Outline

1. Cost Curves II
2. Supply Function
3. One-step Profit Maximization
4. Introduction to Market Equilibrium
5. Aggregation
6. Market Equilibrium in the Short-Run
1 Cost Curves II

Case 3. Technology with setup cost. Plot production function, total cost, average and marginal. Supply function?
2 Supply Function

• Supply function: \( y^* = y^*(w, r, p) \)

• What happens to \( y^* \) as \( p \) increases?

• Is the supply function upward sloping?

• Remember f.o.c:

\[
p - c_y' (w, r, y) = 0
\]

• Implicit function:

\[
\frac{\partial y^*}{\partial p} = -\frac{1}{-c_{yy}'' (w, r, y)} > 0
\]

as long as s.o.c. is satisfied.

• Yes! Supply function is upward sloping.
3 One-step Profit Maximization

- Nicholson, Ch. 9, pp. 265–270 [OLD: Ch. 13, pp. 346–350].

- One-step procedure: maximize profits

- Perfect competition. Price $p$ is given
  
  - Firms are small relative to market
  
  - Firms do not affect market price $p_M$

  - Will firm produce at $p > p_M$?
  
  - Will firm produce at $p < p_M$?

  - $\implies p = p_M$
• Revenue: $py = pf(L, K)$

• Cost: $wL + rK$

• Profit $pf(L, K) - wL - rK$
• Agent optimization:

\[
\max_{L,K} pf (L, K) - wL - rK
\]

• First order conditions:

\[
 pf'_L (L, K) - w = 0
\]

and

\[
 pf'_K (L, K) - r = 0
\]

• Second order conditions? \( pf''_{L,L} (L, K) < 0 \) and

\[
|H| = \begin{vmatrix}
 pf''_{L,L} (L, K) & pf''_{L,K} (L, K) \\
 pf''_{L,K} (L, K) & pf''_{K,K} (L, K) 
\end{vmatrix} =
\]

\[
= p^2 \left[ pf''_{L,L} pf''_{K,K} - ( pf''_{L,K} )^2 \right] > 0
\]

• Need \( f''_{L,K} \) not too large for maximum
• Comparative statics with respect to $p, w, \text{ and } r$.

• What happens if $w$ increases?

$$\frac{\partial L^*}{\partial w} = -\begin{vmatrix} -1 & p f''_{L,K} (L, K) \\ 0 & p f''_{K,K} (L, K) \end{vmatrix} \begin{vmatrix} p f''_{L,L} (L, K) & p f''_{L,K} (L, K) \\ p f''_{L,K} (L, K) & p f''_{K,K} (L, K) \end{vmatrix} < 0$$

and

$$\frac{\partial L^*}{\partial r} =$$

• Sign of $\partial L^*/\partial r$ depends on $f''_{L,K}$. 
4 Introduction to Market Equilibrium


- Two ways to analyze firm behavior:
  - Two-Step Cost Minimization
  - One-Step Profit Maximization

- What did we learn?
  - Optimal demand for inputs $L^*, K^*$ (see above)
  - Optimal quantity produced $y^*$
• **Supply function.** \( y = y^* (p, w, r) \)

  - From profit maximization:
    \[ y = f \left( L^* (p, w, r), K^* (p, w, r) \right) \]

  - From cost minimization:
    \[ MC \text{ curve above } AC \]

  - Supply function is increasing in \( p \)

• Market Equilibrium. Equate demand and supply.

• Aggregation?

• Industry supply function!
5 Aggregation

5.1 Producers aggregation

- $J$ companies, $j = 1, \ldots, J$, producing good $i$

- Company $j$ has supply function

$$y_i^j = y_i^{j*} (p_i, w, r)$$

- Industry supply function:

$$Y_i(p_i, w, r) = \sum_{j=1}^{J} y_i^{j*} (p_i, w, r)$$

- Graphically,
5.2 Consumer aggregation

- Nicholson, Ch. 10, pp. 279–282 [OLD: Ch. 7, pp. 172–176]

- One-consumer economy

- Utility function $u(x_1, \ldots, x_n)$

- Prices $p_1, \ldots, p_n$

- Maximization $\Rightarrow$

\[
\begin{align*}
x_1^* &= x_1^*(p_1, \ldots, p_n, M), \\
&\quad \vdots \\
x_n^* &= x_n^*(p_1, \ldots, p_n, M).
\end{align*}
\]
Focus on good $i$. Fix prices $p_1, \ldots, p_{i-1}, p_{i+1}, \ldots, p_n$ and $M$

Single-consumer demand function:

$$x_i^* = x_i^*(p_i|p_1, \ldots, p_{i-1}, p_{i+1}, \ldots, p_n, M)$$

What is sign of $\partial x_i^*/\partial p_i$?

Negative if good $i$ is normal

Negative or positive if good $i$ is inferior
• Aggregation: $J$ consumers, $j = 1, \ldots, J$

• Demand for good $i$ by consumer $j$:

$$x_{ij}^* = x_{ij}^* \left( p_1, \ldots, p_n, M^j \right)$$

• Market demand $X_i$:

$$X_i \left( p_1, \ldots, p_n, M^1, \ldots, M^J \right) = \sum_{j=1}^{J} x_{ij}^* \left( p_1, \ldots, p_n, M^j \right)$$

• Graphically,
• Notice: market demand function depends on distribution of income $M^J$

• Market demand function $X_i$:
  – Consumption of good $i$ as function of prices $p$
  – Consumption of good $i$ as function of income distribution $M^j$
6 Market Equilibrium in the Short-Run

- Nicholson, Ch. 14, pp. 368–382.

- What is equilibrium price $p_i$?

- Magic of the Market...

- Equilibrium: No excess supply, No excess demand

- Prices $p^*$ equates demand and supply of good $i$:

\[ Y^* = Y_i^S(p_i^*, w, r) = X_i^D(p_1^*, ..., p_n^*, M^1, ..., M^J) \]
• Graphically,

• Notice: in short-run firms can make positive profits
• Comparative statics exercises with endogenous price \( p_i \):

– increase in wage \( w \) or interest rate \( r \):

– change in income distribution
7 Next Lecture

- Elasticities
- Taxes and Subsidies
- Long-Run Equilibrium