

# **The IS-LM Model**

## **Adding Financial Markets to the Real Side**

# Assumptions

- Continue to ignore aggregate supply
  - Prices/inflation fixed (business cycle assumption)
- Continue to ignore rest of world ( $X=M=0$ )
  - Closed economy/autarky *or* large economy

# Add Financial Sector

- At least two assets necessary
  - Money: liquid, safe, low/zero return
  - Bonds: illiquid, risky, interest return

# Changes to Real Markets

- *Investment* now depends negatively on interest rate because of PV reasons ( $I = I_0 - bi$ )
  - A decline in interest rates ( $i \downarrow$ ) causes investment to rise ( $I \uparrow$ )
  - Hence *multiple* expansion in income

# Other Sectors

- Continue to use same (Keynesian)

*Consumption* function

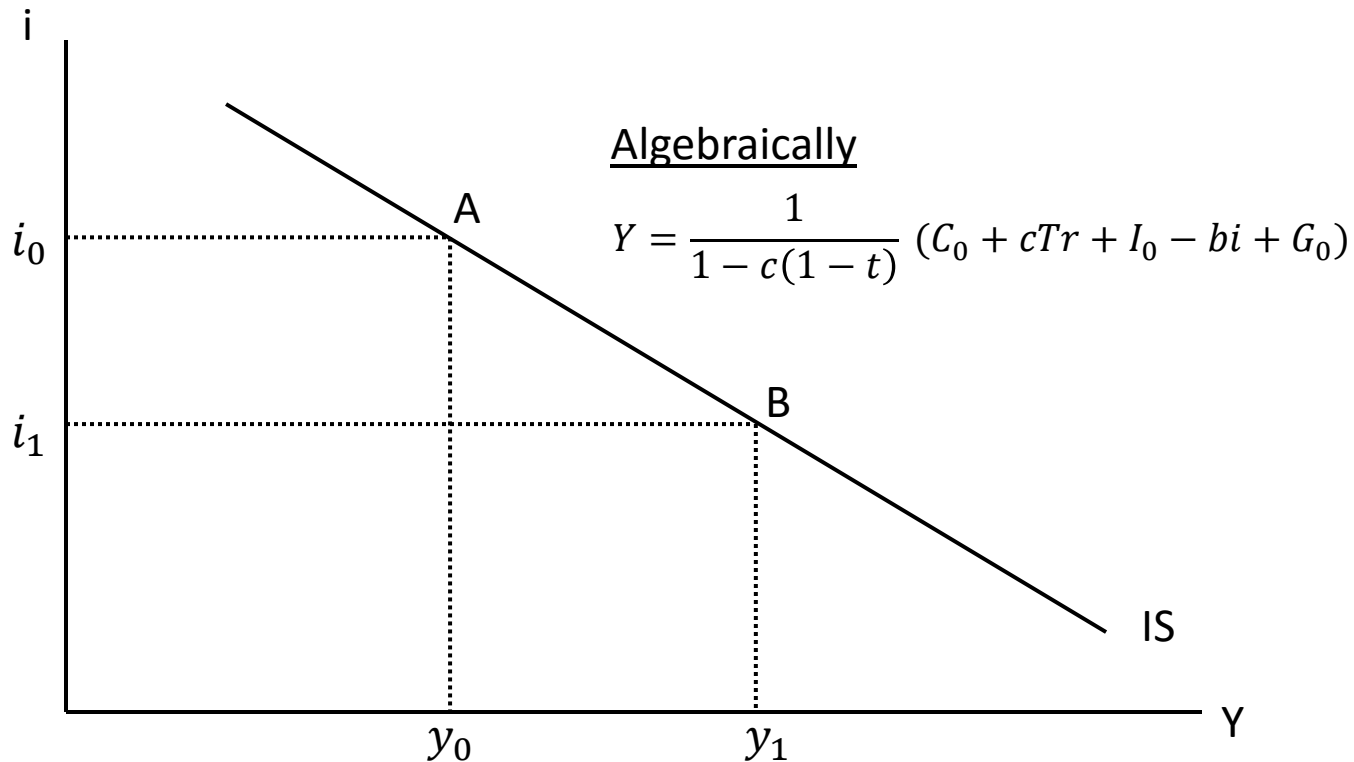
$$- C = C_0 + cY^D = (C_0 + cTr) + c(1-t)Y$$

- Continue to treat G (direct government spending) as exogenous

# Adding It All Up

- $Y=C+I+G$ , but
  - $C = C_0 + cY^D = (C_0 + cTr) + c(1-t)Y$
  - $I = I_0 - bi$
- $Y = (C_0 + cTr) + c(1-t)Y + I_0 - bi + G_0$ , so
- $Y = [1/(1-c(1-t))] * [(C_0 + cTr) + I_0 - bi + G_0]$

# Graphically: IS



Technical Note: this is no longer a “reduced form” or “solution” since interest rates are endogenous and on right-hand side.

# IS: Goods Market Equilibrium

- Name: Investment = Savings – but *only in a closed economy!*
- Equilibrium relationship between interest rate and level of output –the real economy/market for goods and services “clear” and are in equilibrium



# IS Curve

- *Slope* of IS given by impact of change in interest rates on investment and hence output (through multiplier) – likely steep
- *Location* of IS changed by autonomous components of aggregate demand (e.g., autonomous investment,  $I_0$  or fiscal policy,  $G_0$ )
  - Multiplier can also change (taxes, confidence/MPC)

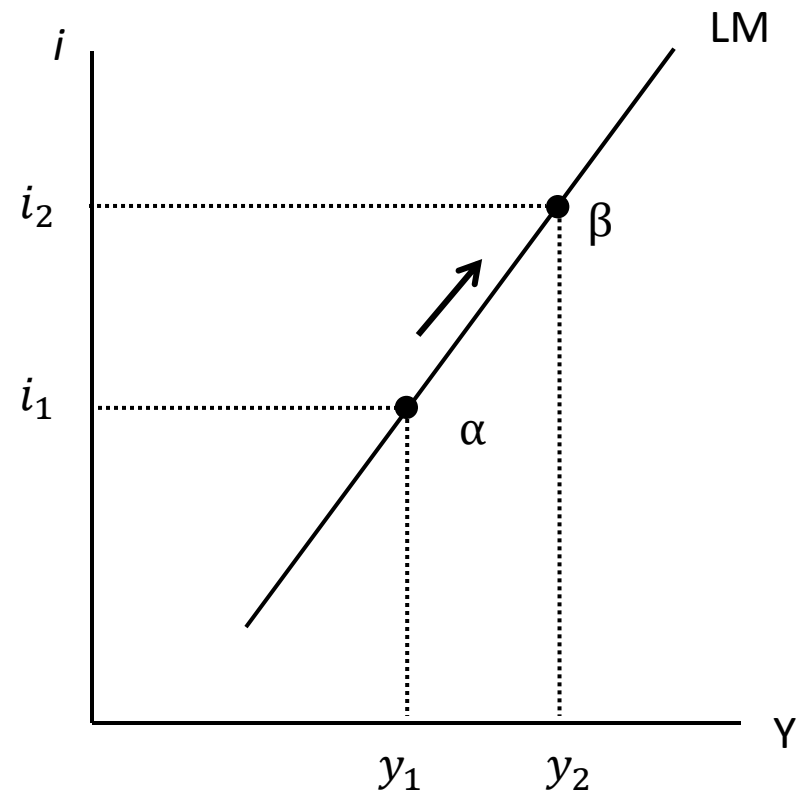
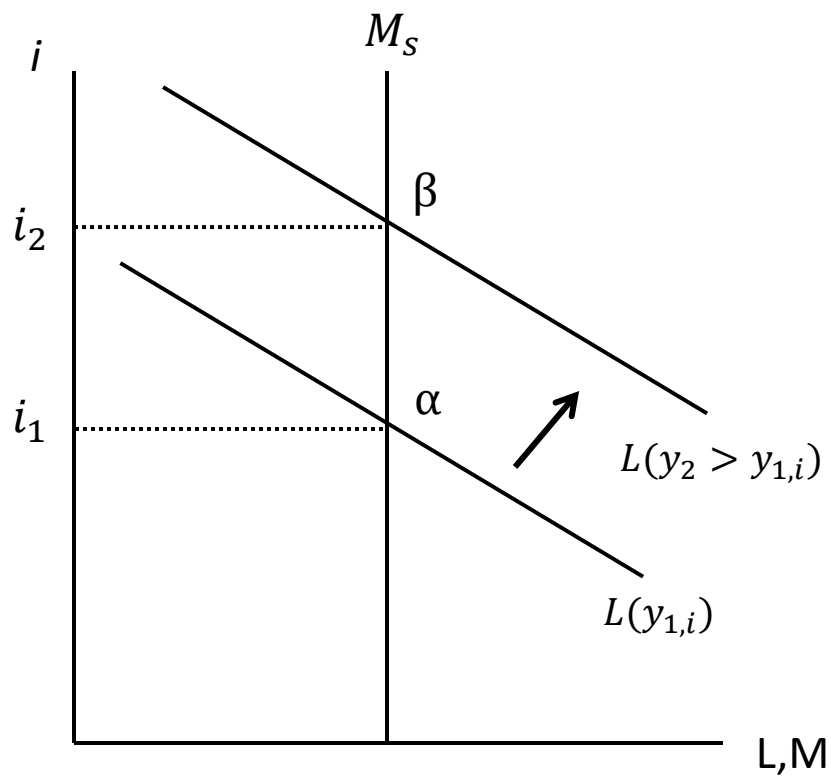
# Financial Market Equilibrium

- *Liquidity Preference* theory: equilibrium portfolios of money and bonds
  - Probably reasonable to assume continuous equilibrium for financial markets (prices move quickly)
  - Money is riskless, liquid but pays no interest
  - Bonds are risky, illiquid and pay interest ( $i$ )
- If money market clears, so does bond market and *vice versa*
  - “Walras' Law”
  - Hence ignore bond market equilibrium if money market in equilibrium

# Money Market Equilibrium

- *Demand for Real Money (Liquidity)*
  - Positive function of real income (transactions demand)
  - Negative (small) function of opportunity cost (interest rate)
- *Real Money Supply* is given by ratio of money supply (determined by central bank) to fixed prices ( $M^s/P$ )

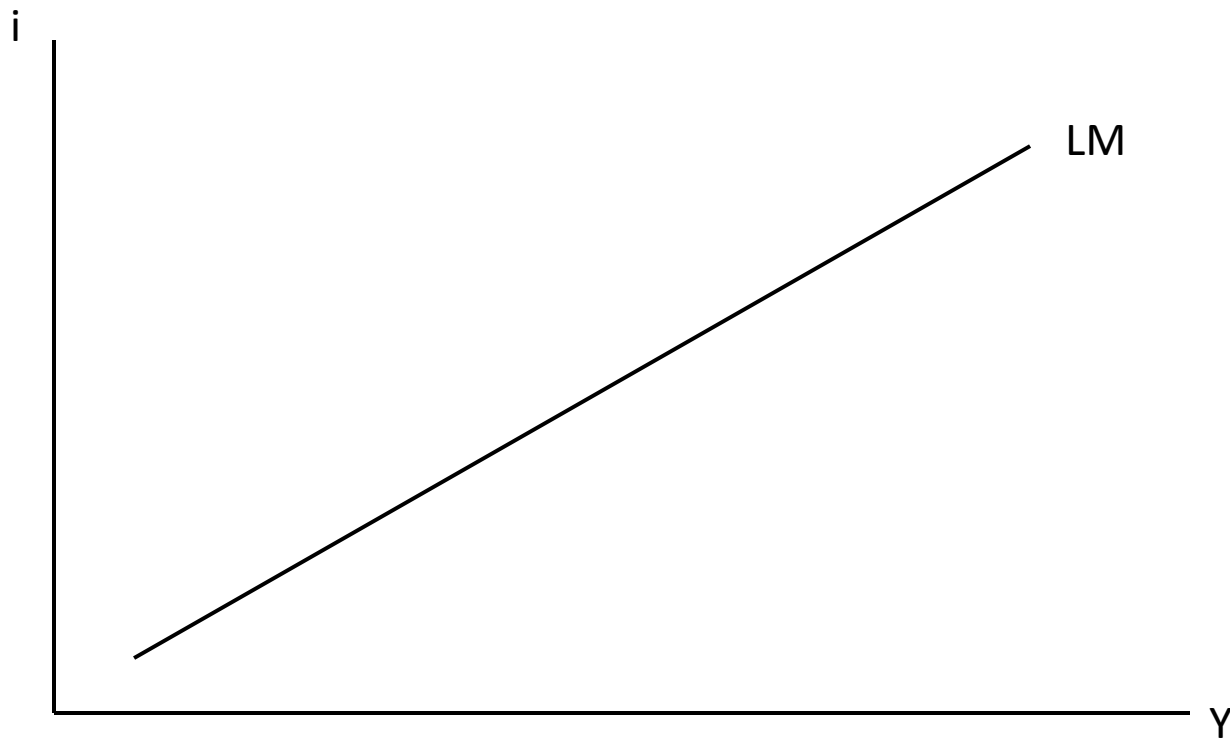
# Money Market Equilibrium



# LM Algebra

- $(M^s/P) = L(i, Y)$

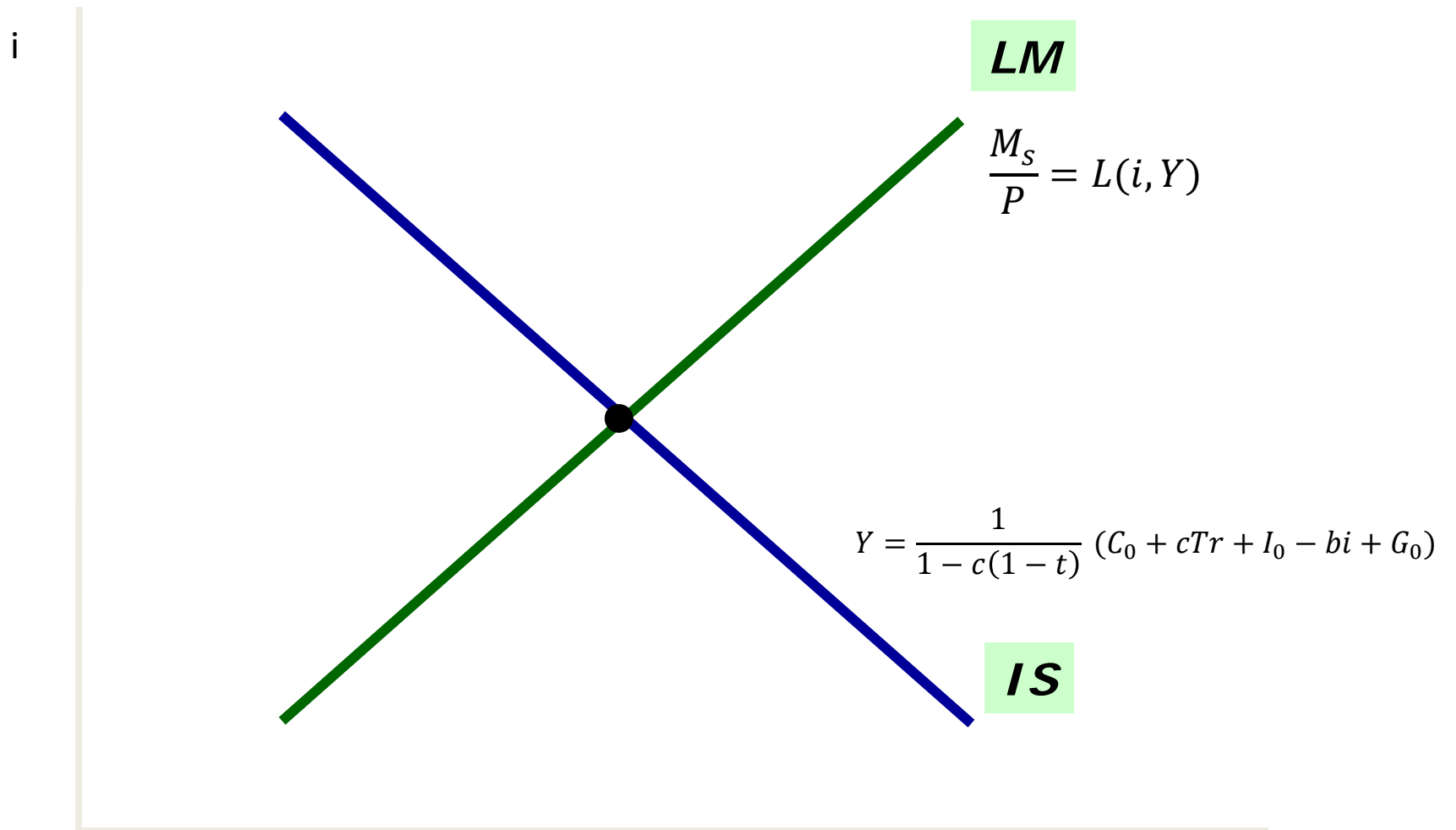
Name: Demand for Liquidity (L) = Money Supply (M)



# More on LM

- *Slope* of LM reflects interest and income elasticities of money demand (likely steep)
- *Location of LM: Expansionary Monetary Policy* raises real balances and hence lowers interest rates at a given level of real income
  - LM curve shifts down and to right

# Together



# IS-LM Equilibrium

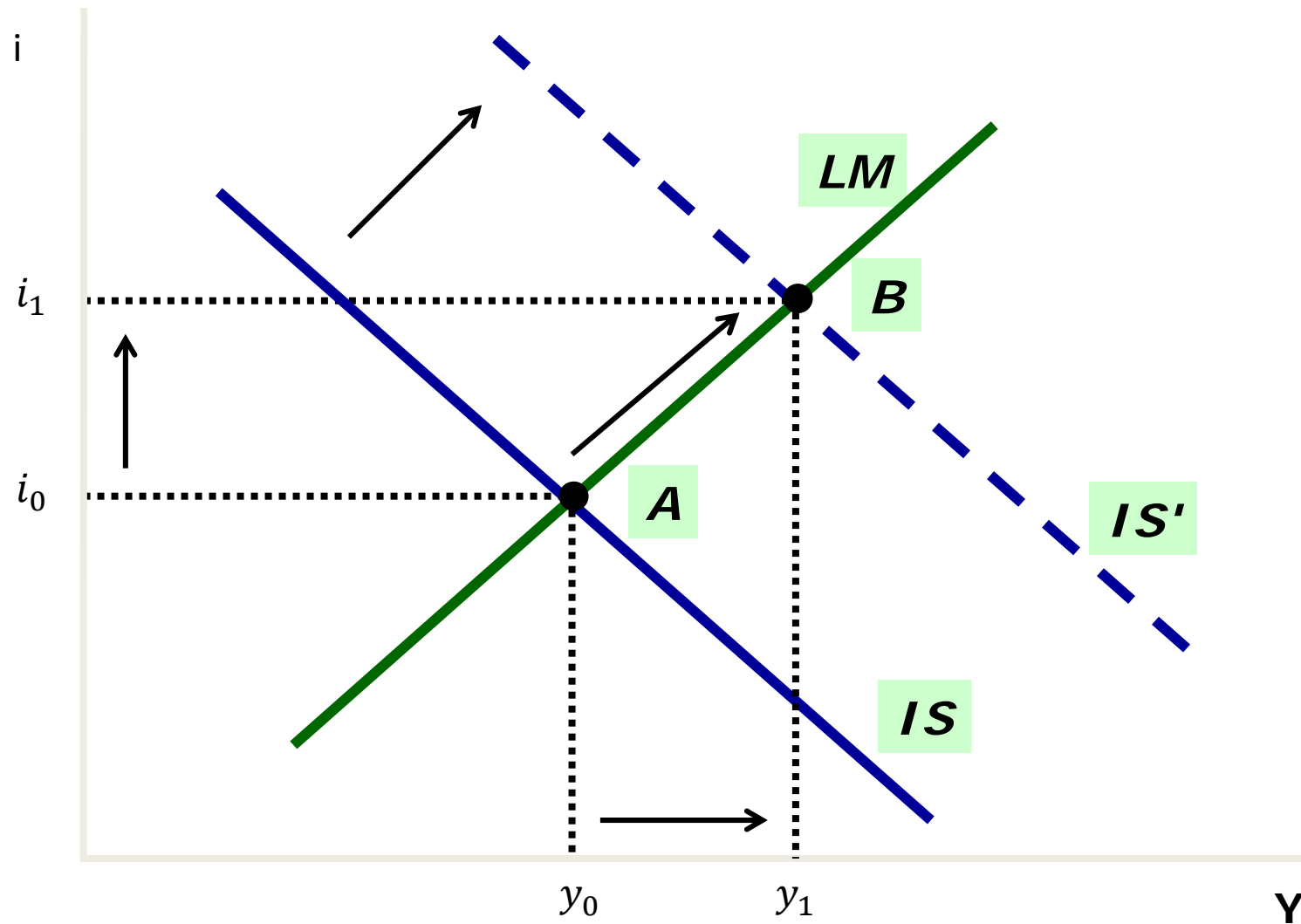
- Both real and financial markets in equilibrium only at intersection of IS and LM curves
- Hence *both* interest rates and output are *endogenous*
  - Things that depend on interest rates (e.g., investment) also endogenous
  - Things that depend on income (e.g., consumption) also endogenous



# Good Question

- How much does output fall if interest rates rise a little (e.g., 100 basis points)?

# Fiscal Policy Shock: $G \uparrow$



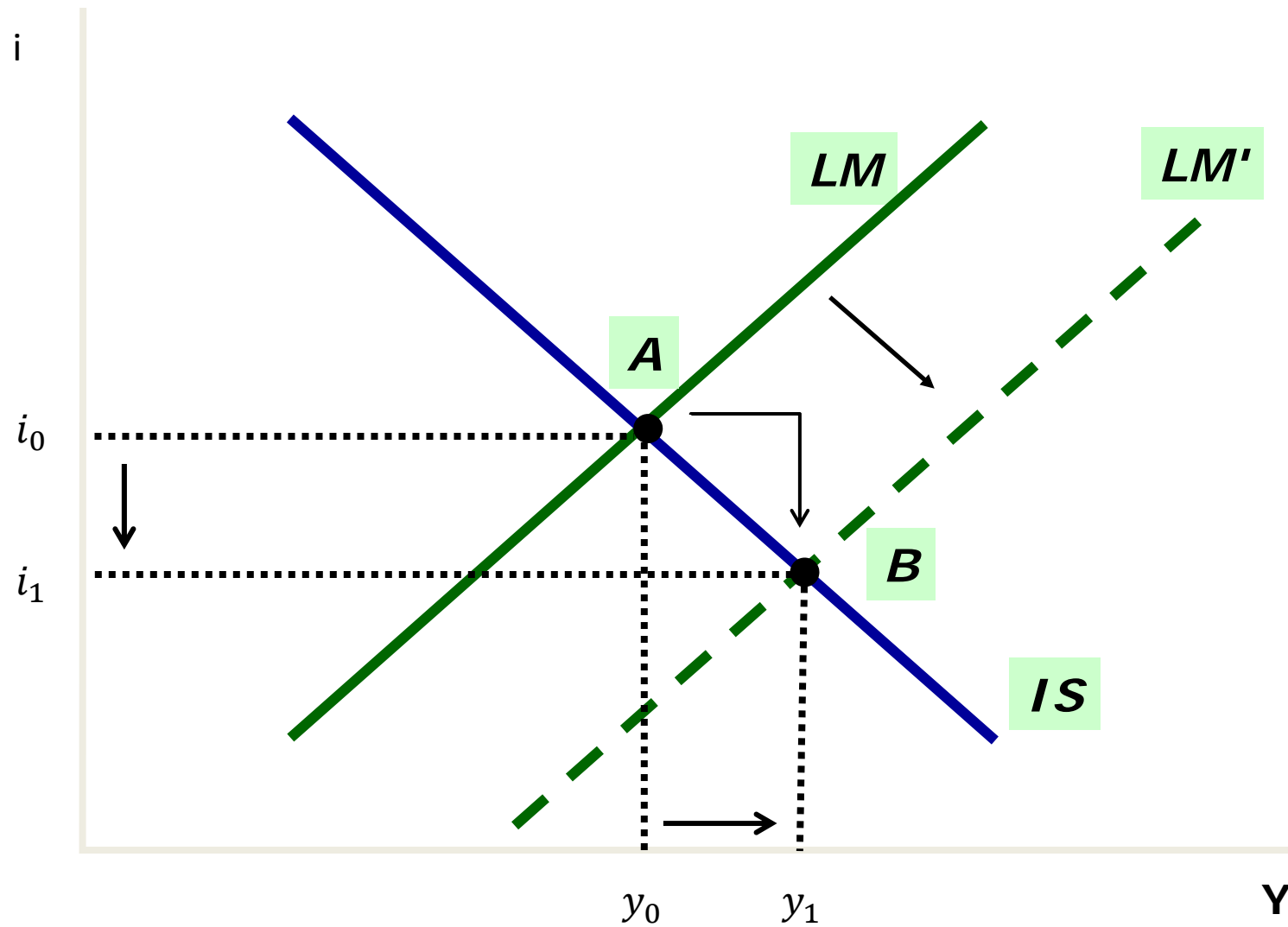
# Discretionary Fiscal Policy

- *Expansionary Fiscal Policy* (e.g., increase in  $G$ )
  - $Y = [1/(1-c(1-t))] * [(C_0 + cTr) + I_0 - bi + G_0]$
  - $G$  rises, shifts IS curve out and to right raising both interest rates and income
  - Extent depends on form of government financing (bonds/taxes/seigniorage – usually treat bonds as default)
    - “Printing Money” implies LM shifts as well
  - Direct government spending “*crowds out*” investment (since interest rates rise)
    - Present crowds out future; also, public crowds out private
  - Can also handle transfers ( $Tr$ ) or taxes ( $t$ )

# Expansionary Monetary Shock: $M \uparrow$

- Money rises, shifts LM curve down/right, lowering interest rates ( $i \downarrow$ ) while raising income ( $Y \uparrow$ )

# Monetary Shock Graphically



# More on Monetary Policy

- Money (M1) is defined as currency held by public and demand deposits
- But central bank doesn't control deposits and hence money (directly)
- Instead, it directly controls a more narrow monetary aggregate

# More on Money Supply

- $M^S = \mu \cdot \text{HPM}$ 
  - $\mu$  is “money multiplier”
    - $\mu$  a function of two ratios (Currency/Deposits), (Commercial Bank Reserves/DD)
    - Usually exogenous, moves slowly
    - Financial crisis may lead to “reserve hoarding” (2008-9)
  - HPM is “high-powered money” or “monetary base” controlled by Central Bank

# High-Powered Money

- Liabilities of central bank:
  - Currency in circulation held by public
  - Commercial bank reserves (CBR)
- Asset side:
  - International Reserves (IR=FX + gold + SDRs)
  - Central Bank Credit (CBC=government debt held by central bank – not *all* treasuries, just those held by central bank)
  - Usually not private bonds/equity except in crisis
- That is,  $HPM \equiv IR + CBC = \text{Currency} + \text{CBR}$

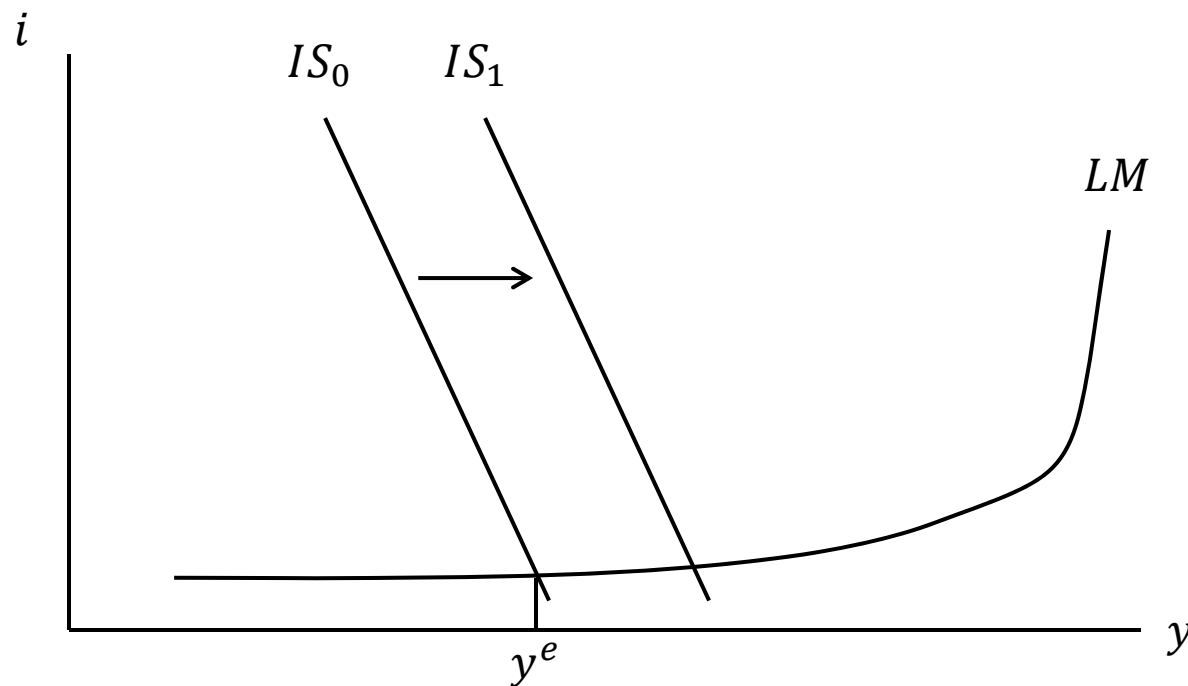


# How Does Central Bank Actually Change Monetary Policy?

- An expansionary “open market operation” consists of central bank sale of Currency/CBR to the public in exchange for increase in CBC (government debt)
- Purchases of government debt raise their price, lower interest rates
  - “Provide liquidity” to markets
- Traditionally at short-maturity end of debt market
  - In US, this is done through “Federal Funds” market
  - Can also do unconventional “Quantitative Easing” at longer maturities – direct central bank purchases of other assets

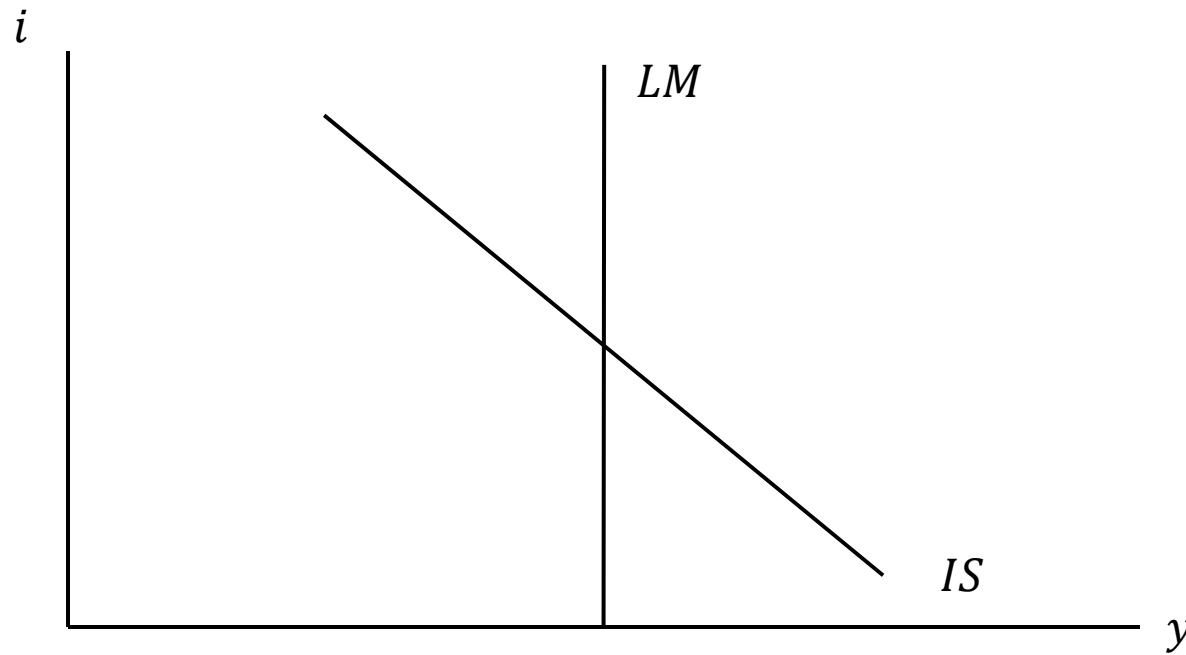
# Exceptional Cases

1. LM may be *flat* at low nominal interest rates
  - Japanese “Liquidity Trap”



# Exceptional Cases

2. LM may be *vertical* if interest rates don't matter
  - “Quantity Theory”



# Two Concluding Notes

- Can derive *Aggregate Demand Curve* by changing prices, shifting LM curve out, raising income
- This all short-run analysis: effects of productivity, capital, labor, and debt accumulate but are ignored in the short run.
  - Remember: *prices are sticky only in short run*

# Key Takeaways

- Interaction of Real and Financial Markets determine both interest rates and output
- Monetary Policy Shocks, open market operations
- Liquidity Trap