

# IV. Models of the business cycle

## b. New Keynesian Economics: Sticky Prices

ECON 4021 - Advanced macroeconomics  
Carleton University  
Christopher Gunn

Winter 2014

## Section 4b Overview

- ▶ In previous chapter we studied flexible price model where all markets cleared (ie prices adjust so that supply equals demand), and money was neutral
- ▶ Keynes argued that wages are prices not perfectly flexible in short-run → “sticky”
- ▶ Since prices clear markets, implies that markets may not clear at all points in time
- ▶ If markets don't clear, economy not optimal, and government intervention could improve economic outcomes

## Section 4b Overview

- ▶ “IS/LM” framework reflected this non-market clearing view
- ▶ Challenged during 1970’s during rational expectations revolution
- ▶ But in 1980’s, researchers incorporated Keynesian ideas into modern micro-founded models
- ▶ During 1990’s, researchers incorporated money, imperfect competition and sticky prices into core RBC model  $\Rightarrow$  “New Keynesian” (NK) models

## Section 4b Overview

- ▶ Primary feature of NK models compared to RBC models is “sticky” prices
- ▶ Prices not flexible to clear markets
- ▶ Yields property that money not neutral
- ▶ Our NK model is essentially Ch.12 intertemporal monetary model, with assumption that prices inflexible  
⇒ Goods market doesn't clear in short-run
- ▶  $\uparrow$  money supply by monetary authority causes  $\uparrow$  output and employment

# Outline

New Keynesian Model

Role of government policy

# Outline

New Keynesian Model

Role of government policy

# New Keynesian Model

- ▶ Start with Ch.12 monetary intertemporal model, and then assume price level sticky in short run  
⇒ Price won't adjust to supply and demand for goods in short run
- ▶ One rationale for assumption of sticky prices is that it is costly for firms to change prices
- ▶ Some modern NK models represent this with fixed cost of price adjustment
- ▶ Others assume that firms receive opportunities at random to change their prices

# New Keynesian Model

- ▶ We will simply assume that price  $P$  cannot change in current period
- ▶ As a result, firms will sell as much output as is demanded in the short run at a fixed price
- ▶ Consistent with practice in reality, central bank in model will use interest rate as target  
⇒ Dispenses with “LM” curve which in IS/LM framework would determine nominal interest rate from money supply and demand

# New Keynesian Model

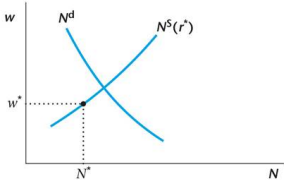
- ▶ MA targets nominal int rate  $R^*$ .
- ▶ But assume  $i = 0$  for simplicity, so that from  $R \approx r + i$ ,  
 $R^* = r^*$
- ▶ ie MA setting  $R^*$  is same as MA setting  $r^*$
- ▶ With sticky prices, MA gains control over real interest rate  $r$

# Complete New Keynesian Model

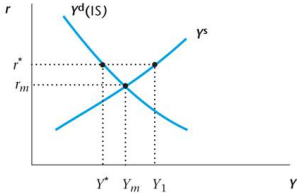
- ▶ Begin with fixed price  $P^*$  and target  $r^*$
- ▶ Given  $r^*$  (and  $P^*$ ), output determined by output demand curve
- ▶ In money market, money demanded is  $PL(Y^*, r^*)$
- ▶ Given  $Y^*, r^*$ , money demanded is  $PL(Y^*, r^*)$   
⇒ So to support its target  $r^*$ , MA must supply amount of money that just meets the money demanded at the target  $r^*$  (and associated  $Y^*$ ), given fixed  $P^*$
- ▶ From prod'n function, firms hire quantity of labour  $N^*$  that is just necessary to produce quantity of output demanded in goods market,  $Y^*$
- ▶ In labour market, real wage  $w^*$  then wage rate at which HH's willing to supply labour  $N^*$

# Complete NK model

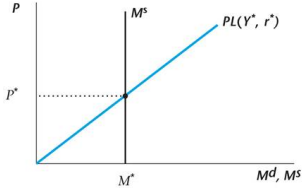
(a)  
Current Labour



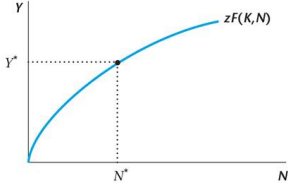
(b)  
Current Goods



(c)  
Money



(d)  
Production



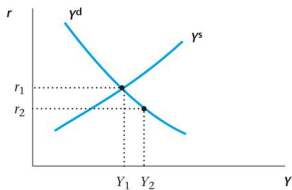
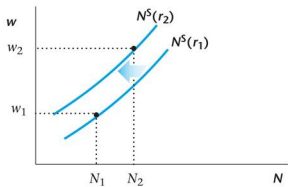
# Complete New Keynesian Model

- ▶ Note that the money market clears, but the goods and labour markets don't necessarily clear
- ▶ In goods market, given  $r^*$ , firms would like to supply  $Y^1$ , but actually only produce  $Y^*$   
⇒ If firms could, they would lower prices
- ▶ Level of output that would prevail if prices flexible is  $Y_m$ ; corresponding market-clearing real int rate is  $r_m$ , “natural rate of interest”
- ▶  $Y_m - Y^*$  referred to as “output gap” (typically these terms reversed, but we'll use Williamson's notation)

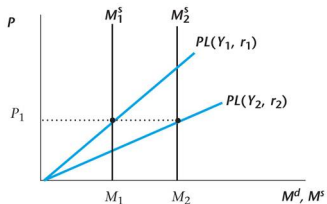
# Non-neutrality of money

- ▶ Gov't ↓'s target  $r^*$
- ▶  $Y$  ↑'s in goods market
- ▶ ↓  $r$  and ↑  $Y$  causes ↑  $M^D$   
⇒ MA ↑'s  $M^S$  to meet money demanded at  $Y^*, r^*$  in order to support target  $r^*$ , given fixed  $P^*$
- ▶ Firm ↑'s  $N$  to produce higher  $Y$ , and in labour market, higher  $N$  corresponds to higher  $w$  on (shifted)  $L^S$  curve (to induce HH's to ↑  $N$ )

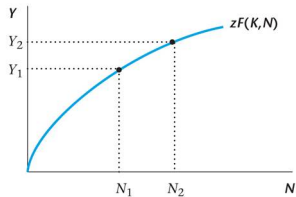
↓ in int rate target



(c)



(d)



# Non-neutrality of money

- ▶ Can also alternatively think of MA as changing  $M$
- ▶ Excess supply of money at original  $r \Rightarrow r \downarrow$ 's to bring money market in eq'm (with  $P$  fixed), decrease in  $r$  increases  $C, I$ , demand and therefore  $Y$  produced
- ▶ Money not neutral  $\Rightarrow$  Has real effects

# Fluctuations in the target interest rate

Could NK model with fluctuations in the target interest rate cause business cycles?

**Table 13.1** Data Versus Predictions of the New Keynesian Model with Fluctuations in the Central Bank's Interest Rate Target

| Variable                   | Data            | Model           |
|----------------------------|-----------------|-----------------|
| Consumption                | Procyclical     | Procyclical     |
| Investment                 | Procyclical     | Procyclical     |
| Price Level                | Countercyclical | Acyclical       |
| Money Supply               | Procyclical     | Procyclical     |
| Employment                 | Procyclical     | Procyclical     |
| Real Wage                  | Procyclical     | Procyclical     |
| Average Labor Productivity | Procyclical     | Countercyclical |

Note that ALP is countercyclical since  $\uparrow N$  is movement *along* prod'n function (as opposed to shift)

# Shocks to aggregate demand

What about shocks to aggregate demand?

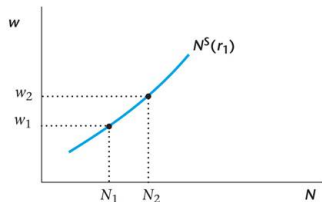
- ▶ ie imagine firms are optimistic about future TFP (“animal spirits”)
- ▶ Assume MA doesn't  $\Delta$  int rate target
- ▶ Begin at flexible price eq'm
- ▶  $\uparrow$ 'd demand for  $I$  shifts  $Y^d$  to right
- ▶ Since target int rate doesn't  $\Delta$ , firms meet  $\uparrow$  demand at existing int rate, producing more  $Y$ .
- ▶ Money demand  $PL(Y, r^*)$   $\uparrow$ 's due to  $\uparrow Y$ , so MA  $\uparrow$ 's  $M^s$  to accommodate money demand and supply  $r^*$  target

# Shocks to aggregate demand

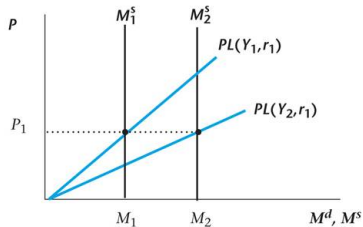
- ▶ From prod'n function,  $N$  ↑'s to level necessary to produced output demanded
- ▶ HH's only willing to supply more  $N$  if  $w$  ↑'s, so  $w$  ↑'s
- ▶  $C$  ↑'s since ↑  $Y$  and no change in  $r$
- ▶  $I$  ↑'s since original shock due to ↑  $I$ -demand, and no change in  $r$

Cyclicity of variables basically same as for interest rate shock  
⇒ ie everything procyclical, except price acyclical and ALP countercyclical

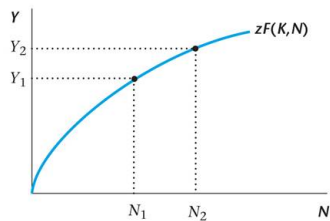
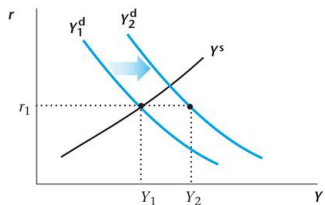
# Shock to aggregate demand



(c)



(d)



# Outline

New Keynesian Model

Role of government policy

# Stabilization policy

Should gov't attempt to stabilize economy? NK implies that it should.

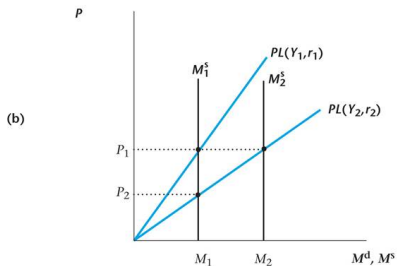
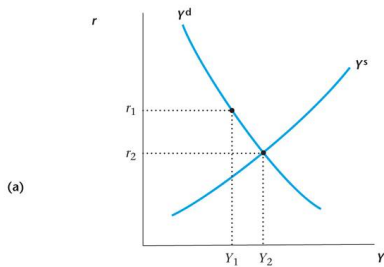
- ▶ Imagine that for some reason (adverse shock etc)  $Y$  lower than  $Y_m$  (and  $P$  higher than LR level)
- ▶ If prices flexible, firms would like to  $\uparrow Y$
- ▶ Economy not in competitive eq'm since demand  $>$  desired supply at prevailing int rate
- ▶ Not in CE, so not optimal - ie allocation of resources inefficient
- ▶ Should gov't intervene?

# Gov't does nothing

If the gov't did nothing

- ▶  $P$  would  $\downarrow$  over time
- ▶  $Y$  would  $\uparrow$  to  $Y_m$ , and  $M^d$  would  $\uparrow$ , so that now  $P$  lower (ie down to  $P_2$  in diagram), and as well,  $r$  lower (ie target falls)

# Gov't does nothing / stabilization using MP



# Stabilization using MP

If the LR is too long to wait, gov't could use MP

- ▶ MA ↓'s  $r$  from  $r_1$  to  $r_2$
- ▶  $Y$  ↑'s
- ▶  $M^d$  ↑'s, and with  $P$  fixed at  $P_1$ , gov't must ↑  $M^s$  so that  $r_2$  supported with money market in eq'm
- ▶ Economy in LR equilibrium, but with higher price than than if adjust occurred over LR

# Stabilization using FP

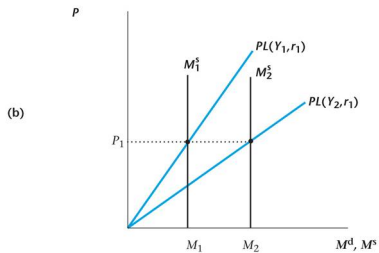
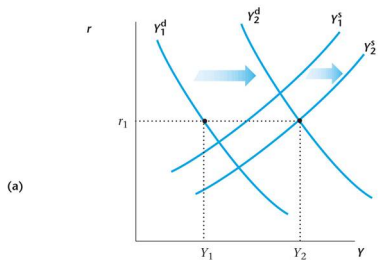
If the LR is too long to wait, gov't could use FP

- ▶ Gov't  $\uparrow$ 's  $G$  (keeping target  $r$  at  $r_1$ )
- ▶ Output demand shifts right, output supply shifts right (from  $\downarrow$  lifetime wealth),  $Y \uparrow$ 's
- ▶  $M^d$  shifts right from  $\uparrow Y$ ; gov't  $\uparrow$ 's  $M$  to maintain eq'm in money market to support target  $r_1$
- ▶ As well, goods market now clears at target rate  $r_1$  (but note without any change in  $r$ )

# Stabilization using FP

- ▶ Note that since no change in  $r$ , there is no change in  $C$  nor  $I$ .
- ▶ ie only component of spending that increases is  $G$
- ▶ Compared to figure with MP intervention only,  $Y$  higher, but composition of output different:  
⇒ Increase in  $Y$  here due just to increase in  $G$ , but with MP only in previous figure,  $C$  and  $I$  higher since  $r \downarrow$ 'd

# Stabilization using FP



# TFP shocks in NK model

What effect does an  $\uparrow z$  have in the NK model?

- ▶ Begin in flexible price eq'm at  $Y_1$  with  $r_1$  (which is also target)
- ▶  $\uparrow z$  shifts up prod'n f'n,  $\uparrow$ 's MPN, and  $Y^s$  shifts to right
- ▶ But in NK model, firm's output is demand-determined. Assuming that MA doesn't change int rate target, output demand doesn't change  
 $\Rightarrow$  Output remains at  $Y_1$ .

# TFP shocks in NK model

- ▶ From prod'n f'n,  $N \downarrow$ 's  $\Rightarrow$  ie  $\uparrow z$  allows firms to produce same level of  $Y$  using less labour
- ▶ Since no change in  $Y$  or  $r$ , no change in money demand and money market
- ▶ Output gap opens up since now  $Y > Y_m$ .
- ▶ Some researchers suggest this result consistent with data
- ▶ TFP used in these studies involves taking Solow Residual and controlling for cyclical factors such as capacity utilization, labour-hoarding etc. to construct "true" measure of TFP.
- ▶ But these empirical studies are subject of current debate

# TFP shocks in NK models

