Microfoundations for Nominal Rigidities

Session 7: Nominal Rigidities

ECO5021F: Advanced Macroeconomics
University of Cape Town

What will we do today?

- Required
  - Romer, **Chapter 6.5 to 6.8** (Microeconomic Foundations of Incomplete Nominal Adjustment)
- Recommended
  - Interview with Greg Mankiw in Snowdown and Vane (2005) *Modern Macroeconomics: Its Origins, Development and Current State*, pp. 433−450 [Note: the edition of Snowdown and Vane I have has the incorrect profile pic for Mankiw]
- We will continue on the topic of nominal rigidities

- Who is this?

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- **N. Gregory Mankiw**
  (1958 -)
  Economic adviser to President Bush
  Introductory economics textbook
  New Keynesian economics

- Married to Janet Yellen…

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- **George Akerlof**
  (1940 -)
  Market for lemons (asymmetric information)
  Efficiency wages
  Nobel prize (2001) with **Michael Spence** and **Joseph Stiglitz**

- This should be easy…

- This should be easy...
- **Robert Lucas, Jr.**
  (1937 - 2023)
  Influential macroeconomist
  Nobel Prize (1995)
  Rational expectations
  Lucas critique

The role of nominal rigidites

- In the previous session we looked at **nominal rigidities** $\rightarrow$ necessary for monetary non-neutrality
- Surprising that nominal rigidities could have such a pronounced impact
  - Given the relative unimportance of nominal versus real prices
- Important part of **New Keynesian economics** concerns the question of how these large macro effects can arise form small nominal rigidities
- To see how this occurs, we will follow **Romer** $\rightarrow$ menu cost model

3 Pillars of **New Keynesian** economics

1. **Menu costs** – Mankiw (1985)
   - Extend economic reasoning to price setting
   - **Menu costs** are a parable for the costs involved in setting prices
   - Some resources diverted from production to price setting
   - Only relevant in market with pricing power
2. **Imperfect competition**
3. **Real rigidities**
   - Imperfections that prevent real prices from moving

A model of imperfect competition

- Assume **perfect price flexibility** and **imperfect competition**
- Construct a baseline model (with NO menu costs) to compare with sticky prices model
- The question is, what happens when prices don't adjust flexibly?
  - **Need a baseline to compare**

Production technology and labour markets

- Start by assuming a continuum of differentiated goods $i \in [0, 1]$
- Each good produced by one firm with monopoly rights
  - i.e. firm i can set the price for good i
- Firm i produces good i using only labour (which is supplied by the **representative household**)
- The production function of this firm is then,

$$Y_i = L_i$$

- Assume that firms hire labour in a perfectly competitive labour market
  - i.e. firm i hires labour quantity L_i
  - Firms are **price takers** in the labour market
- Firms are owned by households, who receive all firm profits
- No government, trade or capital, $Y = C$

Household behaviour: Utility function

- Household's utility depends on consumption $(+)$ and labour $(-)$
- In aggregate, we assume that,

$$U = C - \frac{L^{\gamma}}{\gamma}, \quad \gamma > 1$$

$$\text{where} \quad C = \left[\int_0^1 C_i^{\frac{\eta-1}{\eta}} di\right]^{\frac{\eta}{\eta-1}}, \quad \eta > 1$$

- C is **NOT** total consumption of all goods (why?) $\rightarrow$
  - CES (constant elasticity of substitution) aggregator.
  - The **elasticity of demand** is defined by the value for η.
  - It is a composite index of the household's consumption over a continuum of differentiated goods $C_i \in [0, 1]$, each produced by a different firm that reflects the substitutability across goods.
  - It reflects how much utility the household derives from a basket of differentiated goods - not just the total number of units consumed.

Small detour: Elasticity of demand

- Note that $\left[\int_0^1 C_i^{\frac{\eta-1}{\eta}} di\right]^{\frac{\eta}{\eta-1}}$ is almost like $\left[\sum_i C_i^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}$
- Especially when we take derivatives w.r.t. one of the the elements of the integral/sum
- What do different values of η reflect? Let's look at a possible range of values,

As $\eta \to \infty$, infinitely elastic (perfect substitutes)
As $\eta \to 1$, unit elastic (Cobb-Douglas form)

- We are working with η in the **elastic** range: $1 < \eta < \infty$.
- $0 < \eta < 1$ is the inelastic, but firm markups become negative, which is nonsensical.

Household behaviour: Budget constraint

- Households receive a wage W per unit of labour supplied
- They receive R in total, as **profits** from the firms
- All income $(R + WL)$ is spent on consumption goods
  - Spending $P_i C_i$ on each good i
- Budget constraint is then given by,

$$R + WL = \int_0^1 P_i C_i di$$

- Utility and the budget constraint are **additively separable** in consumption and labour

Household behaviour: Consumption problem

- Household must choose how much to work and how much to consume $\rightarrow$ **maximise utility**
  - Take prices, wages and profit from the firms as given
- Whatever the labour decision, there will be some amount of money $S = R + WL$ available to spend on consumption goods
- We want to find out, how much is spent on each type of good (**consumption problem**)
- So let us set up the Lagrangian to find the answer

Household behaviour: Consumption problem

$$\mathcal{L} = \underbrace{\left[\int_0^1 C_i^{\frac{\eta-1}{\eta}} di\right]^{\frac{\eta}{\eta-1}}}_{\text{Utility function}} + \lambda \underbrace{\left[S - \int_0^1 P_i C_i di\right]}_{\text{Budget constraint}}$$

- Have to take the **FOC** with respect to one of the goods C_j: $\frac{\partial \mathcal{L}}{\partial C_j}$
- This will require using the **chain rule** for the utility function
- Let the **inner function** be $F = \int_0^1 C_i^{\frac{\eta-1}{\eta}} di$
- Then the **outer function** becomes $\rightarrow F^{\frac{\eta}{\eta-1}}$
- This means that we want ,

$$\frac{\partial F^{\frac{\eta}{\eta-1}}}{\partial F} \cdot \frac{\partial \left[\int_0^1 C_i^{\frac{\eta-1}{\eta}} di\right]}{\partial C_j}$$

Household behaviour: Consumption problem

$$\mathcal{L} = \left[\int_0^1 C_i^{\frac{\eta-1}{\eta}} di\right]^{\frac{\eta}{\eta-1}} + \lambda \left[S - \int_0^1 P_i C_i di\right]$$

- The first order condition for this problem is then,

$$\left(\frac{\partial \mathcal{L}}{\partial C_j}\right) \qquad \underbrace{\frac{\eta}{\eta-1}\left[\int_0^1 C_i^{\frac{\eta-1}{\eta}} di\right]^{\frac{1}{\eta-1}}}_{\text{Outer}} \underbrace{\frac{\eta-1}{\eta} C_j^{\frac{-1}{\eta}}}_{\text{Inner}} - \lambda P_i = 0$$

- Let us simplify this function a bit by isolating the items that depend on j

Household behaviour: Consumption problem

$$\frac{\eta}{\eta-1}\left[\int_0^1 C_i^{\frac{\eta-1}{\eta}}\,di\right]^{\frac{1}{\eta-1}}\frac{\eta-1}{\eta}C_j^{\frac{-1}{\eta}}=\lambda P_j$$

- The simplification works as follows,

$$C_j^{\frac{1}{\eta}}=\frac{\left[\frac{\eta}{\eta-1}(F)^{\frac{1}{\eta-1}}\right]\cdot\frac{\eta-1}{\eta}}{\lambda P_j}$$

$$\left(C_j^{\frac{1}{\eta}}\right)^{\eta}=\underbrace{\left(\frac{\left[\frac{\eta}{\eta-1}(F)^{\frac{1}{\eta-1}}\right]\cdot\frac{\eta-1}{\eta}}{\lambda}\right)^{\eta}}_{=A\text{: not a function of } j}\cdot\left(\frac{1}{P_j}\right)^{\eta}$$

$$C_j=A\cdot P_j^{-\eta}$$

Household behaviour: Consumption problem

- Next, we want to solve for A (to replace λ and simplify)
- Plug $C_j = AP_j^{-\eta}$ $\forall\, j$ into the budget constraint $\left[S - \int_0^1 P_i C_i di\right]$, which is binding $\forall\, i$ at the optimum solution:

$$S = \int_0^1 P_i A P_i^{-\eta} di$$

$$A = \frac{S}{\int_0^1 P_i^{1-\eta} di}$$

$$\therefore \quad C_j = A \cdot P_j^{-\eta} = \underbrace{\frac{S}{\int_0^1 P_i^{1-\eta} di}}_{\text{not a function of } j} P_j^{-\eta}$$

- Now we plug this back into the utility function, to get C in terms of S and P

Household behaviour: Consumption problem

$$C = \left[\int_0^1 C_j^{\frac{\eta-1}{\eta}} dj\right]^{\frac{\eta}{\eta-1}}$$

$$C = \left[\int_0^1 \left(\frac{S}{\int_0^1 P_i^{1-\eta} di} P_j^{-\eta}\right)^{\frac{\eta-1}{\eta}} dj\right]^{\frac{\eta}{\eta-1}}$$ (Split the integrals)

$$C = \left[\left(\frac{S}{\int_0^1 P_i^{1-\eta} di}\right)^{\frac{\eta-1}{\eta}} \int_0^1 (P_j^{-\eta})^{\frac{\eta-1}{\eta}} dj\right]^{\frac{\eta}{\eta-1}}$$

$$C = \frac{S}{\int_0^1 P_i^{1-\eta} di}\left[\int_0^1 P_j^{1-\eta} dj\right]^{\frac{\eta}{\eta-1}}$$ (Combine identical integrals $\{i, j\}$ over $[0, 1]$)

$$C = S\left[\int_0^1 P_i^{1-\eta} di\right]^{\frac{\eta}{\eta-1}-1} = S\left[\int_0^1 P_i^{1-\eta} di\right]^{\frac{1}{\eta-1}}$$

$$C = \frac{S}{\left[\int_0^1 P_i^{1-\eta} di\right]^{\frac{1}{1-\eta}}}$$

Household behaviour: Consumption problem

- We define the aggregate price index as,

$$P = \left[\int_0^1 P_i^{1-\eta} di \right]^{\frac{1}{1-\eta}}$$

- Cost of buying one unit of the composite good C is going to be equal to the aggregate price index P
- Means that, **by definition**, total spending is equal to total expendable resources $\rightarrow S = P \cdot C$
- **Important:** This is true when the consumer optimally allocates expenditure over the available goods given the utility function

- **Note:** Attractive feature of this index is that if all the P_i's are equal, the index equals the common level of the P_i's

Household behaviour: Consumption problem

$$P = \left[\int_0^1 P_i^{1-\eta} di \right]^{\frac{1}{1-\eta}}$$

- How does this price index compare to other indices, like **CPI**?
- Differs in **one important way**
  - It averages a power $1 - \eta$ of the prices, rather than the prices itself
  - Then returns it to the original units by taking the average to the $1/(1-\eta)$ power
  - If $\eta = 0$ then the price index becomes an **equally weighted** average of the prices across all goods
  - All goods then purchased in equal quantities – goods are symmetric, not identical (**same elasticity parameter**)
- Linearly vs. non-linearly weighted average of prices

Household behaviour: Consumption problem

- Finally, we want to get the consumer's demand function

$$P = \left[\int_0^1 P_i^{1-\eta} di\right]^{\frac{1}{1-\eta}}$$

$$P^{1-\eta} = \left[\int_0^1 P_i^{1-\eta} di\right]$$

$$\therefore \quad C_j = \frac{S}{\int_0^1 P_i^{1-\eta} di} P_j^{-\eta}$$

$$C_j = \frac{S}{P^{1-\eta}} P_j^{-\eta}$$

$$C_j = \left(\frac{P_j}{P}\right)^{-\eta} \cdot \frac{S}{P}$$

$$C_j = \left(\frac{P_j}{P}\right)^{-\eta} \cdot C$$

$$Y_i = \left(\frac{P_i}{P}\right)^{-\eta} \cdot Y, \quad C_i = Y_i (= L_i)$$

Household behaviour: Consumption problem

$$\frac{C_i}{C} = \left(\frac{P_i}{P}\right)^{-\eta}$$

- Reflects the consumption choice through **substitution**
- Ratio of consumption of good i to the average consumption index **depends negatively** on the relative price of i

- We have found an expression for the households optimal consumption decisions, and now we need to solve for the households other decision variable (**labour**)

Household behaviour: Labour decision

- Since the household's are assumed to be identical, we only need to solve the decision for one household to know how **aggregate labour supply** will behave

- The household gets **profit** R and a **wage** W
- Household consumption must therefore equal,

$$C = \frac{WL + R}{P}$$

- We can substitute this into the utility function,

$$\max_L U, \quad U = \frac{WL + R}{P} - \frac{L^\gamma}{\gamma}$$

Household behaviour: Labour decision

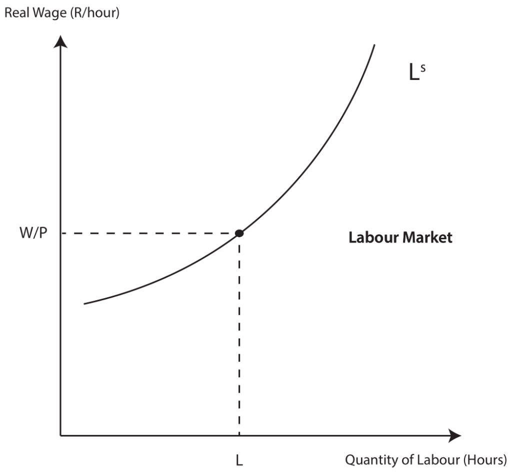
- Now we need to find the first order condition with respect to labour,

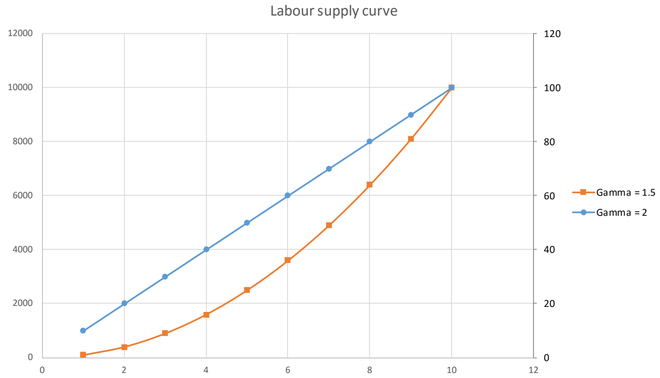
$$\left(\frac{\partial U}{\partial L}\right) \quad \frac{W}{P} - L^{\gamma-1} = 0$$

- Gives the **labour supply** as a function of the real wage,

$$L = \left(\frac{W}{P}\right)^{\frac{1}{\gamma-1}}$$

- Exactly what we expect, **positive relationship** between the real wage and quantity of labour (hours) supplied


Real Wage (R/hour)
Ls
W/P
Labour Market
L
Quantity of Labour (Hours)


Labour supply curve
12000
10000
8000
6000
4000
2000
0
0
2
4
6
8
10
12
120
100
80
60
40
20
0
Gamma = 1.5
Gamma = 2

Firm behaviour

- Firms are assumed to be profit maximisers who know the optimal decision made by the household
- They choose their **relative price** P_i/P to maximise profit
- Real **profits** of the firm i are real **revenues** minus real **costs**

$$\frac{R_i}{P} = \frac{P_i}{P} Y_i - \frac{W}{P} L_i$$

- Given the simple production function $Y_i = L_i$ and consumer demand $Y_i = Y(\frac{P_i}{P})^{-\eta}$

$$\frac{R_i}{P} = \left(\frac{P_i}{P}\right)^{1-\eta} Y - \frac{W}{P} \left(\frac{P_i}{P}\right)^{-\eta} Y$$

Firm behaviour

- First order condition with respect to the relative price (P_i/P) is,

$$\frac{\partial \frac{R_i}{P}}{\partial \frac{P_i}{P}}: \quad (1-\eta)\left(\frac{P_i}{P}\right)^{-\eta} Y + \eta \frac{W}{P}\left(\frac{P_i}{P}\right)^{-\eta-1} Y = 0$$

- Rearranging this equation gives,

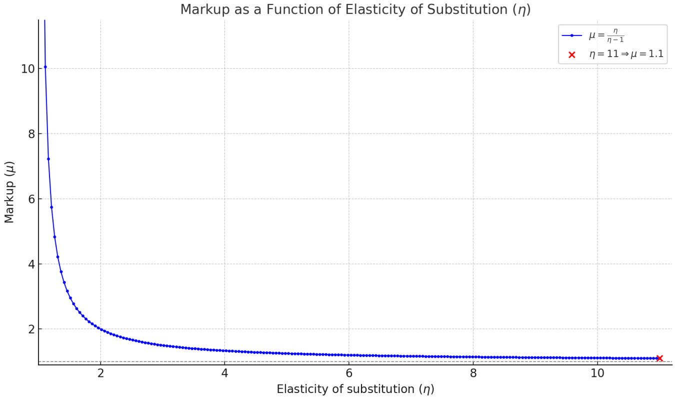
$$\begin{aligned}
(1-\eta)\left(\frac{P_i}{P}\right)^{-\eta} &= -\eta \frac{W}{P}\left(\frac{P_i}{P}\right)^{-\eta-1} \\
\left(\frac{P_i}{P}\right)^{-\eta+\eta+1} &= \frac{-\eta}{(1-\eta)}\frac{W}{P} \\
\therefore \quad \frac{P_i}{P} &= \frac{\eta}{(\eta-1)}\frac{W}{P}
\end{aligned}$$

Firm behaviour

$$\frac{P_i}{P} = \frac{\eta}{(\eta - 1)} \frac{W}{P} = \mu \frac{W}{P}$$

- This equation shows that the monopolistically competitive firm optimizes by setting prices as a **mark-up over marginal cost**: μ
- The size of the markup $\rightarrow$ determined by the elasticity of demand
- The greater the elasticity of demand, the lower the power over the relative price and therefore markup

$$\eta \rightarrow \infty, \quad \frac{\eta}{\eta - 1} \rightarrow 1, \quad \text{infinitely elastic}$$



- The point $\eta = 11 \Rightarrow \mu = 1.1$ (i.e., a 10% markup over marginal cost)
- Horizontal dashed line at $\mu = 1$ is the perfect competition limit ($\eta \to \infty$).

η	**Elasticity**	**Economic Interpretation**
$\eta \to \infty$	Perfect substitutes	Consumer buys only the cheapest good; complete substitutability
$\eta > 1$	Elastic substitution	Standard assumption in NK models; demand is responsive to relative prices; markups > 1
$\eta = 1$	Cobb-Douglas (log utility)	Equal expenditure shares across goods; substitution elasticity equals 1
$0 < \eta < 1$	Inelastic substitution	Goods are difficult to substitute; demand is steep; implies markups < 1 (unrealistic)
$\eta \to 0$	Leontief-type (fixed proportions)	Consumption occurs in fixed proportions; not well-defined under CES form
$\eta \leq 0$	Undefined	Breaks CES aggregator structure; not economically meaningful

Table: Interpretation of CES elasticity parameter η

Aggregate equilibrium

- Household's are identical $\rightarrow$ all take precisely the same decisions
- The same is true for firms, accordingly, $Y = C = L$, which means

$$L = \left(\frac{W}{P}\right)^{\frac{1}{\gamma-1}}$$

$$\therefore \quad Y = \left(\frac{W}{P}\right)^{\frac{1}{\gamma-1}}$$

$$\therefore \quad Y^{\gamma-1} = \frac{W}{P}$$

Aggregate equilibrium

- To find each firm's **equilibrium price**, we substitute $Y^{\gamma-1} = \frac{W}{P}$ into the firm's price equation,

$$\frac{P_i^*}{P} = \frac{\eta}{\eta - 1} Y^{\gamma-1}, \quad * \rightarrow \text{Equilibrium value.}$$

- When all firms **charge the same price** $P_i^* = P^*$, the aggregate price is also equal to this price, by definition, of the aggregator
- Real output is determined by the features of the economy alone, not a function of aggregate prices

$$Y^* = \left(\frac{\eta - 1}{\eta}\right)^{\frac{1}{\gamma-1}} < 1$$

- This gives us our **equilibrium level of output**

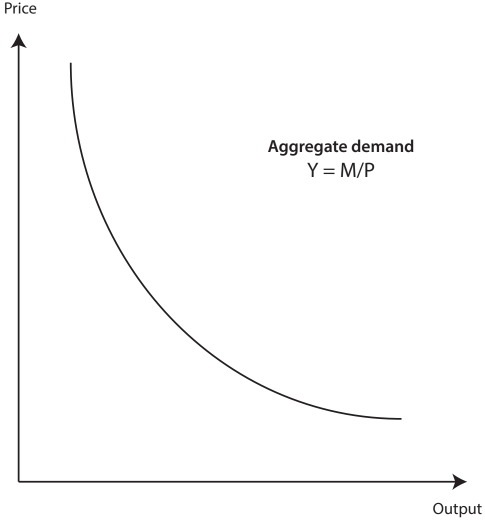
Slight detour (1 of 2)

For future reference ('Slight detour (2 of 2)'):

- It is useful to write the firm's price equation expression from the previous slide in logarithms:

$$p_i^* - p = \ln \frac{\eta}{\eta - 1} + (\gamma - 1)y \equiv c + \phi y \ , \quad (1)$$

  where lowercase letters denote the logs of the corresponding uppercase variables.
- This equation states that a price-setter's optimal relative price is increasing in aggregate output.


Price
Aggregate demand
Y = M/P
Output

Aggregate demand

$$Y = \frac{M}{P} \rightarrow \text{AD function}$$

- Demand shifts are crucial to **Keynesian models**
- In this case, very simple **AD** model is assumed
  - Inverse relationship between aggregate price level and output
  - M stands not just for money, but for all factors that affect aggregate demand

- Comment from **Mankiw**: *To a large extent **New Keynesian economics** has been about the theory of aggregate supply and why it is that prices adjust*

Aggregate equilibrium

$$\frac{M}{P} = \left(\frac{\eta - 1}{\eta}\right)^{\frac{1}{\gamma - 1}}$$

$$\therefore \quad P^* = \frac{M}{\left(\frac{\eta-1}{\eta}\right)^{\frac{1}{\gamma-1}}}$$

- Combining the equilibrium level of output (Y^*) and the **AD** function, we find the **equilibrium price level** as a function of the
  - Demand shock M (+)
  - Disutility of labour γ (-)
  - Demand elasticity of the product η (-) Mark-up $\rightarrow \mu$ (+)

Slight detour (2 of 2)

What happens if real rigidities are so strong that desired real prices are decreasing in output ($\phi < 0$)?

- The fact that price-setters' desired real prices are increasing in aggregate output in (1) is necessary for the flexible-price equilibrium to be stable.
- To see this, note that we can use the fact that $y = m - p$ to rewrite (1) as
$$p_i^* = c + (1 - \phi)p + \phi m \tag{2}$$
- If $\phi < 0$, an increase in the price level raises each price-setter's desired price **more than one-for-one**.
- i.e., if p is above (below) the level that causes individuals to charge a relative price of 1, each individual wants to charge more (less) than the prevailing price level.
- Thus, if $\phi < 0$, **the flexible-price equilibrium is unstable**. (See sections 6.7 & 6.8 of Romer)
- In our specific example, $\phi < 0$ implies that the elasticity of labour supply is negative: $0 < \gamma < 1$.

Implications

- Market power $\rightarrow$ production is below the socially optimal amount
- We can show this by referring to a scenario where a omniscient **social planner** takes over all decisions
- This **social planner** only has one goal: maximise utility of all
- One way to think about this is the maximisation of $C - \frac{L^\gamma}{\gamma}$, given the fact that $C = L$ (constraint)
- The solution to this problem is easy $\rightarrow \bar{L} = 1^{\frac{1}{\gamma - 1}}$
- Equilibrium labour supply, however, is below this level

$$L^* = \left(\frac{\eta - 1}{\eta}\right)^{\frac{1}{\gamma - 1}} < \bar{L} = 1$$

- In addition, equilibrium real wage is below marginal product (MPL = 1)

$$\frac{W^*}{P} = \left(\frac{\eta - 1}{\eta}\right) < 1$$

Implications

- The **socially optimal level** of output is $\bar{L} = \bar{Y} = 1$
- Looking at our equilibrium solution for output, we see that $Y^* < 1$
- Gap between the equilibrium level of output and the socially optimal level ($\bar{Y} - Y^*$) is a function of market power η and disutility of labour γ
- In other words, equilibrium moves farther from optimal when
  - market power increases $\eta \downarrow$
  - labour supply is more reactive to the real wage $\gamma \downarrow$

Implications

- This result means that booms and recession have **asymmetric welfare consequences**
  - Booms bring the economy closer to the social optimum
  - Recessions push us further away
- Outcome also implies that **individual pricing decisions** have macroeconomic externalities
  - If one person lowers price all prices are cut (leading to a lower P) then **AD** would rise as would $Y \rightarrow$ positive welfare effect via higher firm profits
  - This effect is called an **aggregate demand externality**
    - **Externality** $\rightarrow$ decision of one firm is felt by all firms in the economy

Implications

- This aggregate demand externality for prices does NOT yet establish **monetary non-neutrality**
- **Mankiw** states: *To get monetary non-neutrality, which is the central challenge for macro-theorists, you need some nominal rigidity, such as sticky prices*
- Imperfect competition is not enough, we need a **nominal rigidity**

Impact of an AD shock

- If demand is as expected (as in the model we derived), then $MR = MC$ for each firm
- After prices are set **AD** is determined for the entire economy
- Firms can now change their individual prices only by paying a **menu cost**
  - They will only do so if the actual **AD** is different from the **AD** the firm expected
- Now introduce an adverse demand shock
  - This will lower the MR curve for each firm
  - A firm will only change its price in response to this shock if the the gain from changing the price exceeds the **menu cost** associated with the change

6.6 Are Small Frictions Enough?

General Considerations

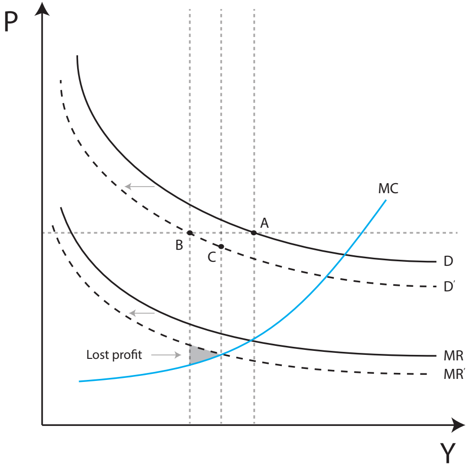


Figure: A representative firm's incentive to change its price in response to a fall in aggregate output

Impact of an AD shock

- Two effects of an **AD** shock for each firm
  1. Fall in demand
  2. Move away from optimum position on the revenue function for each firm
- Latter is order of magnitude smaller, but creates first order effect if firms don't respond
- Failure to adjust individually $\rightarrow$ massive **co-ordination failure**
  - Even small obstacles to price adjustment can cause large output losses from demand shocks

Are menu costs high enough?

- **Romer** looks at a calibrated version of our derived model
- He shows in the example (pp. 277 - 279) that *no plausible cost of price adjustment can prevent firms from changing prices in the face of this incentive*

- This means that money will mostly be **neutral** in the model
- Underlying cause of the monetary neutrality is that the **labour market clears** due to large real wage adjustment (no wage rigidity) in the face of demand shocks
  - Labour supply is inelastic in our model, drop in real wages will lower marginal cost and increase the cost of non-adjustment

6.7 Real Rigidity

General Considerations

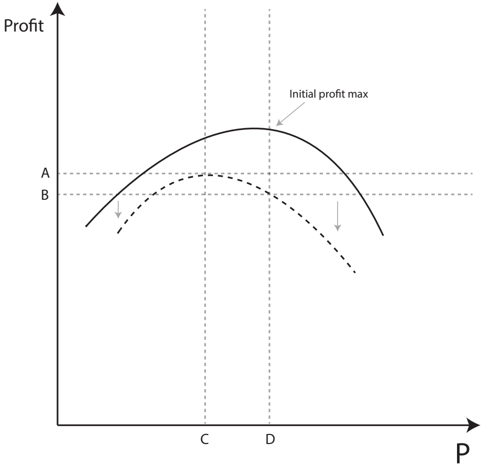


Figure: The impact of a fall in aggregate output on the representative firm's profits as a function of its price

The need for real rigidities

- The incentive to lower firm's price depends on
  1. Difference between the old and new profit maximising prices
  2. Curvature of the profit function
- Real rigidities refer to **non-price factors** that make the firm's profit function less responsive
- These real rigidities cannot cause monetary non-neutrality on their own $\rightarrow$ no impact when prices are **fully flexible**
- It is the combination of nominal and real rigidities that cause non-neutrality in New Keynesian models
- Real rigidities **magnify the impact** of nominal rigidities

Potential sources of real rigidities

- Sources of **real rigidities** (either on MC or MR curve)
- In terms of the **marginal cost curve**,
  - Shifts in the MC curve (smaller shift $\rightarrow$ greater real rigidity)
  - Slope of MC curve (flatter MC curve $\rightarrow$ greater real rigidity)
- In terms of the **marginal revenue curve**,
  - Shifts in the MR curve (larger leftward shift $\rightarrow$ greater real rigidity)
  - Slope of MR curve (steeper MR curve $\rightarrow$ greater real rigidity)

Some examples…

- If marginal costs do not fall steeply with **AD shift**, incentive to adjust is small (sticky real wages)

- **Efficiency wage theory** could be a potential cause of real rigidities,
  - Reduced shirking
  - Lower staff turnover
  - Improved loyalty
  - Attract the best workers

- **Romer** discusses several other examples, such as
  - Capital market imperfections $\rightarrow$ raise finance costs during recessions
  - Thick market effects $\rightarrow$ easier to disseminate information during a boom (demand less elastic during recessions)
  - Labour market imperfections

Self-study

You don not need to cover the final two sections in technical depth, but are required to build the intuition:

- 6.8 Coordination-Failure Models and Real Non-Walrasian Theories
  - Take special note of *fragile* equilibriums and the idea of *real non-Walrasian theories*.
- 6.9 The Lucas Imperfect-Information Model
  - Take special note of *The Phillips Curve and the Lucas Critique*, the role of *Stabilization Policy*, and the *Discussion*.