

## ECO 3302 - Intermediate Macroeconomics

Lecture 14: Aggregate Demand—Applying the IS-LM model

Luis Pérez (luisperez@smu.edu) April 30 & May 2, 2025

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## Introduction

## Introduction

- In previous lectures, we put together the pieces that make the IS-LM model in a first step toward understanding short-run economic fluctuations
  - IS curve represents equilibrium in market for goods and services
  - *LM* curve represents equilibrium in market for real money balances
  - Together, the *IS* and *LM* curves determine interest rate and national income in the short run when the price level is fixed
- ▶ Today, we apply *IS*-*LM* model to analyze:
  - Causes of fluctuations in national income (Ie, how policy variables and shocks affect output)
  - 2. Position and slope of aggregate demand curve
  - 3. Great depression of 1930s (other modern-day recessions in book)

## Explaining Fluctuations with *IS*-*LM* Model

▶ Intersection of *IS* and *LM* curves determines national income

- When one of these curves shift, income fluctuates and economy moves to new short-run equilibrium
- ▶ We now study how changes in policy and shocks affect economy:
  - Policy variables: government spending, taxes, money supply
  - Shocks: animal spirits, financial innovation, financial regulations, ...

$$IS \text{ curve}: \quad Y = C(Y-T) + I(r) + G$$

## $\blacktriangleright$ Consider an increase in government purchases of $\Delta G$

• Gvt-spending multiplier tells us that at any given interest rate:

$$\Delta Y = \frac{1}{1 - MPC} \times \Delta G$$

Recall that when G rises, so do planned expenditures, stimulating production

- *IS* curve shifts to the right (by this amount)
- Economy moves to new equilibrium with higher income and higher interest rate
  - Higher interest rate results from people wanting more money when income rises
  - *LM* curve however doesn't shift because money supply is fixed

Increase in government spending shifts *IS* curve outward and economy moves to new equilibrium with higher income and higher interest rate



## Fiscal policy and the IS curve

Partial-equilibrium income response  $= (1 - MPC)^{-1}\Delta G$ General-equilibrium income response  $< (1 - MPC)^{-1}\Delta G$  (due to eq. responses to  $\uparrow r$ )



## PE income response larger than GE income response due to **crowding-out investment effect** of higher interest rate $(\uparrow r, \downarrow I)$



$$IS \text{ curve}: \quad Y = C(Y-T) + I(r) + G$$

## $\blacktriangleright$ Consider a decrease in taxes of $\Delta T$

- Tax cut encourages consumer to spend more since disposable income higher
- Tax multiplier tells us that at any given interest rate:

$$\Delta Y = \frac{MPC}{1-MPC} \times \Delta T$$

- IS curve shifts to the right (by this amount)
- Economy moves to new equilibrium with higher income and higher interest rate
  - Higher interest rate results from people wanting more money when income rises
  - *LM* curve however doesn't shift because money supply is fixed

# Tax cut shifts *IS* curve outward and economy moves to new equilibrium with higher income and higher interest rate



Partial-equilibrium income response is larger than general-equilibrium response due to **crowding-out investment effect** of higher interest rate ( $\uparrow r, \downarrow I$ )



## Monetary policy and the *LM* curve

$$LM$$
 curve :  $\frac{M}{P} = L(r, Y)$ 

#### $\blacktriangleright$ Consider an increase in the money supply of $\Delta M$

- An increase in M leads to increase in real money balances M/P since P is fixed
- Increase in real money balances leads to lower interest rate at any given income (by theory of liquidity preference)
  - When Fed increases *M*, people have more money than what they want to hold at prevailing interest rate so they start buying interest-paying assets and *r* falls
- · Economy moves to new equilibrium with higher income and lower interest rate
  - Right movement along IS curve because desired investment increases

Increase in money supply shifts *LM* curve downward and economy moves to new equilibrium with higher income and lower interest rate



**Monetary transmission channel**: increase in money supply lowers the interest rate, stimulating investment and thus the demand for goods and services



## Recap: Policy in the *IS-LM* model

- **Fiscal policy** influences income by changing planned expenditures
  - Expansionary fiscal policy ( $\uparrow G$  and/or  $\downarrow T$ ) shifts *IS* curve to the right, resulting in higher income and higher interest rate
  - Contractionary fiscal policy ( $\downarrow G$  and/or  $\uparrow T$ ) shifts *IS* curve to the left, resulting in lower income and lower interest rate
- Monetary policy influences income by changing the interest rate
  - Expansionary monetary policy († *M*) shifts *LM* curve downward, resulting in lower interest rate and higher income
  - Contractionary monetary policy ( $\downarrow M$ ) shifts *LM* curve upward, resulting in higher interest rate and lower income

## Interaction between fiscal and monetary policy

### ▶ In modern economies, there is independence of fiscal and monetary policy

- Fiscal policy carried by government provided it's supported by Congress
- Monetary policy is dictated by the Fed following FOMC recommendations

- However, Fed (government) can respond to fiscal (monetary) policy actions to mitigate/amplify its effects in the economy
  - Typically, the Fed responds to fiscal policy; not the other way around

> We now study one particular example of this interaction between policies

## Interaction between fiscal and monetary policy

- Suppose government raises taxes by  $\Delta T > 0$ 
  - Absent changes in monetary policy, economy contracts and moves to new eq. with lower income and lower interest rate (recession)



#### (a) Fed Holds Money Supply Constant

## Suppose government raises taxes by $\Delta T > 0$

- ...But ultimately what happens to the economy depends on whether there is a monetary policy response that counteracts or amplifies this fiscal policy action:
  - If Fed is committed to hold interest rate constant (say, because of past promises), recession is magnified
  - If Fed is committed to avoid recession, it must expand money supply by the right amount to mitigate contractionary effect of fiscal policy

## Interaction between fiscal and monetary policy

- Suppose government raises taxes by  $\Delta T > 0$ 
  - If Fed is committed to hold interest rate constant (because of past promises), recession is magnified



## Interaction between fiscal and monetary policy

- Suppose government raises taxes by  $\Delta T > 0$ 
  - If Fed is committed to avoid recession, it must expand money supply by the right amount to mitigate contractionary effect of fiscal policy



#### (c) Fed Holds Income Constant

#### Shocks in the *IS*-*LM* model

# Shocks can also cause short-run economic fluctuations by shifting either the *IS* or the *LM* curve

- Shocks to the IS curve are exogenous changes in demand for goods & services
  - Keynes emphasized animal spirits: changes in consumers' and/or firms' sentiments regarding future (eg, changes in *C*, changes in *I*, ...)
- Shocks to the LM curve are exogenous changes in demand for money
  - Financial innovation can change amount of money people want to hold in cash (eg, availability of Robinhood and Acorns moves portfolios away from cash)
  - Financial regulation can change amount of money people want to hold in cash (eg, restrictions on credit move people's portfolios toward cash)

## Policymakers can use fiscal & monetary policy tools to undo effect of shocks

## ▶ We said that the Fed can influence economy by altering the money supply

- ▶ In the news, however, you'll read that the Fed raises or cuts interest rates
- ► In practice, both statements are correct. Monetary policy works as follows:
  - FOMC meets and sets target for the Fed funds rate (FFR) (FFR is the interest rate at which banks loan to one another overnight)
  - To reach FFR target, Fed changes money supply according to IS-LM discussion

## Monetary policy: FFR and money supply

#### To achieve its FFR target $(r_2)$ , Fed expands money supply and LM curve shifts right



## IS-LM as a Theory of Aggregate Demand

## IS-LM as a theory of aggregate demand

- Used IS-LM model to explain short-run income fluctuations when price level is fixed
- Can also use IS-LM model to explain position and slope of AD curve by allowing fluctuations in the price level
  - Recall AD curve gives (downward-sloping) relationship b/w price level & income
- ▶ How does a price change affect the equilibrium in the *IS*-*LM* model?
  - For given money supply M, a higher price reduces supply of real money M/P
  - Lower supply of real money balances shifts LM curve upward
  - Such shift raises interest rate and lowers income

#### AD curve shows equilibrium points in IS-LM model as we vary the price level



## Shifts in the aggregate demand curve

- Events that cause the *IS* or the *LM* curve to shift for a given price level cause the AD curve to shift as well. Examples:
  - Monetary policy. Increase in money supply M shifts LM curve to the right
    - Economy moves to new equilibrium with higher income and lower interest rate
    - Because price level is fixed and income is higher, AD curve must shift right
  - Fiscal policy. Increase in gvt spending shifts IS curve to the right
    - Economy moves to new equilibrium with higher income and higher interest rate
    - Because price level is fixed and income is higher, AD curve must shift right
- ▶ We now see these examples graphically

## Expansionary monetary policy $(\uparrow M)$ shifts LM and AD curves outward



### Expansionary fiscal policy $(\uparrow G)$ shifts IS and AD curves outward



## **Recap:** The *IS*-*LM* model and the aggregate demand curve

- When prices are fixed, a change in income in the IS-LM model resulting from (fiscal or monetary) policy or shocks represents a shift in the AD curve
  - Expansionary fiscal/monetary policy shifts the AD curve to the right
  - Contractionary fiscal/monetary policy shifts the AD curve to the left

- When prices fluctuate, a change in income in the IS-LM model represents a movement along the AD curve
  - + For given money supply M, a price change alters the supply of real money M/P
  - A change in real money balances causes shifts the position of the LM curve
  - Such shift causes movements in equilibrium output and interest rate

- IS-LM model designed to understand economic fluctuations and appropriate policy responses in the short run when prices are fixed
- Can also use model to study economy in long run when prices are flexible
  - Keynesian (*IS-LM* model in the long run) vs. classical theory
  - Keynesian theory: prices are stuck and output may deviate from its natural level
  - Classical theory: prices are flexible & adjust so output is always at natural level

In short run, prices are stuck at  $P_1$  and the equilibrium of the economy is KIn long run, prices are flexible and the equilibrium of the economy is C



## Keynesian vs. Classical theory

#### Two common equations:

$$Y = C(Y - T) + I(r) + G (IS \text{ curve})$$
  
$$\frac{M}{P} = L(r, Y) (LM \text{ curve})$$

#### ▶ Two equations and three endogenous variables: *Y*, *P*, *r*

- Exogenous (fiscal and monetary policy) variables: T, G, M
- + Parameters governing consumption, investment & money demand functions
- Third equation needed to complete/close model
  - Keynesian theory (short run):  $P = \overline{P}$  (sticky prices) so Y and r adjust
  - Classical theory (long run):  $Y = \overline{Y}$  (output at natural level) so P and r adjust

▶ We said that *IS-LM* theory was formulated by (Keynesian) economists in response to the Great Depression, which Classical theory couldn't explain

Let's try to understand the depression through the *IS-LM* model!

Year	Unemployment	Real GNP	Consumption	Investment	Government	Nominal	Money supply	Price level	Inflation	Real money
	rate				expenditures	interest rate				balances
1929	3.2	203.6	139.6	40.4	22.0	5.9	26.6	50.6	_	52.6
1930	8.9	183.5	130.4	27.4	24.3	3.6	25.8	49.3	-2.6	52.3
1931	16.3	169.5	126.1	16.8	25.4	2.6	24.1	44.8	-10.1	54.5
1932	24.1	144.2	114.8	4.7	24.2	2.7	21.1	40.2	-9.3	52.5
1933	25.2	141.5	112.8	5.3	23.3	1.7	19.9	39.3	-2.2	50.7
1934	22.0	154.3	118.1	9.4	26.6	1.0	21.9	42.2	7.4	51.8
1935	20.3	169.5	125.5	18.0	27.0	0.8	25.9	42.6	0.9	60.8
1936	17.0	193.2	138.4	24.0	31.8	0.8	29.6	42.7	0.2	62.9
1937	14.3	203.2	143.1	29.9	30.8	0.9	30.9	44.5	4.2	69.5

▶ Was the depression caused by an inward shift of the *IS* curve or *LM* curve?

• **Spending hypothesis**: it was the *IS* curve! The decline in output coincided with a falling interest rate (perhaps due to firms' and consumers' pessimism)

Year	Unemployment	Real GNP	Consumption	Investment	Government	Nominal	Money supply	Price level	Inflation	Real money
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- **Spending hypothesis**: it was the *IS* curve! The decline in output coincided with a falling interest rate (perhaps due to firms' and consumers' pessimism)
- Consumption fell in response to 1929 stock market crash (↓wealth, ↑uncertainty)

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- **Spending hypothesis**: it was the *IS* curve! The decline in output coincided with a falling interest rate (perhaps due to firms' and consumers' pessimism)
- Investment fell mostly because residential boom of 1920s came to an end

Year	Unemployment	Real GNP	Consumption	Investment	Government	Nominal	Money supply	Price level	Inflation	Real money
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- **Spending hypothesis**: it was the *IS* curve! The decline in output coincided with a falling interest rate (perhaps due to firms' and consumers' pessimism)
- Bank failures and Fed's reluctance to act as lender of last resort led to further contractions in investment and consumption

Year	Unemployment	Real GNP	Consumption	Investment	Government	Nominal	Money supply	Price level	Inflation	Real money
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- **Spending hypothesis**: it was the *IS* curve! The decline in output coincided with a falling interest rate (perhaps due to firms' and consumers' pessimism)
- Fiscal policy was not appropriate: government cut spending and raised taxes with Revenue Act of 1932

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- Money hypothesis: it was the *LM* curve! The decline in output coincided with a fall in the money supply (the Fed's monetary policy was inappropriate!)
- From 1929 to 1933, output fell by 30% and the money supply by 25%

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- Was the depression caused by an inward shift of the IS curve or LM curve? (Spending hypothesis vs. money hypothesis)
  - Two problems with the money hypothesis:
    - 1. Real money balances rose from 1929 to 1931 (so it can't explain initial downturn)

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- Was the depression caused by an inward shift of the IS curve or LM curve? (Spending hypothesis vs. money hypothesis)
  - Two problems with the money hypothesis:
    - 1. Real money balances rose from 1929 to 1931 (so it can't explain initial downturn)
    - 2. Interest rates fell throughout (and LM shift requires rising interest rate)

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#### **Recap: The Great Depression**

- The Great Depression was caused by inadequate aggregate spending (spending hypothesis triumphs over money hypothesis)
  - Decline in output coincided with falling interest rate
  - This is consistent with *IS* curve shift, not with *LM* curve shift (*LM* shift requires rising interest rates)
- ▶ Factors that contributed to the depression:
  - 1929 stock market crash led consumers to save more to rebuild/protect wealth
  - Residential investment boom of 1920s came to end
  - Inadequate (contractionary) fiscal policy: lower gvt spending & higher taxes
  - Inadequate monetary policy: it fell short

#### ▶ We overlooked an important factor: the price level fell 22% from 1929 to 1933

Year	Unemployment	Real GNP	Consumption	Investment	Government	Nominal	Money supply	Price level	Inflation	Real money
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> Many economists argue deflation is to blame for the severity of the recession

▶ How do changes in prices affect income in the *IS*-*LM* model?

**Falling prices have stabilization effect in** *IS-LM* **model** (ie, they raise income):

- Given money supply M, a lower price rises real money balances M/P
- This shifts the LM curve to the right
- Resulting in lower interest rates and higher income

**Pigou effect** is another channel through which falling prices expand income:

- Pigou argued that as prices fall, real money balances rise
- This rise in real money balances makes consumers feel wealthier & spend more
- Higher spending shifts the *IS* curve to the right
- Resulting in higher interest rates and higher income
- ► If IS-LM stabilization effect of falling prices dominates Pigou effect, money hypothesis could account for Great Depression (since  $\downarrow M \Rightarrow \downarrow P$ ) 40/50

#### **But falling prices can also have destabilizing effects** (ie, reduce income) :

- 1. **Debt-deflation theory**: Unanticipated changes in price level redistribute wealth between debtors and creditors
  - Real value of debt = Nominal value of debt / P
  - If price level falls (rises), real value of debt rises (falls)
  - So creditor receives larger (smaller) amount in real terms
  - If debtors and creditors have different MPCs, aggregate consumption changes (debtors typically have higher MPCs than debtors, so fall in P lowers C)
  - Unanticipated fall in prices shifts *IS* curve to the left, resulting in lower interest rate and lower income (if MPC of debtors > MPC of creditors)

**But falling prices can also have destabilizing effects** (ie, reduce income) :

- 2. Changes in expected inflation shift the  ${\it IS}$  curve
  - Augmented IS-LM model:

$$Y = C(Y - T) + I(i - \mathbb{E}\pi) + G$$
 (IS curve)  
$$M/P = L(i, Y)$$
 (LM curve)

Investment now depends on *ex-ante* real interest rate and money demand on nominal interest rate (where  $\mathbb{E}\pi$  is expected inflation)

- If price level expected to remain constant (ie,  $\mathbb{E}\pi = 0$ ), usual *IS*-*LM* model
- If price level expected to fall (ie,  $\mathbb{E}\pi < 0$ ), real interest rate becomes higher for given nominal interest, which depresses investment and shifts *IS* curve to the left
- Expected fall in prices shifts IS curve left, resulting in lower interest and income

#### Expected fall in prices shifts IS curve left, resulting in lower interest and income



### ▶ The falling money supply can possibly be responsible for the 1930s deflation

Year	Unemployment	Real GNP	Consumption	Investment	Government	Nominal	Money supply	Price level	Inflation	Real money
	rate				expenditures	interest rate				balances
1929	3.2	203.6	139.6	40.4	22.0	5.9	26.6	50.6	_	52.6
1930	8.9	183.5	130.4	27.4	24.3	3.6	25.8	49.3	-2.6	52.3
1931	16.3	169.5	126.1	16.8	25.4	2.6	24.1	44.8	-10.1	54.5
1932	24.1	144.2	114.8	4.7	24.2	2.7	21.1	40.2	-9.3	52.5
1933	25.2	141.5	112.8	5.3	23.3	1.7	19.9	39.3	-2.2	50.7
1934	22.0	154.3	118.1	9.4	26.6	1.0	21.9	42.2	7.4	51.8
1935	20.3	169.5	125.5	18.0	27.0	0.8	25.9	42.6	0.9	60.8
1936	17.0	193.2	138.4	24.0	31.8	0.8	29.6	42.7	0.2	62.9
1937	14.3	203.2	143.1	29.9	30.8	0.9	30.9	44.5	4.2	69.5

► If deflation has overall destabilizing effects on output, it can shift *IS* curve, resulting in lower output and a lower interest rate

▶ In this case, the money hypothesis may triumph over (or reign with) the spending hypothesis in explaining the Great Depression!

#### ▶ In the 1930s, interest rates in the US were very close to zero

Year	Unemployment	Real GNP	Consumption	Investment	Government	Nominal	Money supply	Price level	Inflation	Real money
	rate				expenditures	Interest rate				balances
1929	3.2	203.6	139.6	40.4	22.0	5.9	26.6	50.6	_	52.6
1930	8.9	183.5	130.4	27.4	24.3	3.6	25.8	49.3	-2.6	52.3
1931	16.3	169.5	126.1	16.8	25.4	2.6	24.1	44.8	-10.1	54.5
1932	24.1	144.2	114.8	4.7	24.2	2.7	21.1	40.2	-9.3	52.5
1933	25.2	141.5	112.8	5.3	23.3	1.7	19.9	39.3	-2.2	50.7
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1937	14.3	203.2	143.1	29.9	30.8	0.9	30.9	44.5	4.2	69.5

► A similar situation occurred in the Great Recession of 2008–09

(From 2008 to 2016, the Fed funds rate was basically zero; see here)

## Liquidity traps and unconventional monetary policy

Economists refer to situations w interest rates close to zero as **liquidity traps** 

- When interest rate is basically zero, monetary policy looses grip (ie, Fed cannot cut interest rates further to stimulate investment)
- Rather than making loans at negative interest rates, people would hold cash
- Even if Fed increases money supply, making the public's asset portfolio more liquid, this liquidity can't have any effect since interest rates can't fall further
- Aggregate demand, production and employment are "trapped"
- Nowadays, it is also common to hear the term "zero lower bound" to refer to the stance of monetary policy (ie, nominal interest rates are close to zero)

## Liquidity traps and unconventional monetary policy

### ▶ What can the Fed do when monetary policy hits the zero lower bound?

- This was basically the question facing the Fed in 2008–09 and in recent years
- Instead of using FFR as its main tool, the Fed can resort to unconventional monetary policy:
  - Forward guidance: Fed can commit to keep interest rate low for long period
  - **Quantitative easing**: Fed can conduct open-market operations in a larger variety of instruments than it normally does:
    - Long-term gvt bonds
    - Mortgage-backed securities
    - Corporate debt

**Taking Stock** 

## Taking stock

- ▶ Applied *IS*-*LM* model to understand causes of fluctuations in income
  - Fiscal policy influences income by affecting planned expenditures
    - Expansionary (contractionary) fiscal policy shifts the *IS* curve to the right (left), resulting in higher (lower) income and higher (lower) interest rate
  - · Monetary policy influences income by affecting interest rate
    - Expansionary (contractionary) monetary policy shifts the LM curve to the right (left), resulting in lower (higher) interest rate and higher (lower) income
  - Although fiscal and monetary policy are independent in modern economies, authorities understand their interaction and policy actions often coordinated
  - Shocks to demand for goods and services (IS curve) and the demand for money (LM curve) also cause economic fluctuations
    - Fiscal and monetary policy can be used to undo/mitigate effects of these shocks

## Taking stock

#### ▶ Used *IS*-*LM* model to explain position and slope of agg. demand curve

- For given money supply, a price change alters real money balances, which in turn shifts LM curve, affecting equilibrium levels of output and interest rates
- When prices allowed to fluctuate, changes in income represent movement alongs *AD* curve
- Short- vs. long-run in the *IS*-*LM* model:
  - Keynesian theory: prices are stuck and output may deviate from its natural level
  - Classical theory: prices are flexible & adjust so output is always at natural level
  - Economy as IS-LM model (ie, IS and LM curves) and two time horizons (short run with  $P = \overline{P}$  and long run with  $Y = \overline{Y}$ ) reflecting different theories

## Taking stock

## ▶ Used *IS*-*LM* model to study causes of Great Depression of 1930s

- Two hypothesis:
  - Recession caused by inadequate aggregate spending, a left shift of the *IS* curve (spending hypothesis)
  - Recession caused by inadequate monetary policy, a left shift of the *LM* curve (money hypothesis)
- Empirical support in favor of spending hypothesis
- Some problems with money hypothesis (rising real money balances and falling interest rates inconsistent with *LM* curve shift)
- But if deflation has destabilizing effects on output, money hypothesis can cause shifts in *IS* curve and also explain the Great Depression

Briefly discussed liquidity traps, zero lower bound, and unconventional MP 50/50

## Questions?

## Thank You!

(Email: luisperez@smu.edu)
(Website: https://luisperezecon.com)