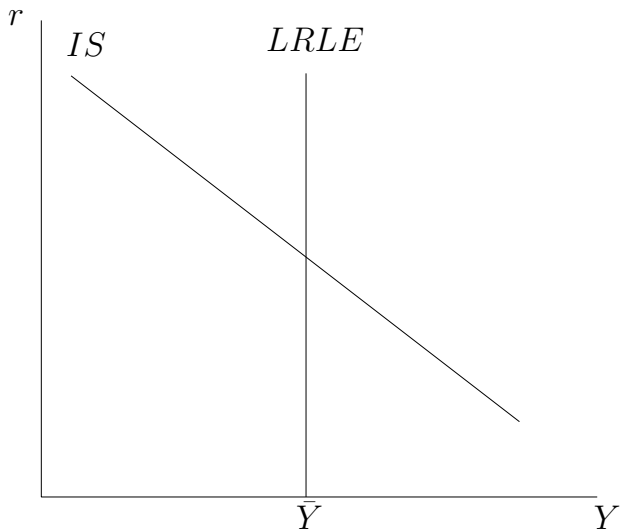


$$\frac{W}{P} = \frac{MPL(N)}{1+\bar{\mu}} \qquad \text{(PS)}$$

$$\frac{W}{P} = F\left(1-\frac{N}{\bar{L}},\bar{z}\right) \qquad \text{(WS)}$$

$$Y = \bar{Y}(\bar{\mu},\bar{z}) \qquad \text{(LRLE)}$$

Recapping: LR labour + goods market equilibrium



$$Y = \bar{Y}(\bar{\mu}, \bar{z}) \qquad \text{(LRLE)}$$

$$Y = \underbrace{\bar{C} + c(Y - \bar{T})}_{C} + \underbrace{a - br}_{I} + \bar{G} \qquad \text{(IS)}$$

LR general equilibrium

All markets have to be in equilibrium.

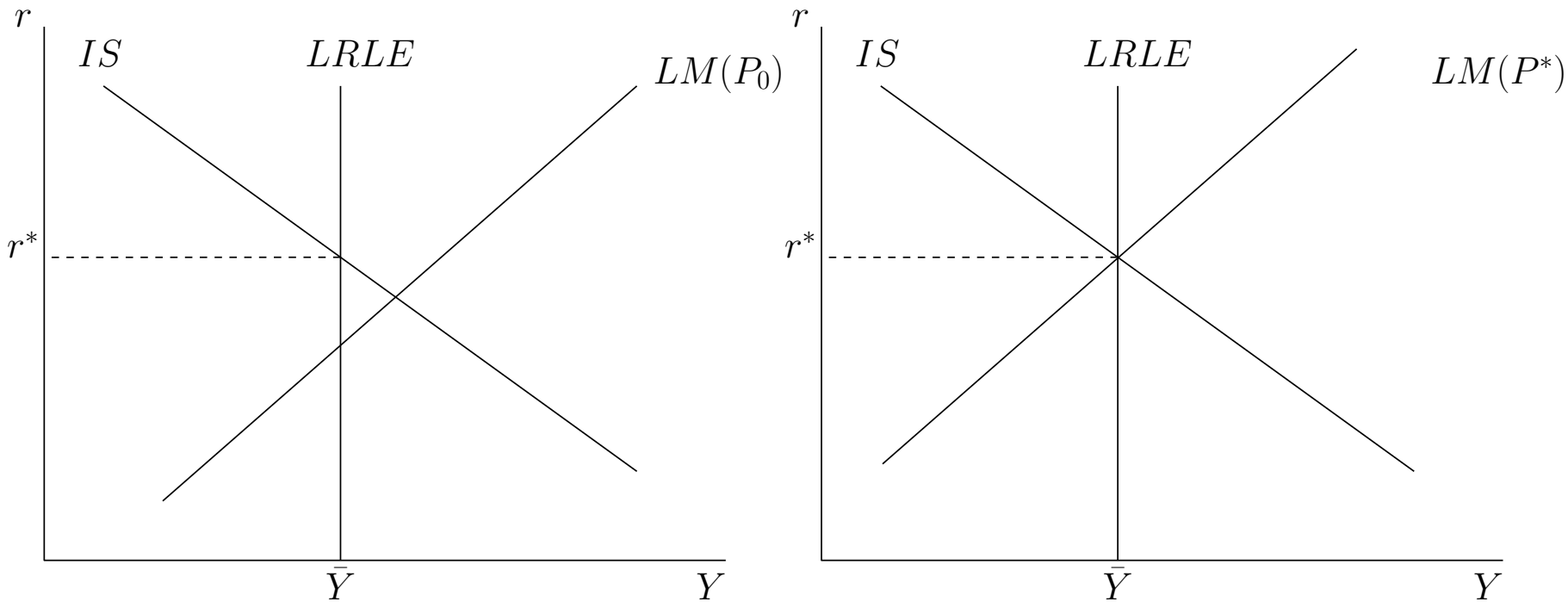
$$Y = \bar{Y}(\mu, \bar{z}) \tag{LRLE}$$

$$Y = \bar{C} + c(Y - \bar{T}) + a - br + \bar{G} \tag{IS}$$

$$\frac{\bar{M}}{P} = Y L(r + \pi^e). \tag{LM}$$

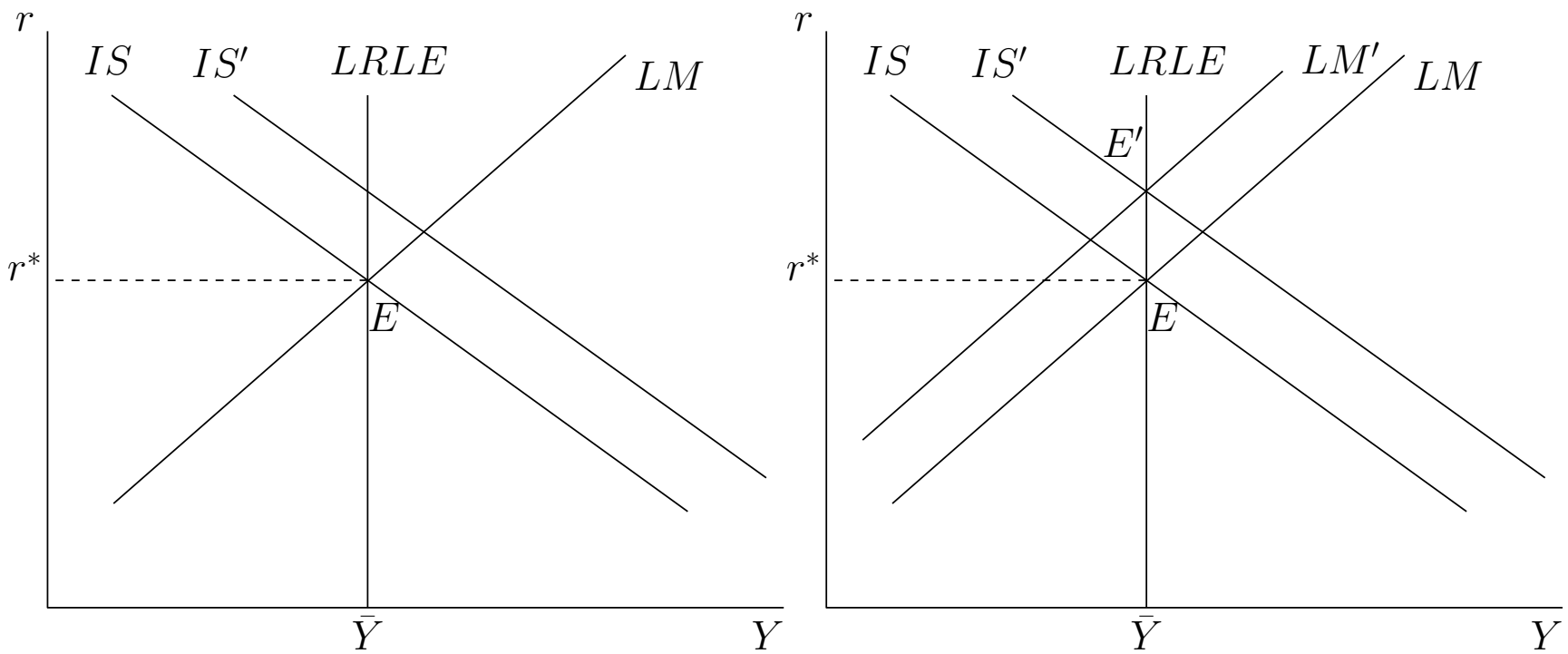
- For given π^e the equilibrium is vector $[Y^*, r^*, P^*]$.
- Three equations: Good!
- With Y and r determined on the first two markets, P has to ensure that the money market clears.

LR general equilibrium: graphically



LR effect of goods market shocks I

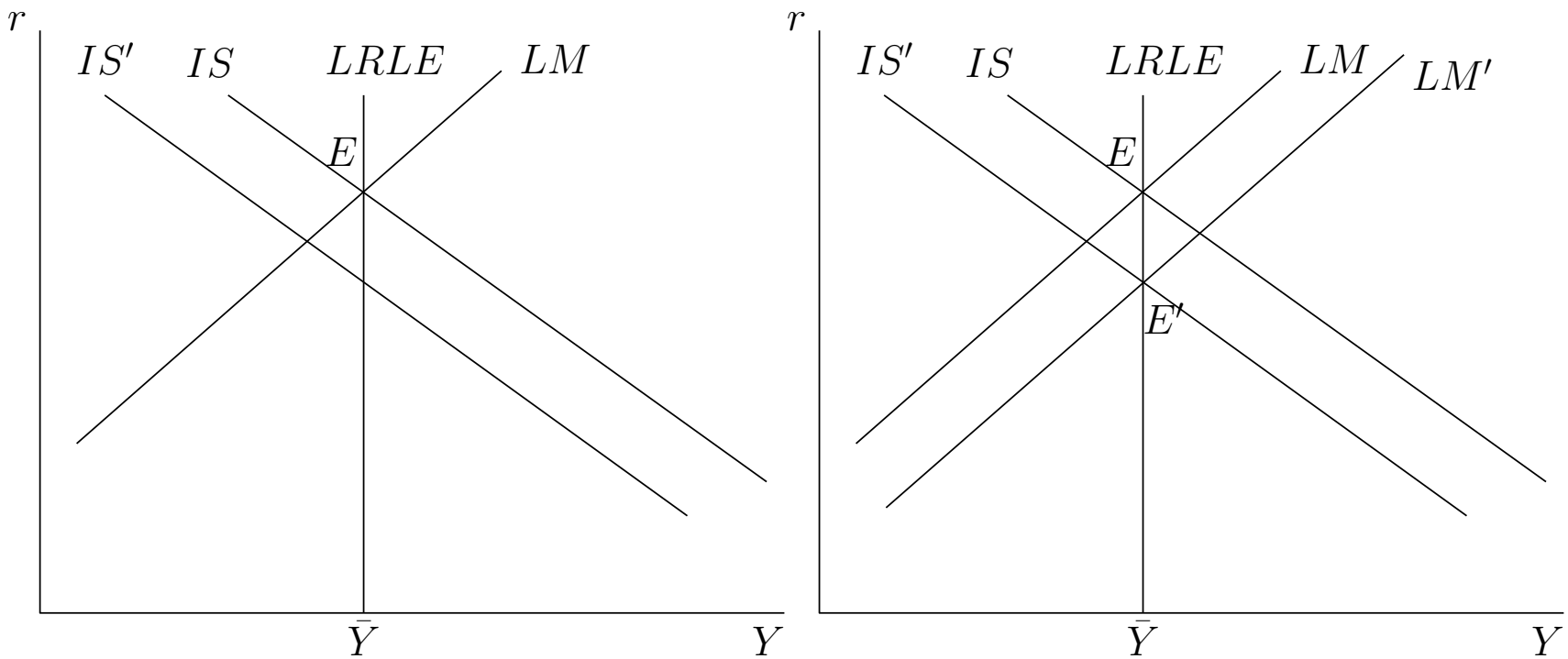
Positive good market shock: e.g. $G \uparrow$ or $a \uparrow$. Wars, investment boom in Spain in the last decade.



- No effect on output.
- Interest rate $\uparrow$ to crowd out investment.
- $P \uparrow$.

LR effect of goods market shocks II

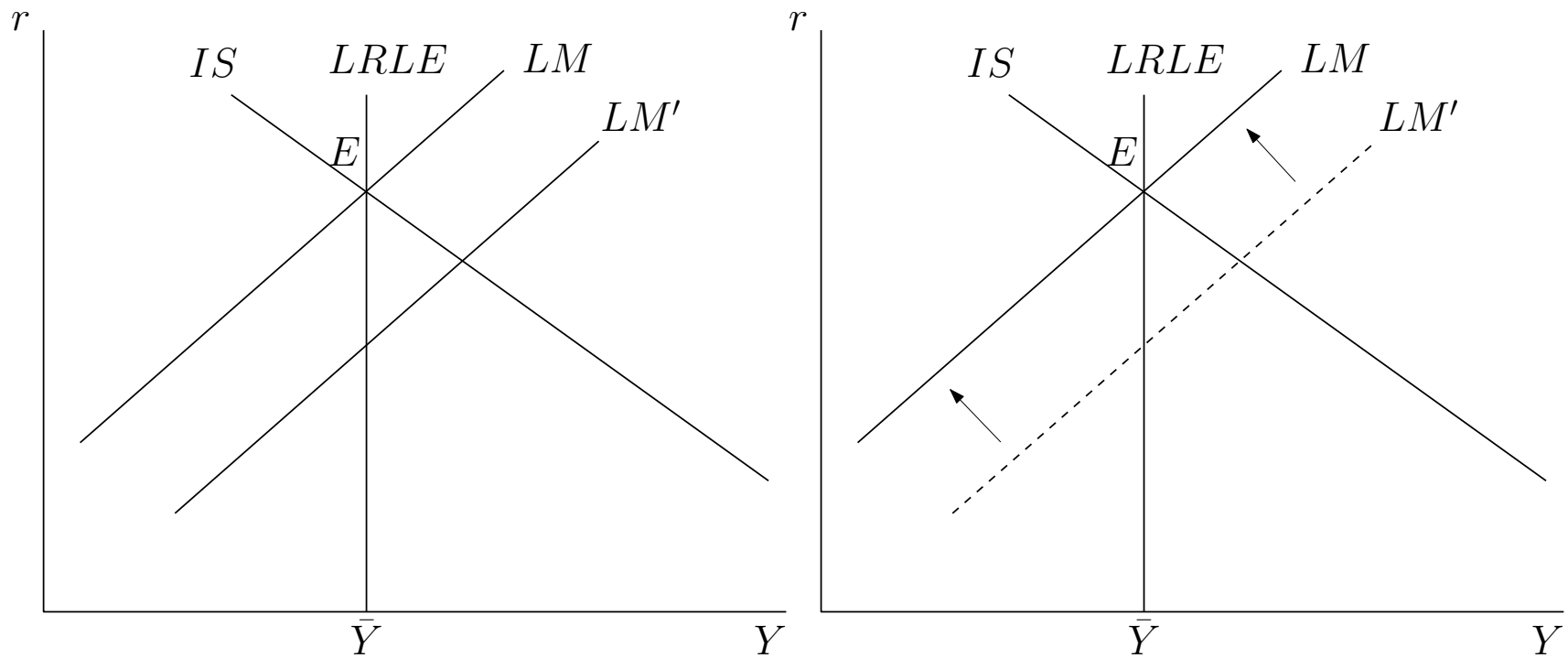
$I = a - b(r + \rho)$. Usually we assume risk-premium $\rho = 0$. $\rho \uparrow$.



- No effect on output.
- Real (risk-free) interest rate $\downarrow$.
- Risk-adjusted rate $r + \rho$ unchanged. I unchanged.
- $P \downarrow$.

LR effect of monetary shocks

Positive money market shock: e.g. $\bar{M} \uparrow$ or exogenous fall in M^d.



- No effect on output.
- No effect on real interest rate.
- $P \uparrow$.
- No effect on **nominal** interest rate. Puzzling?

LR effect of monetary shocks: intuition

- With Y and r determined on the labour and goods market, the real (i.e. measured in units of output) demand for money is fully pinned down.
- Money market equilibrium requires the - real - money supply to adjust to money demand.
- With the nominal money supply M exogenous, the price level P has to clear the money market.

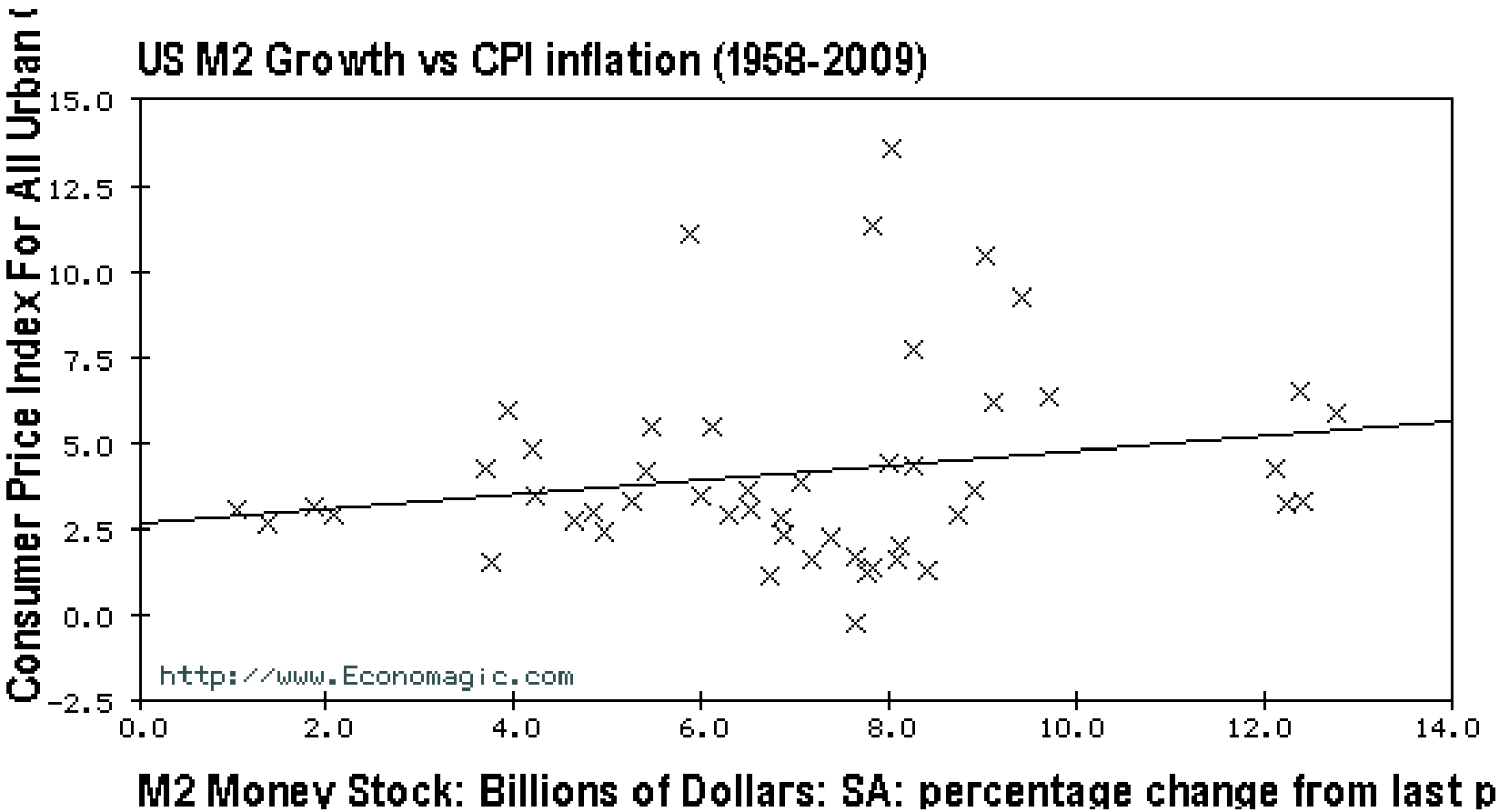
LR effect of monetary shocks: intuition

- P needs to adjust until the LM goes through the intersection of IS and LRLE.
- Money is neutral:
  - it does not affect real variables;
  - itaffects only nominal variables (P and the nominal wage W).
- Classical dichotomy: no need to consider nominal variables to determine real variables.

Inflation and money growth

- Suppose the money supply grows at the constant rate μ.
- The price level grows at the same rate as the money supply.
- Friedman: "Inflation is always and everywhere a monetary phenomenon."
- Not really: also expansionary fiscal policy...
- Yet, money growth *does* generate inflation: e.g. Zimbabwe.

Inflation and money growth: evidence



Expected inflation and money growth

- We have seen that with π^e exogenous, a 1% increase in the rate of money growth increases the (actual) inflation rate by 1%.
- If agents are rational, in the long run their expectations have to catch up with actual inflation.
- Hence, in the long run the **expected** rate of inflation cannot be exogenous. It has to respond to anticipated changes in the rate of money growth.
- In the long run, the expected and actual rate of inflation coincide with the rate of money growth.

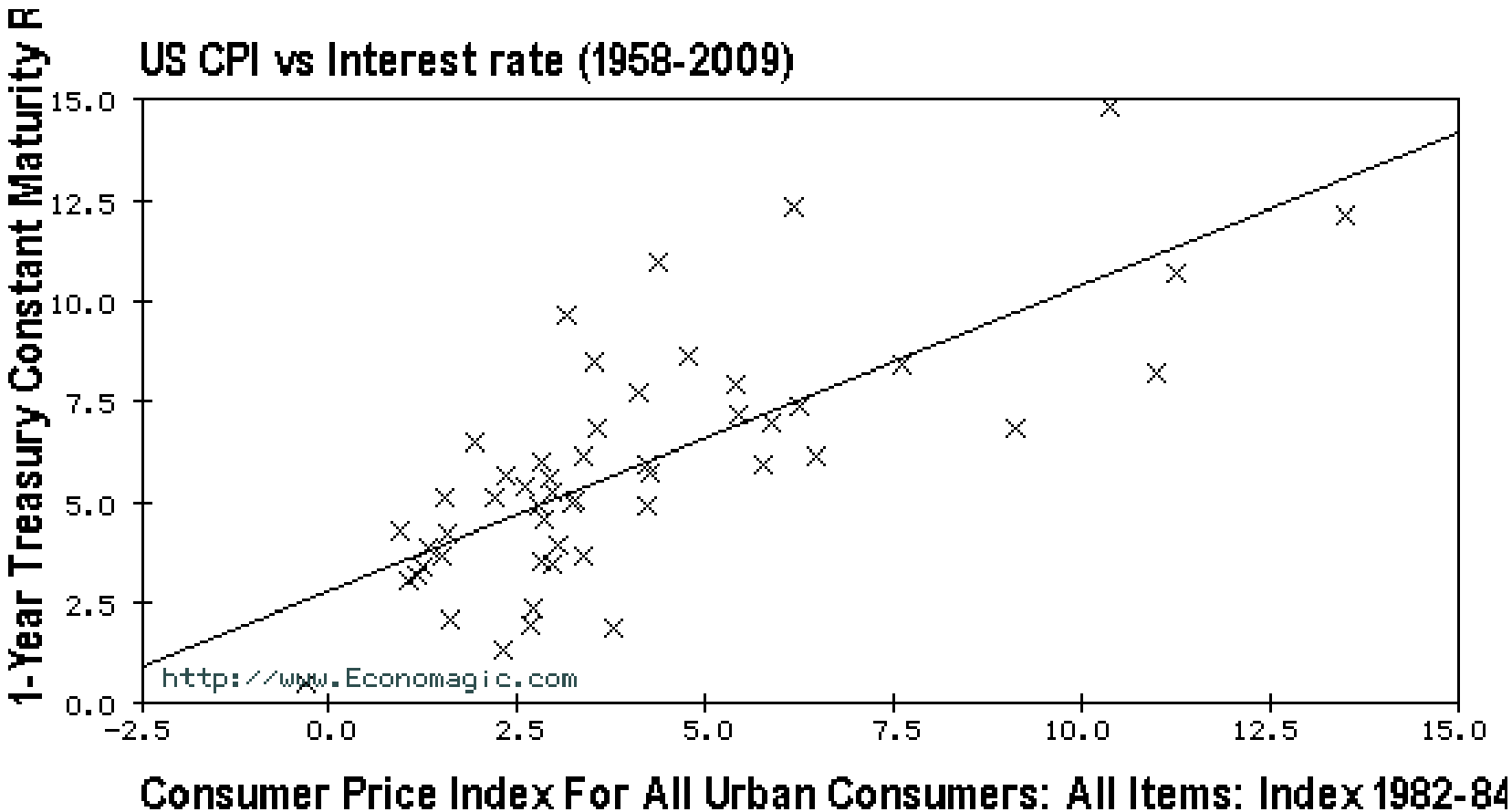
Money growth and nominal interest rates

- In the long run $\pi^e = \pi = \mu$ and from Fischer equation

$$i = r + \pi^e = r + \mu$$

- Money **growth** (though not one-off changes in the **level** of the money supply) does affect nominal interest rates.
- Higher rates of money growth result in higher **nominal** interest rates, as agents need to be compensated for higher expected rates of inflation (Fischer effect).

Money growth and nominal interest rates (evidence)



General equilibrium: a different representation

- Since one of the variables which is determined in equilibrium is the price level P it is useful to have P on one of the axes.
- The other variable we want to have on one of the axes is output Y.
- To do this we need we need counterparts of the LRLE, IS and LM curves in the (Y, P) space.

The long run aggregate supply curve

- The counterpart of the LRLE must be a curve which describes long run labour market equilibrium. Such a curve is called **long run aggregate supply (LRAS)**.
- **LRAS:** locus of combinations of P and Y for which the labour market is in long run equilibrium.
- Since

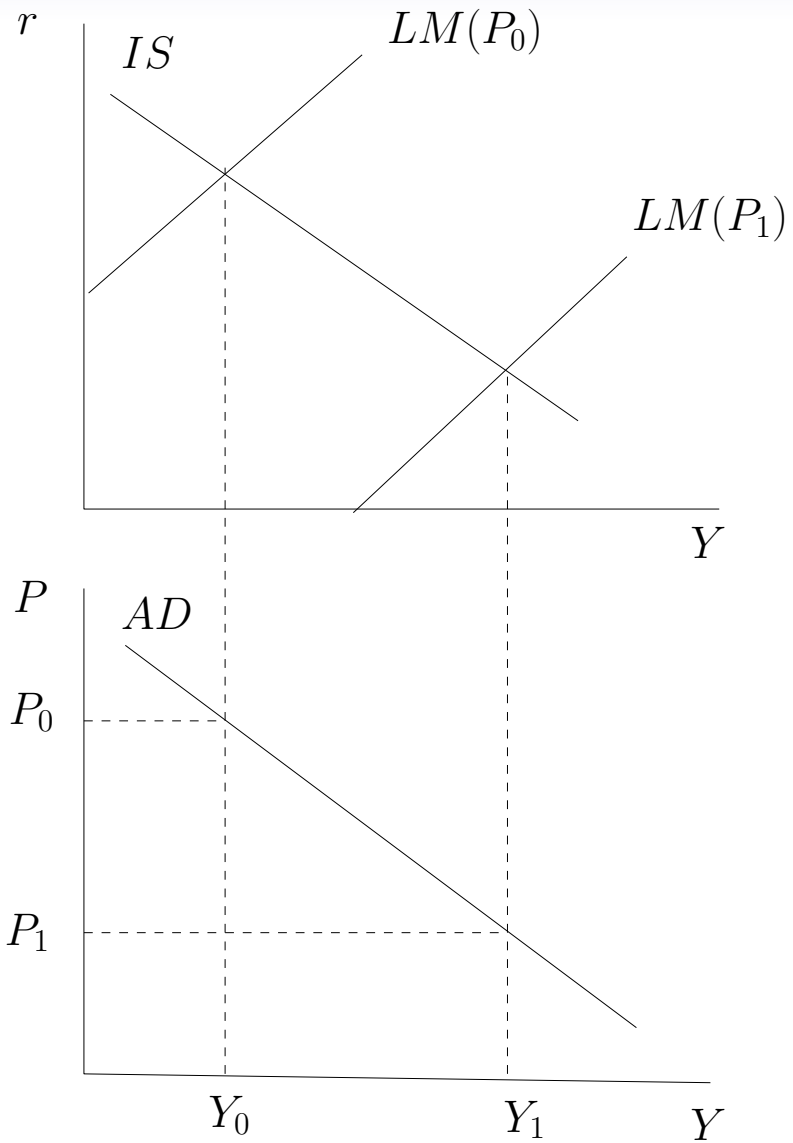
$$Y = \bar{Y}(\bar{z}, \bar{\mu})$$

is independent of the price level, the LRAS is vertical in the (Y, P) space.

Aggregate demand

- Now we want to construct the counterpart of the IS and LM curves in the (Y, P) space.
- One way of doing so uses the **aggregate demand** (**AD**) curve.
- **AD:** combinations of P and Y for which both the goods and financial (money) markets are in equilibrium.
- One curve describes equilibrium on two markets (so it cannot contain more information than the IS and LM).

Deriving the AD curve: graphical construction



The mechanics of the AD curve

- All variables that shift the IS curve to the right, shift the AD curve in the same direction: i.e. all components of $\bar{Z}$.
- All variables that shift the LM curve to the right (except for the **price level**) shift the AD curve in the same direction: i.e. higher $\bar{M}, \pi^e$, an exogenous fall in money demand.
- Changes in the price level are associated with a movement along a given AD curve.

Deriving the AD curve: algebraic construction

- Since the AD demand curve is the locus of intersections of the IS and LM curve for all possible levels of P, it must be the solution to the system

$$Y = \frac{1}{1-c}\left[\bar{Z} - br\right] \tag{IS}$$

$$\frac{\bar{M}}{P} = YL(r + \pi^r) \tag{LM}$$

- We can use the IS curve to recover r. That is

$$r = \frac{\bar{Z} - (1-c)Y}{b}$$

- Replacing in the LM curve we obtain

$$\frac{\bar{M}}{P} = YL\left(\frac{\bar{Z} - (1-c)Y}{b} + \pi^e\right).$$

Deriving the AD algebraically II

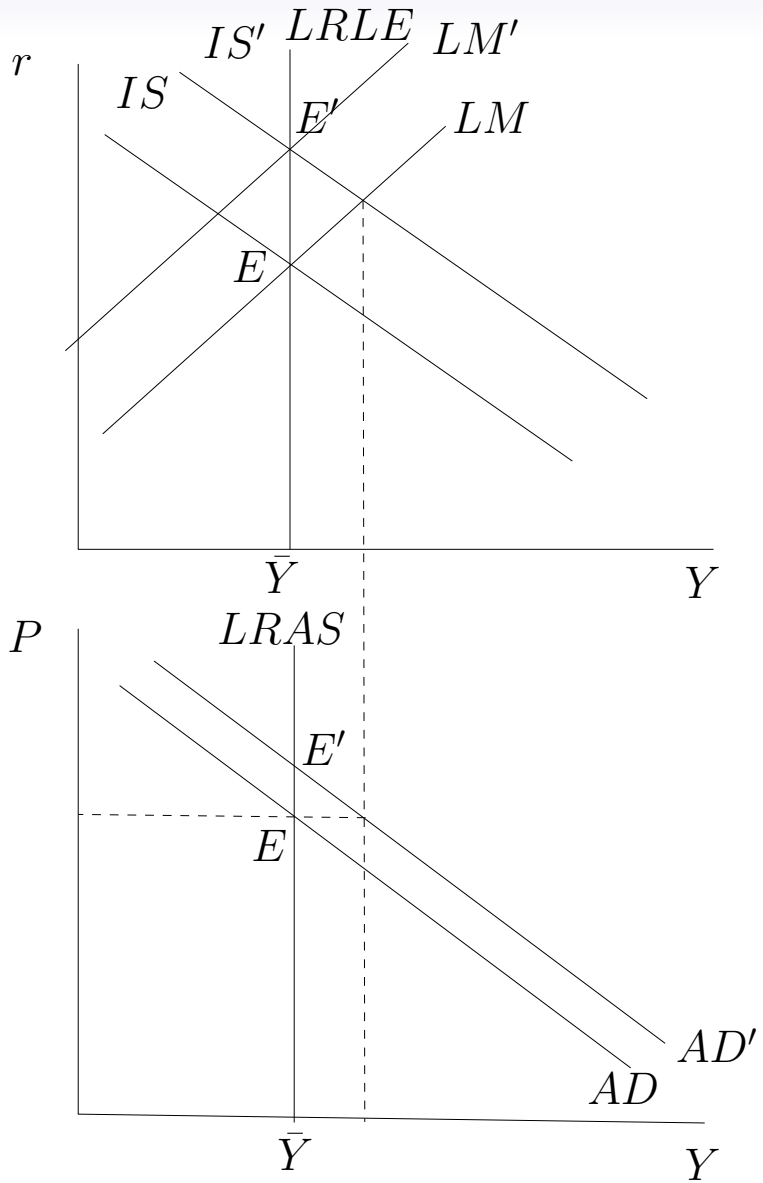
$$\frac{\bar{M}}{P} = YL\left(\frac{\bar{Z} - (1-c)Y}{b} + \pi^e\right).$$

- Since $L(.)$ is a decreasing function, the right hand side of the equation is increasing in Y.
- Downward sloping relationship between P and Y such that both the goods (IS) and money (LM) markets are in eq.
- So we can write the aggregate demand curve as

$$Y = Y^{AD}\left(\frac{\bar{M}}{P}, \bar{Z}, \pi^e\right).$$

- Vertical if $b = 0$; if the IS is vertical.

Fiscal policy shocks using AD and LRAS



Monetary policy shocks in the long run