

# Theory of Competitive markets

- In consumer and producer theory we assume that prices are constant now we consider how those price are determined
- Bring demand and supply together to determine the market outcome
- Adopt partial equil approach to give -general equilibrium important but consider later
- **Short run equilibrium:** let  $x_i = D_i(p)$  be the it consumers demand for the commodity x at price p, giving a market demand function

$$x = \sum_i x_i = \sum_i D_i(p) = D(p)$$

the short run supply function of firm j is

$$y_j = s_j(p, w)$$

- When considering the firms supply and assuming prices were constant we missed out on the impact that changes in output can have on input prices. Now need to consider that when output increases across firms demand for inputs is likely to increase the price
- Using  $z(y)$  to represent the amount of variable inputs consider

$$w = (wz(y))$$

where  $w'(z) > 0$  meaning that as total output increases the price to the firm goes up

- Diagram: price increase makes initial supply  $s_j(p, w^0)$  rise (SRMAC and SRS of all firms rise) to  $s_j(p, w^1)$  so supply curve shifts up -joining the locus of such shifts and price gives  $s_j(p)$  an effective market supply curve that is less elastic and may even be backward bending.
- Law of diminishing returns means firms supply curve has positive slope, but this doesn't mean the effective one will. Effective supply function can be written

$$y_j = s_j(p, w(z(y(p)))) = s_j(p)$$

summing gives effective industry supply curve

$$y = \sum_j y_j = \sum_j s_j(p) = s(p)$$

so differentiate wrt p gives effective supply response of firm j, after allowing for the effect of the change in w caused by the change in production by all firms

$$\frac{\partial y_j}{\partial p} = s_{jp} + s_{jw} w'(z) z'(y) \frac{dy}{dp} = s'_j(p, w) \leq 0$$

since

$$s_{jp} = \frac{\partial s_j(p, w)}{\partial p} > 0 \text{ and } s_{jw} = \frac{\partial s_j}{\partial w} < 0$$

i.e. can be increasing or decreasing in terms of p

$$\begin{aligned} \frac{dy}{dp} &= \sum_j \frac{dy_j}{dp} = \sum_j s_{jp} + w' z' \frac{dy}{dp} \sum_j s_{jw} = s'_j(p, w) \\ &= \frac{\sum_j s_{jp}}{1 - w' z' \frac{dy}{dp} \sum_j s_{jw}} > 0 \end{aligned}$$

meaning that even though the individual firm effective supply curves need not be positive sloped the industry one is -an important result

- So can have an equilibrium when add in demand curve
- But possible discontinuities
  - price below AVC before hit demand curve -all firms have same AVC
  - min point of lowest AVC cost axis above demand when first have different AVC, evenly distributed across a range

- Discontinuities in the demand and/or supply curves and hence the excess demand functions:

$$z(p) = D(p) - s(p)$$

may imply there is no equilibrium

- **Existence** theory for one market
  - \* if excess demand function  $z(p)$  is continuous  $p \geq 0$
  - \* and there exists a price  $p^0 > 0$  such that  $z(p^0) > 0$
  - \* and there exists a price  $p^1 > 0$  such that  $z(p^1) < 0$

then there exists an equilibrium price  $p^* > 0$  such that  $z(p^*) = 0$

basically if excess demand passes from positive to negative it must also pass through a point where it is zero

- **Stability:** important since generally comparing effects of changes in demand and supply before and after
- Define: market is stable if price is not an equilibrium one it will converge in time to the equilibrium

$$\lim_{t \rightarrow \infty} p(t) = p^*$$

-can distinguish locally and globally stable -more interested in global as make be multiple local equilibria

- Need to consider:
  - \* how prices respond to excess demand
  - \* how agents obtain information
  - \* at what point trading takes place

- **How prices respond:      tattonement process**

- Market operates as if there is an auctioneer- announces price agents make decisions auctioneer works out excess demands and makes adjustments to prices until equilibrium is reached and then trade takes place. Uses the rule:

$$\frac{dp}{dt} = \lambda x(p(t)) \quad \lambda > 0$$

changing price at rate proportional to excess demand

- Sufficient conditions for stability are: that if  $z$  is positive whenever price is below its equilibrium values and vice versa

define distance function

$$\partial(p(t), p^*) = (p(t) - p^*)^2$$

$$\frac{d\partial}{dt} = 2(p(t) - p^*) \frac{dp}{dt} = 2(p(t) - p^*) \lambda x(p(t))$$

meaning  $\frac{d\partial}{dt} < 0$  iff  $(p(t) - p^*)$  and  $z(p(t))$  have opposite signs. If  $p(t)$  is always moving closer to  $p^*$  whenever they are not equal, then it cannot tend to anything other than  $p^*$

- **How prices respond: Marshallian process**

- Marshall suggest that sellers will sell for whatever their product will fetch and will expand output when demand price is above the supply price and reduce output when it is not. Can think of this as auctioning off the excess. The supply price equals each sellers marginal cost so  $p_D > p_S$  implies output expansion increases profits and  $p_S > p_D$  means contraction increase profits. This suggests the adjustment rule

$$\frac{dy}{dt} = \lambda(p_D(y) - p_s(y)) \quad \lambda > 0$$

where  $p_D(y)$  is the inverse demand function and  $p_s(y)$  the inverse supply function

- For this process to be stable we can show diagrammatically that the supply curve has to have a positive slope -or if it is negative to have the demand curve cut it from above. More precisely can define distance function:

$$\partial(y(t), y^*) = (y(t) - y^*)^2$$

meaning

$$\frac{d\partial}{dt} = 2(y(t) - y^*) \frac{dy}{dt} = 2(y(t) - y^*) \lambda [p_D(t) - p_S(t)]$$

and so for  $\frac{d\partial}{dt} < 0$  we need  $(y(t) - y^*)$  and  $p_D(t) - p_S(t)$  to have different signs

- Difference between Walrasian and Marshallian adjustment
  - \* Walrasian adjusment to non negative excess demand through tatonnement process, Marshallian through auction mechanism that determine the demand price
  - \* Walrasian info transmitted simultaneously to buyers and sellers, Marshallian only need know demand price
  - \* Walrasian trade only takes place at equilibrium, Marshallian trading out of equilibrium with efficient rationing rule.

Both processes are centralised and don't really deal with expectations

- **Expectations**

- Consider a market in which there is a lag between the price and the response to it, so action takes place based on expected price:

$$y_t = s(p_t^e) \quad s' > 0$$

leave the demand function as before

$$x_t = D(p_t)$$

assume 'naive expectations'

$$p_t^e = p_{t-1}$$

which would be fine if moved from equilibrium to equilibrium,

$$D(p_t) = s(p_{t-1}^e) = s(p_t^*)$$

but assume a demand shift takes place then disequilibrium adjustment will take place

- For example with linear demand and supply curves

$$y_t = a + bp_{t-1}, x_t = \alpha - \beta p_t$$

can solve or linear difference equation setting  $y_t = x_t$

$$p_t = \frac{\alpha - a}{\beta} - \frac{b}{\beta} p_{t-1}$$

for stability the differences in price have to become smaller and smaller

$$\left( \frac{\alpha - a}{\beta} - \frac{b}{\beta} p_{t-1} \right) - \left( \frac{\alpha - a}{\beta} - \frac{b}{\beta} p_t \right) < p_t - p_{t-1}$$

that is

$$\frac{b}{\beta} (p_t - p_{t-1}) < p_t - p_{t-1}$$

or

$$\beta > b$$

Note only assume naive expectations and as we shall see we have other options such as rational expectations which would lead to the market always being in equilibrium -no systematic errors. Using this method shifts in prices only driven by shifts in underlying demand and supply curve not disequilibrium adjustments

### Long run equilibrium

- When looking at the firm we saw long run supply curve was the part of its long run marginal cost curve above the long run average cost curve. But cant just add these up to get market supply curve as:

- \* Input prices may change
- \* Cost curves may shift : expansion of scale of all companies leading to congestion or improvement in common facilities
- \* Changes in the number of firms in the market as a result of entry and exit -as price rises the marginal firm will leave

So not assured that LRS curve will be positively sloped but generally assume it

- May have excess profits -called 'quasi rents' -rents accruing to contractual property rights in certain efficient input services which become costs in the long run. In the long run all firms will be marginal firms
- Not all agree with L&R interpretation of Marshall :Trees of the forest...biological analogy
- Also importance of upward sloping curves -no increasing returns to scale
- Long run market supply curve is a complex entity -its slope and elasticity is dependent on returns to scale, input price variation, technological economies and diseconomies and new entrants. Adjustment in response to demand changes also complex: affected by relation bet SR and LR supply and nature of expectations.
- Analysis of long run competitive equil needs to be treated with care
- General equilibrium and the criticisms of New Classicals.

- **Monopoly**

- So far have assumed that firms are price takers but obviously not always true, particularly in the extreme case of monopoly. Assumed to maximise profits in a stable known environment with given technology and market conditions, diminishing MP with fixed inputs and u shaped cost curves.
- Faces a downward sloping demand curve -its demand curve is the market- Writing in the inverse form and defining a cost function allows us to write the profit function:

$$\begin{aligned}
 p &= D(q) \\
 C &= C(q) \\
 \pi(q) &= pq - C(q)
 \end{aligned}$$

maximising this gives first and second order conditions:

$$\begin{aligned}\pi'(q) &= p + q \frac{dp}{dq} - C'(q) = 0 \\ \pi''(q) &= 2 \frac{dp}{dq} + q \frac{d^2p}{dq^2} - C''(q) < 0\end{aligned}$$

the term

$$p + q \frac{dp}{dq}$$

is the derivative of total revenue with respect to output i.e. it is marginal revenue. We can rewrite as

$$\begin{aligned}MR &= p \left( 1 + \frac{q}{p} \frac{dp}{dq} \right) \\ &= p \left( 1 + \frac{1}{e} \right)\end{aligned}$$

where  $e$  is the elasticity of demand

$$\begin{aligned}e < -1 &\Rightarrow MR > 0 \\ e = -1 &\Rightarrow MR = 0 \\ e > -1 &\Rightarrow MR < 0\end{aligned}$$

from first order condition  $MR=MC$

$$p \left( 1 + \frac{1}{e} \right) = C'(q)$$

Monopolist price always exceeds marginal cost since price elasticity is finite. Optimal output is always at a point on demand curve where  $e < -1$

- Comparing the monopolist price to that which would rule under competition is often used to give a measure of market power/degree of monopoly. The Lerner index of monopoly power is:

$$\frac{p - MC}{p} = \frac{-1}{e}$$

as  $e \rightarrow -\infty$  the competitive case monopoly power tends to zero

- **Price discrimination**
- different customers charged different prices for the same good -couldn't happen in competitive market because of arbitrage

- Suppose can divide the market up in two subgroups with different demand curves, set  $MR = MC$ , but in this case  $MR_1 = MR_2 = MC$  which implies charging different prices to the two groups.

$$MC = p_1\left(1 + \frac{1}{e_1}\right) = p_2\left(1 + \frac{1}{e_2}\right)$$

$$\frac{p_1}{p_2} = \frac{\left(1 + \frac{1}{e_2}\right)}{\left(1 + \frac{1}{e_1}\right)}$$

so

$$e_1 = e_2 \Rightarrow \frac{p_1}{p_2} = 1$$

meaning there is no discrimination

- In fact this is just one form of discrimination we could consider:
  - \* First degree price discrimination: where monopolist can identify the demand of each individual customer and prevent arbitrage
  - \* Second degree discrimination: where the monopolist knows the demand characteristics of customers in general, but cannot identify individual customers
  - \* Third degree discrimination: where the monopolist has some information that allows partitioning of buyers into submarkets and prevent arbitrage between them. -as above
- See textbook