MANCHESTER 1824

The University of Manchester

Fundamentals of Markets

Important Acknowledgement:

These notes on Kirschen/Strbac (Chapter 2.2, 2004) are based on slides prepared by Daniel Kirschen (U Manchester) **with edits by Leigh Tesfatsion (Iowa State U).**

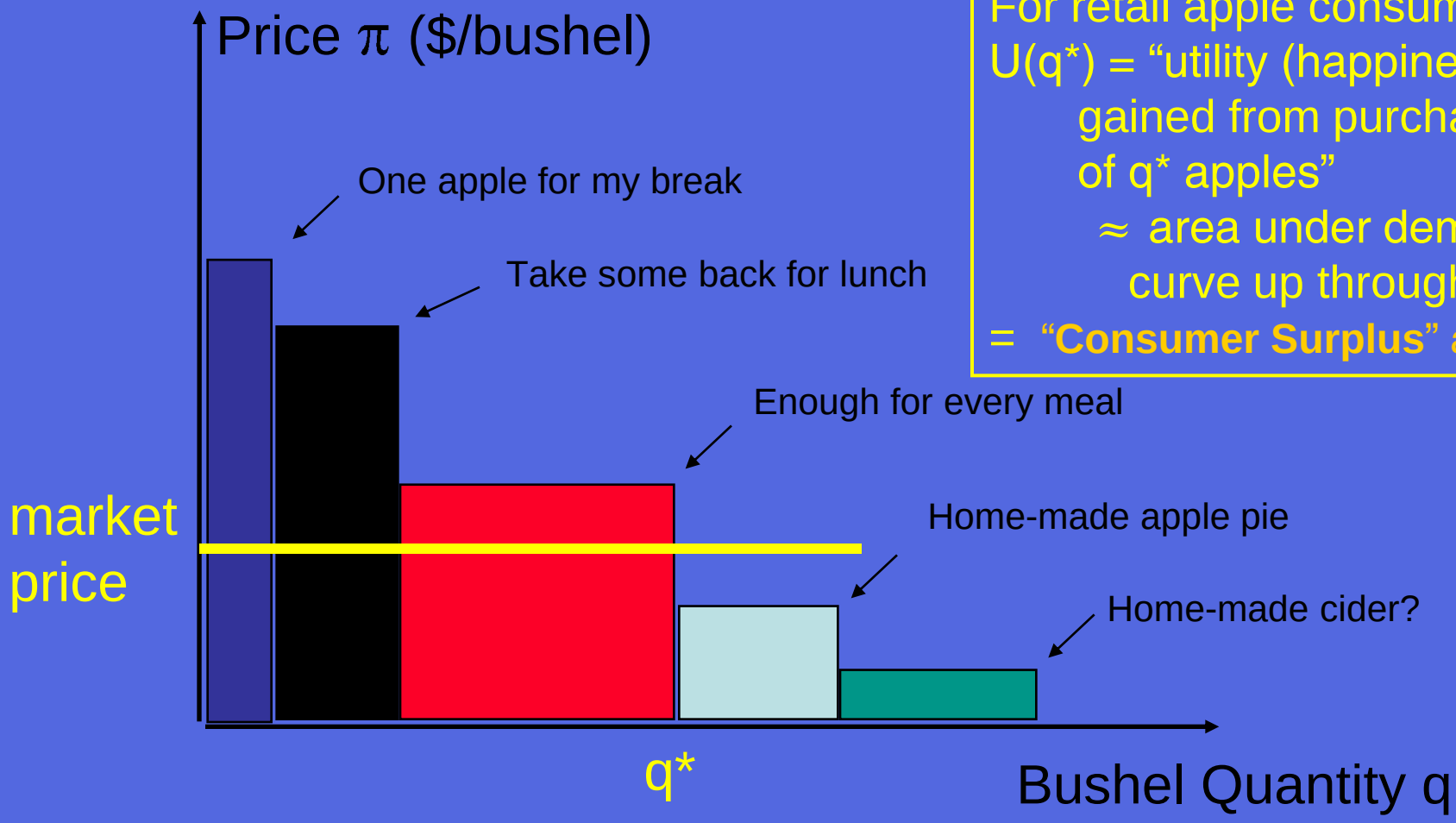
Last Revised: 8 September 2011

Why markets…

- Opportunity for sellers and buyers to:
  - compare prices
  - make supply offers
  - make demand bids
- Facilitates the achievement of an equilibrium (balance) between supply and demand

Demand Example: How does a competitive (i.e., a price-taking) apple consumer decide on his apple purchase?

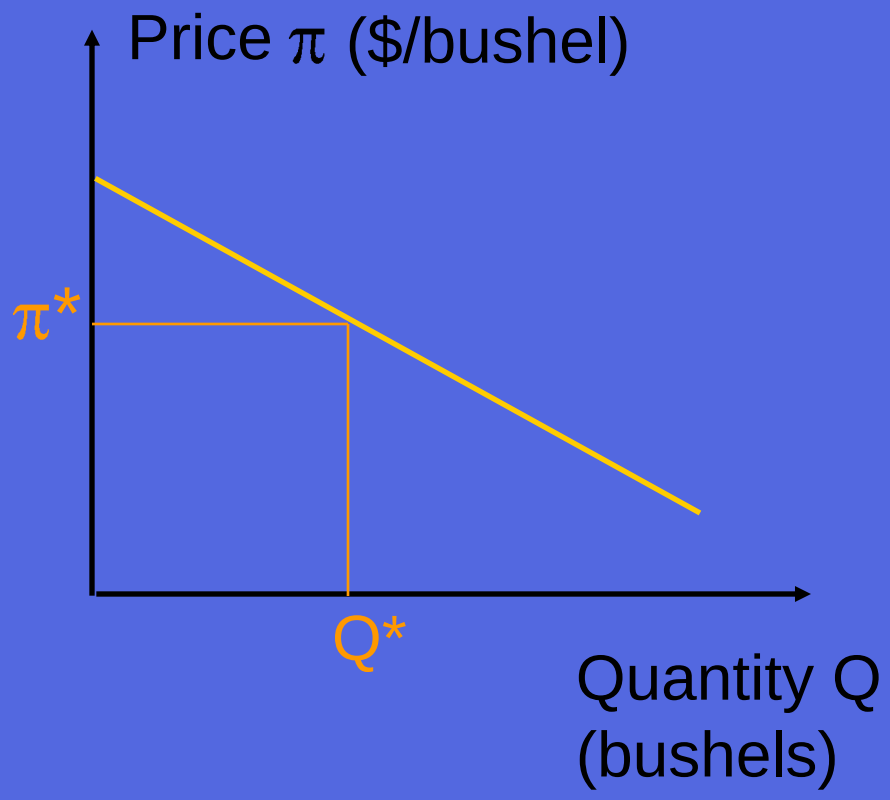
For retail apple consumers,
U(q*) = "utility (happiness) gained from purchase of q* apples"
≈ area under demand curve up through q*
= "**Consumer Surplus**" at q*



A competitive (price-taking) utility-maximizing consumer purchases bushels up to the level q* where the market price first exceeds his reservation price.

Total Market Demand Function:

Example below for “infinitesimal” (continuous) bushel units



- Aggregation of the individual demands of all buyers
- **Ordinary demand function:**

(For each price π, maximum amount Q consumers are willing to buy)

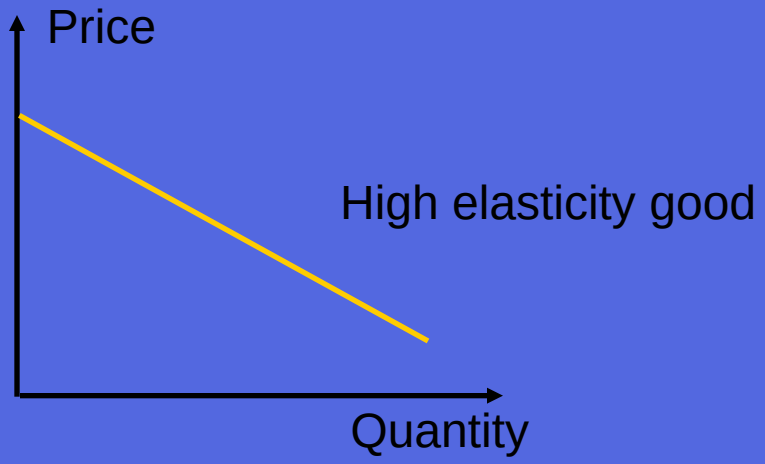
$$Q = D^{o}(\pi)$$

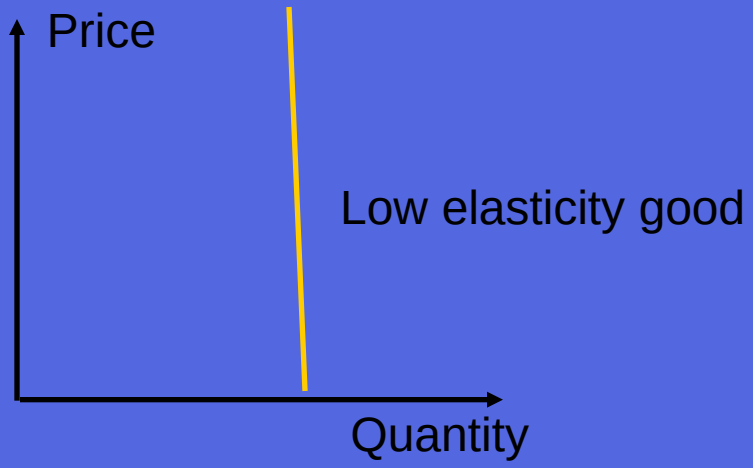
- **Inverse demand function:**

(For each quantity Q, max price π consumers are willing to pay for ***last*** bushel bought at Q)

$$\pi = D(Q)$$

Price Elasticity of Demand:





- Slope of demand schedule *roughly* indicates the "price elasticity of demand," i.e., the % change in quantity demanded per % change in price
- **High elasticity (flat slope)**
  - Non-essential good
  - Easy substitution by other goods
- **Low elasticity (steep slope)**
  - Essential good
  - No substitutes
- **Demand for electrical power in U.S. currently has very low elasticity in the short run !**

Rigorous Mathematical Definition for the Price Elasticity of Demand:

- Assuming a differentiable ordinary demand function $q = D^o(\pi)$, where π = price and q = quantity demanded:

$$\varepsilon = \frac{\frac{dq}{q}}{\frac{d\pi}{\pi}} = \frac{\pi}{q} \cdot \frac{dq}{d\pi} = \frac{\text{\% change in q}}{\text{\% change in } \pi}$$

- Dimensionless quantity
- Negative sign (the higher the price, the lower the demand)

Supply-Side Example: How does a "competitive" (i.e., a price-taking) apple producer decide on his supply function?

Preliminary Definitions:

- ***Avoidable costs*** = Costs that **CAN** be avoided by shutting down production and possibly taking additional actions such as sale or alternative use of productive assets
- ***Sunk costs*** = Costs that **CANNOT** be avoided by shutting down production
  - Example of SC: Investment in specialized production equipment with no resale value
- ***Net earnings*** = Revenues Minus Avoidable Costs

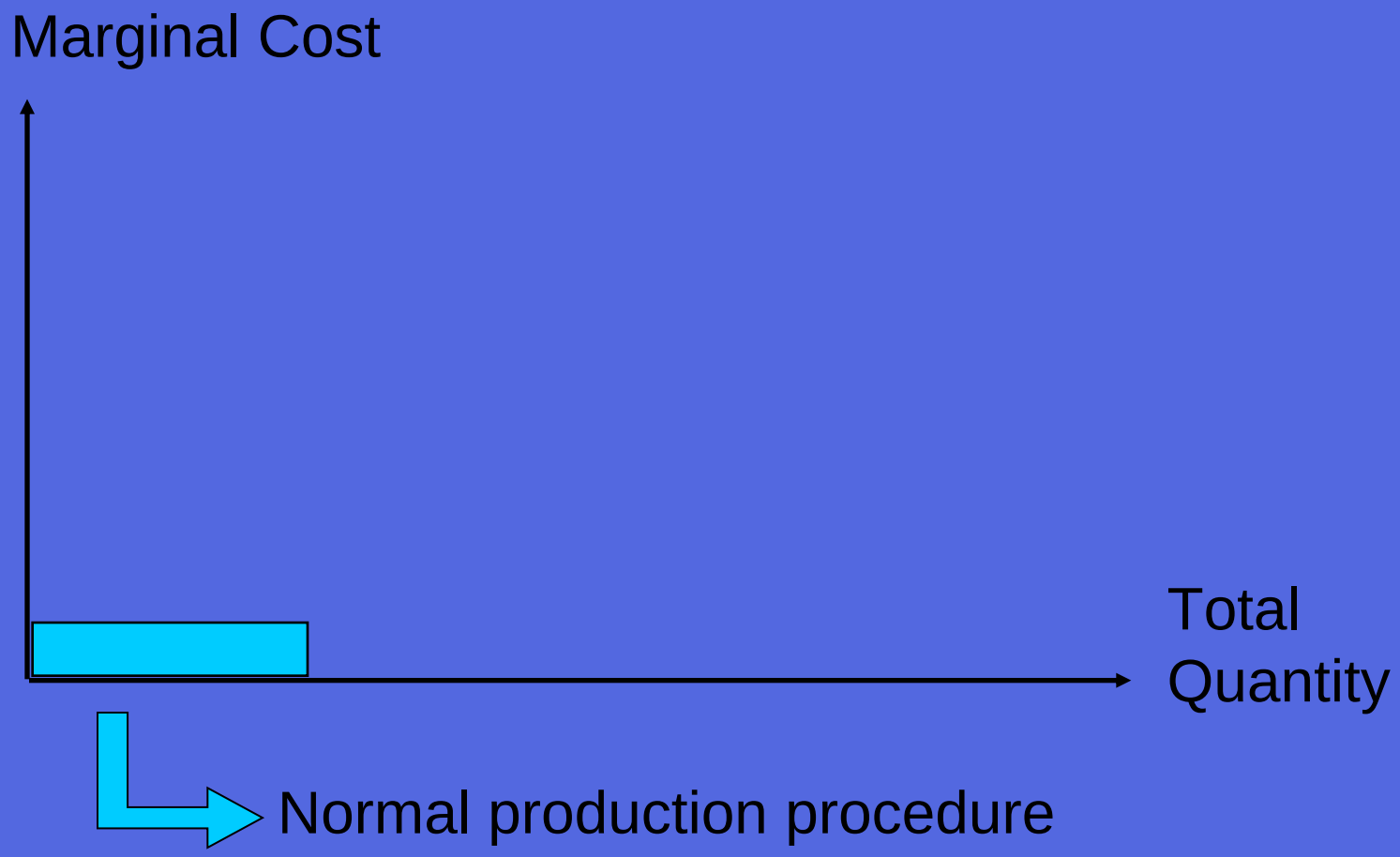
Supply-Side Example … Continued

How many apples should I produce today?

- **Goal:** Maximize ***net earnings***
- **Basic Rule of Thumb:**
  - Produce (rather than shut down) only if net earnings are positive for some $q > 0$
  - If net earnings are positive at $q > 0$, produce one more unit if and only if the sale price π for this unit is at least as great as the marginal cost MC of producing this unit:

$$\pi \geq MC$$

How much does the next bushel cost?



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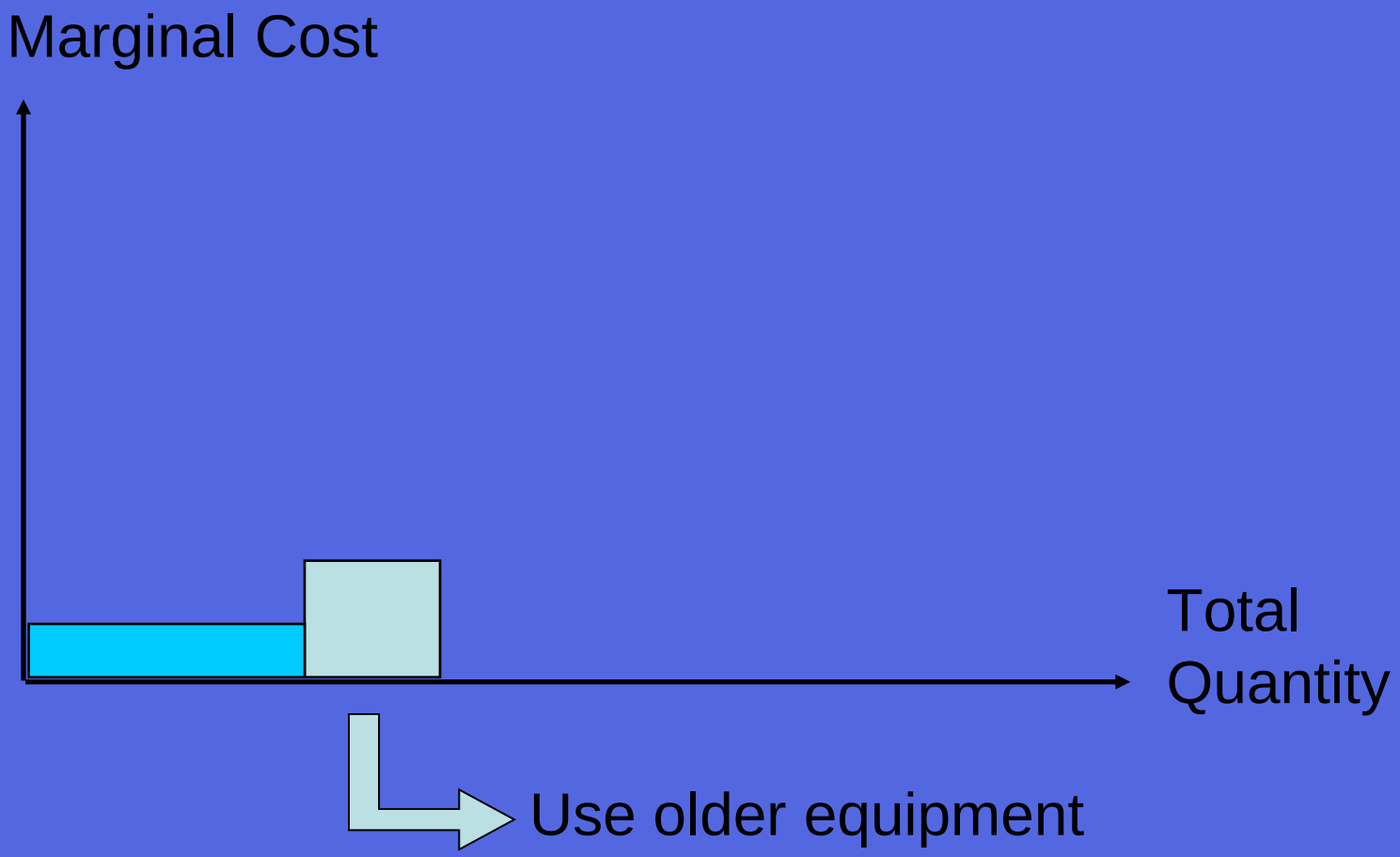

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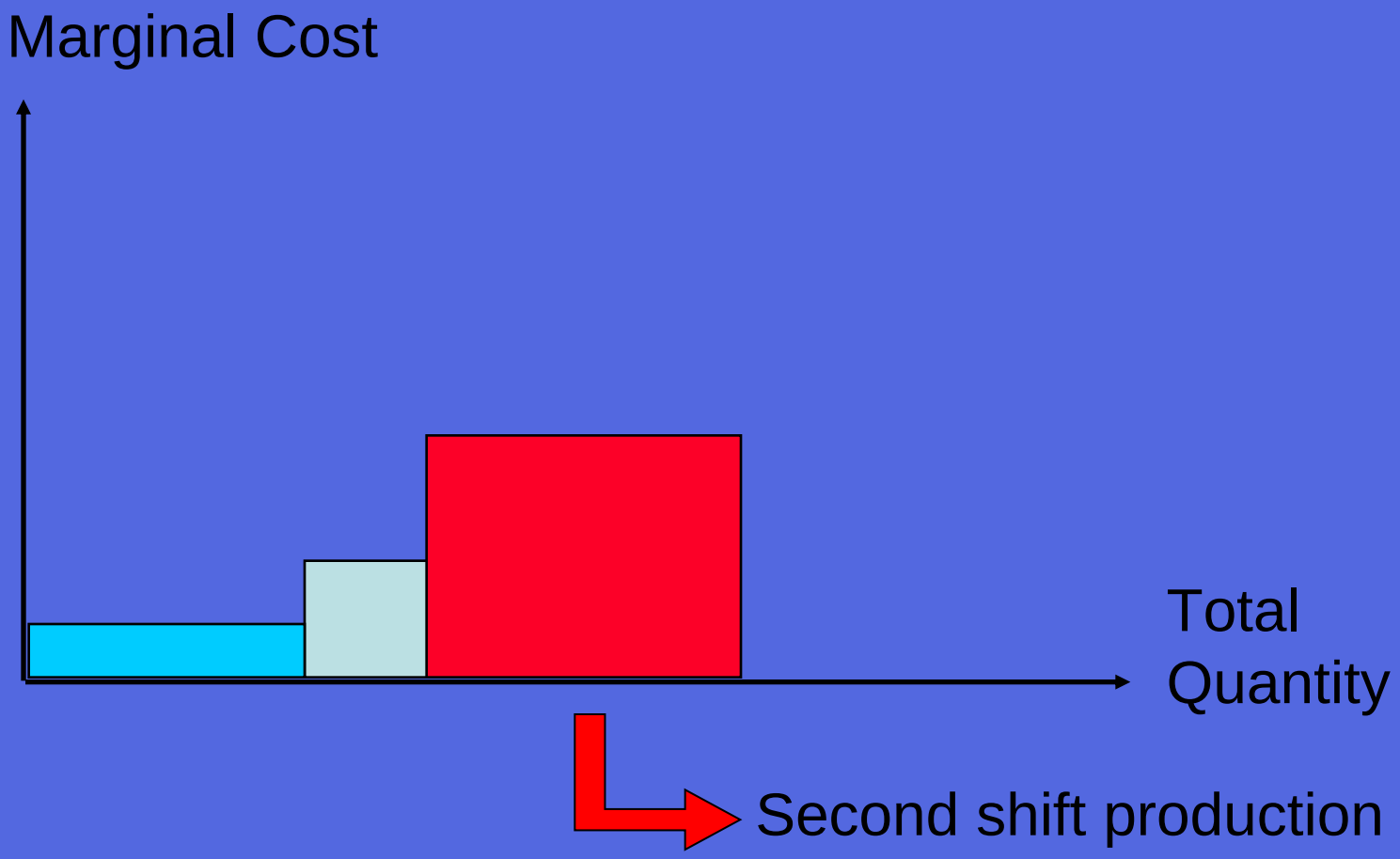

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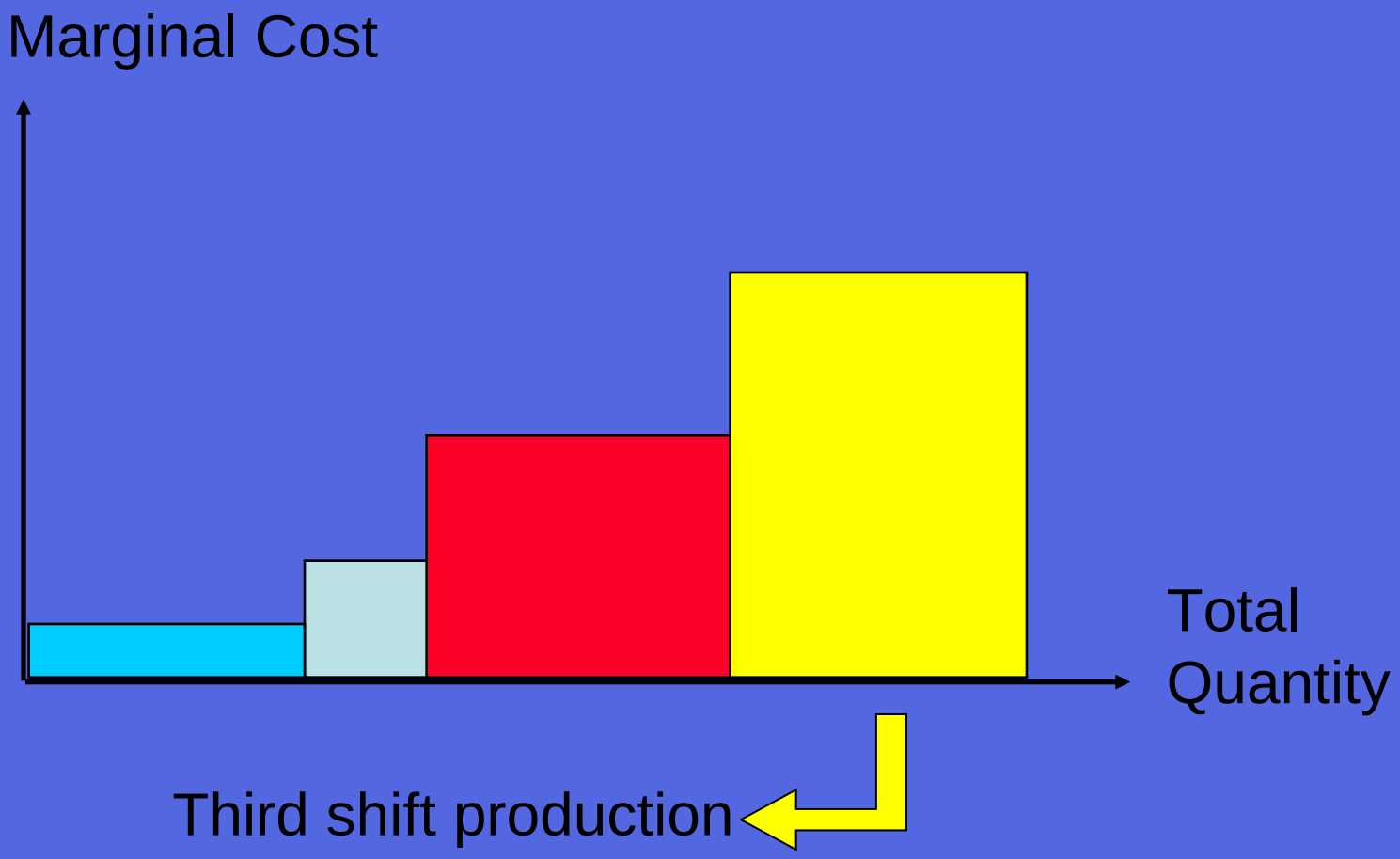

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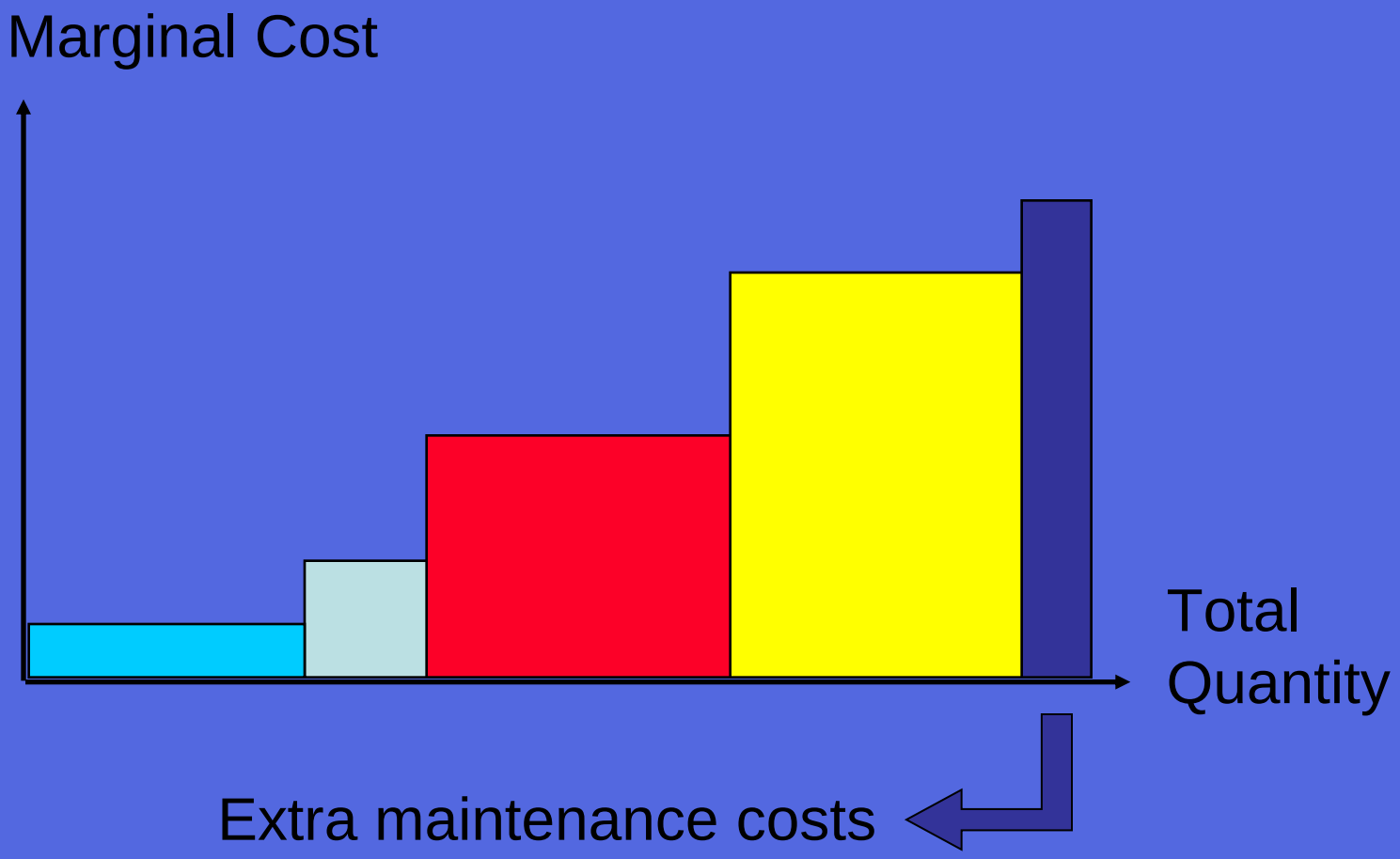
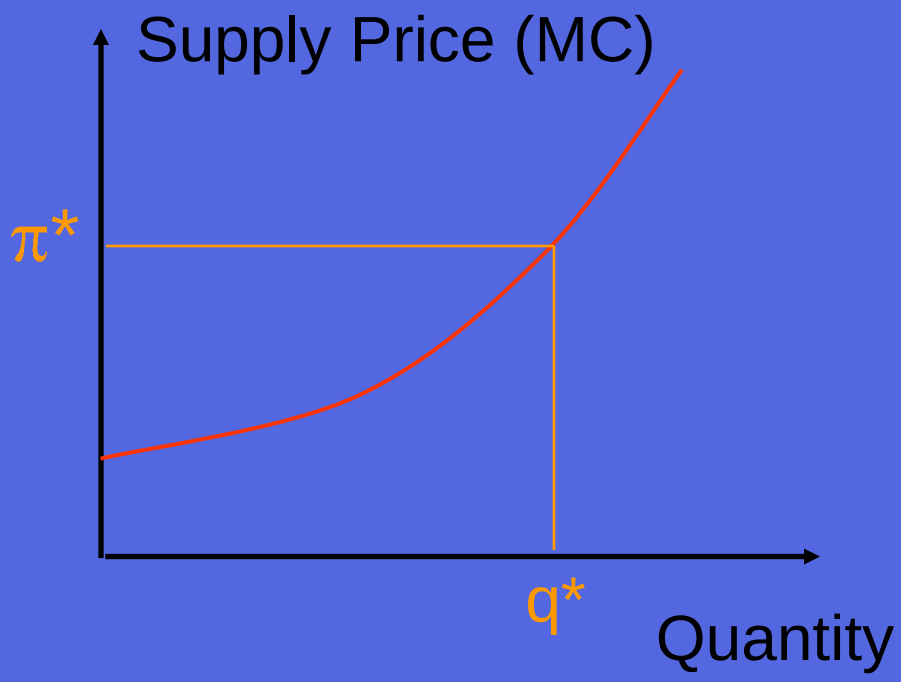


Economists assume a competitive producer's supply function coincides with ***upward sloping*** portion of his MC function:



- Considers only avoidable costs
- Does not take sunk costs into account
- Inverse supply function:

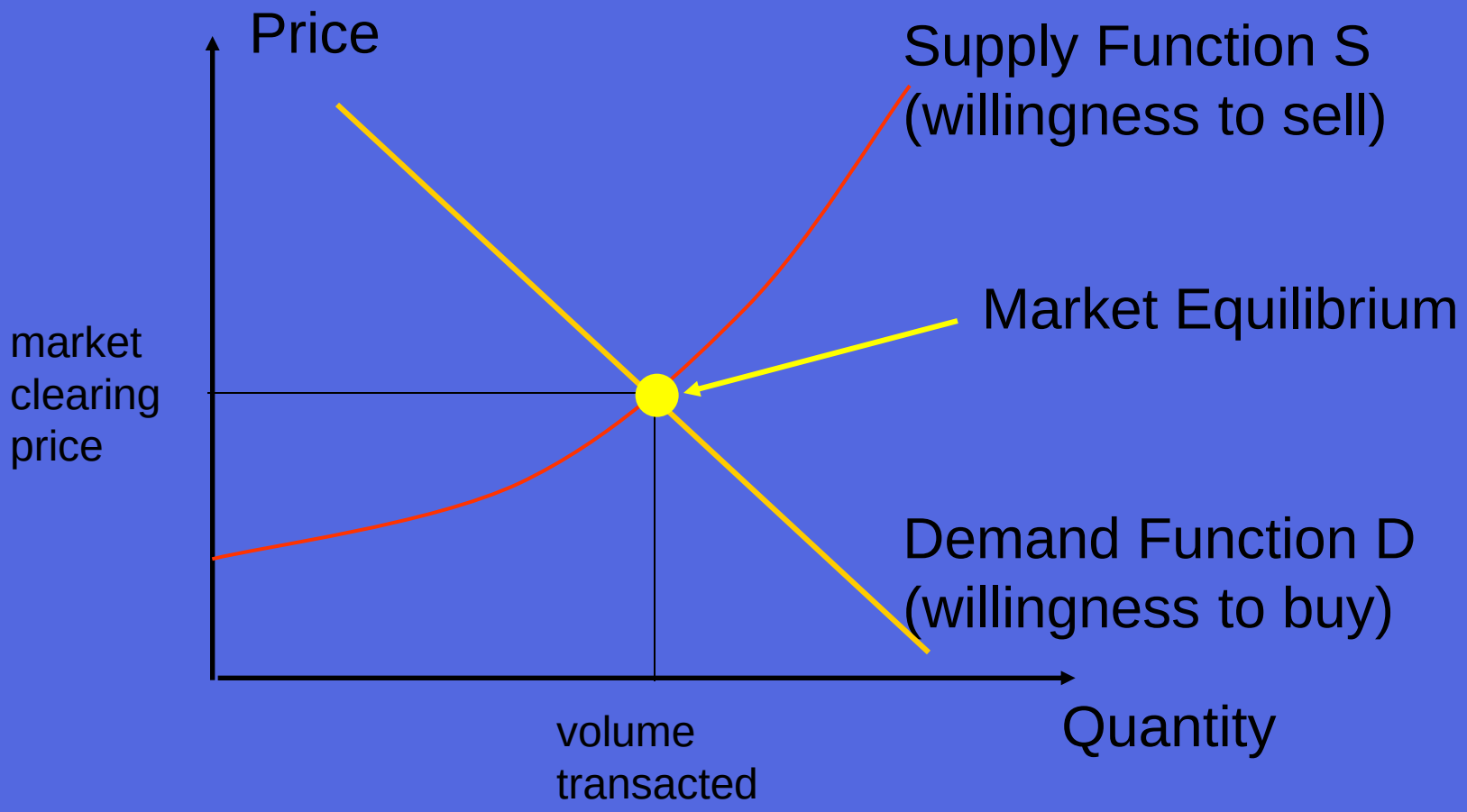
$$\pi = S(q)$$

- Ordinary supply function:

$$q = S^{o}(\pi)$$

- Total supply function for a competitive market is formed from aggregation of individual producers' supply functions

Competitive Market Equilibrium (S=D):



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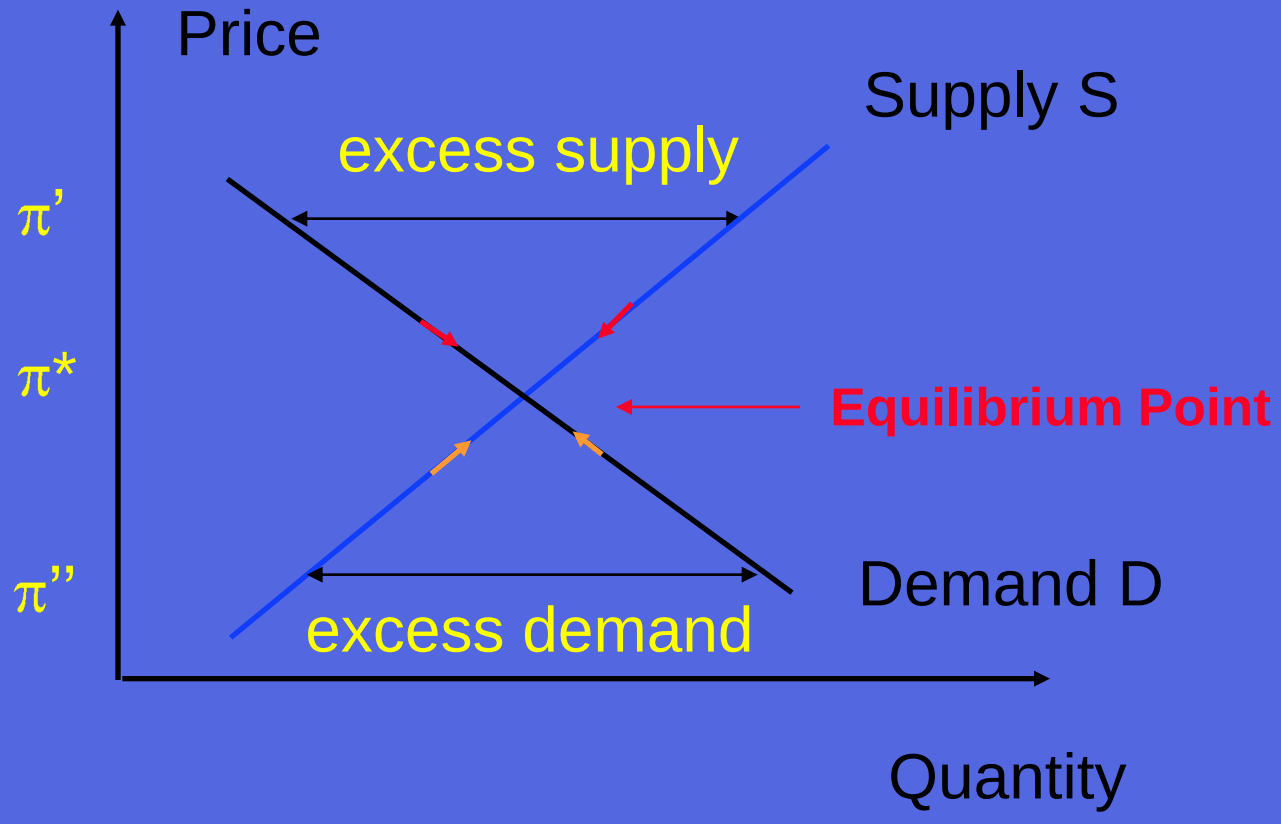

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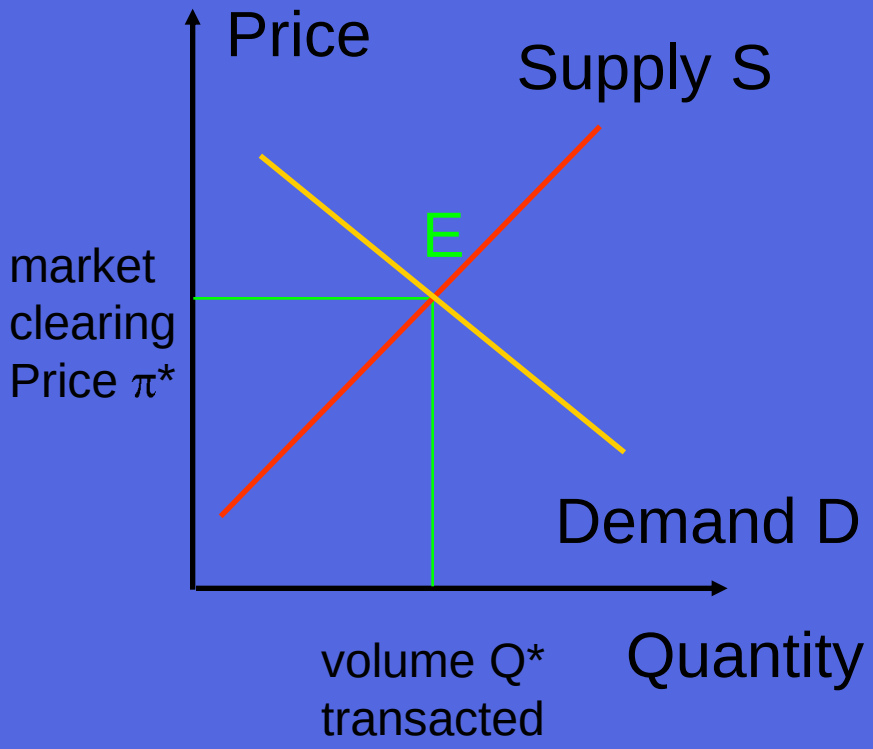


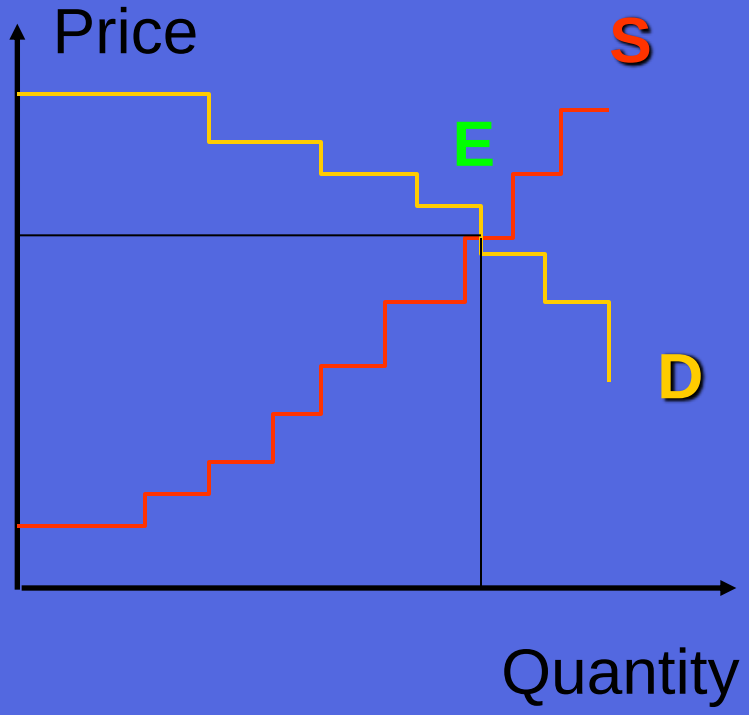
$$Q^* = D(\pi^*) = S(\pi^*)$$

$$\pi^* = D(Q^*) = S(Q^*)$$

- At E, *price-taking* sellers have no incentive to change their quantity supplies
- At E, *price-taking* buyers have no incentive to change their quantity demands

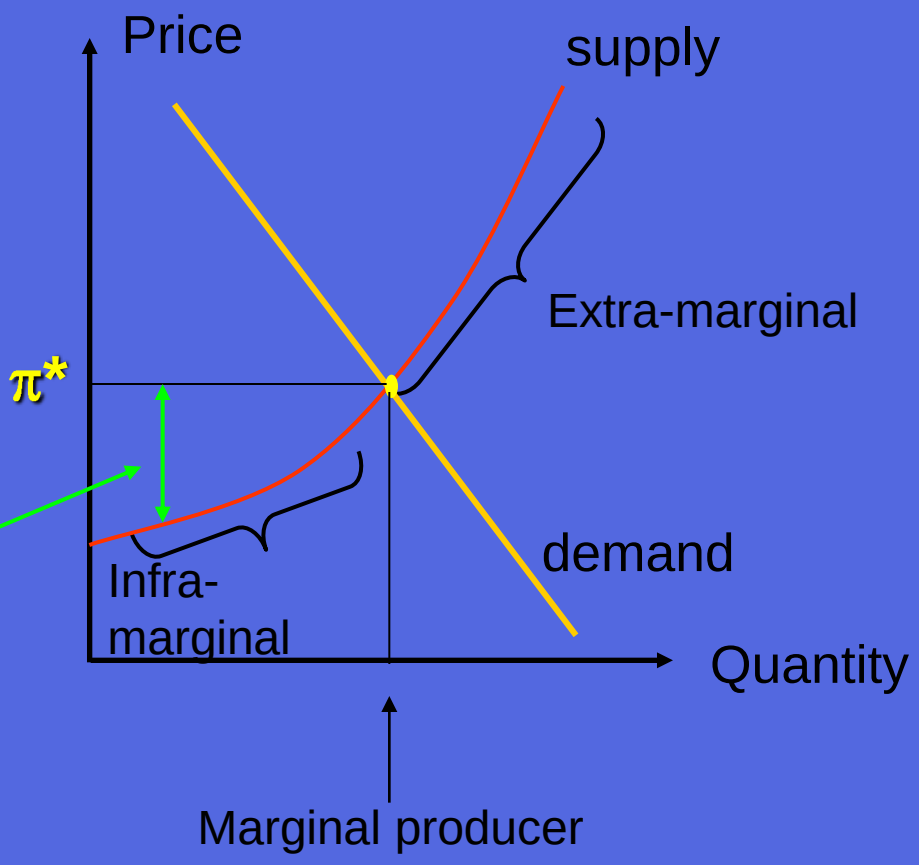
Uniform-Price Double Auction:

- Sellers submit supply offers: quantity and price
  - Offers are stacked in *ascending* order (by reservation price) to construct **Total Supply Function S**
- Buyers submit demand bids: quantity and price
  - Bids are stacked in *descending* order (by reservation price) to construct **Total Demand Function D**
- The auctioneer announces an intersection point S=D as the **outcome of the auction E**
  - Market clearing price
  - Market clearing quantity



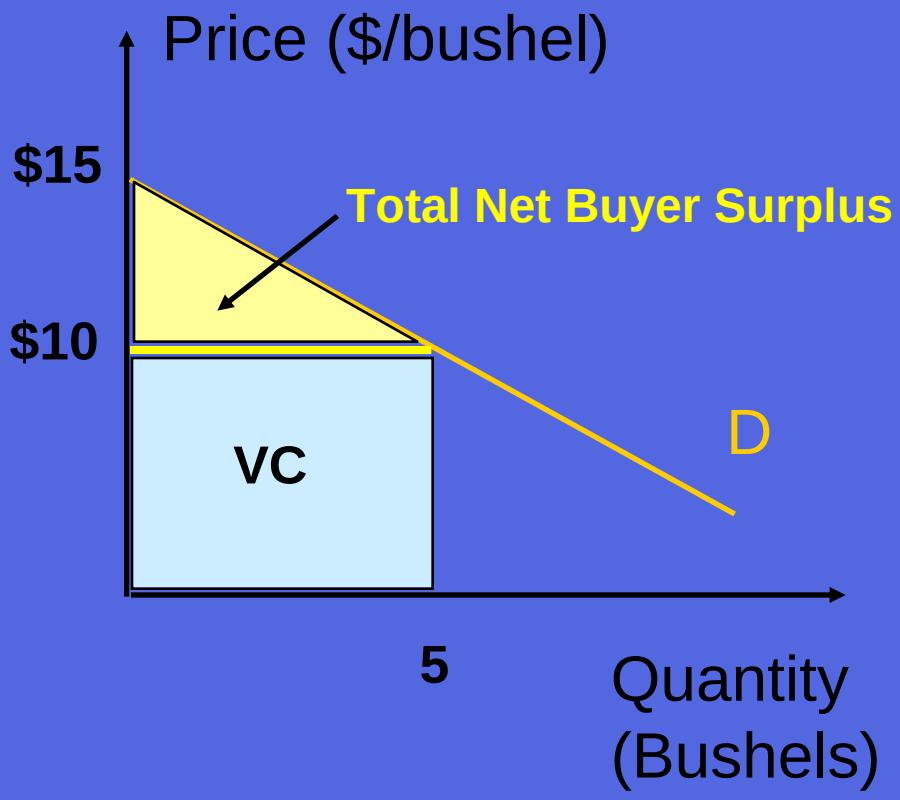
Uniform-Price Double Auction … Continued

- Every quantity unit sells at the market clearing price π^*
- Market price set by "last" unit sold
- ***Marginal producer:***
  - Sells this last unit
  - Gets exactly its offer price
- ***Infra-marginal producers:***
  - Collect positive net earnings
  - Get paid more than their offer
- ***Extra-marginal producers:***
  - Sell nothing

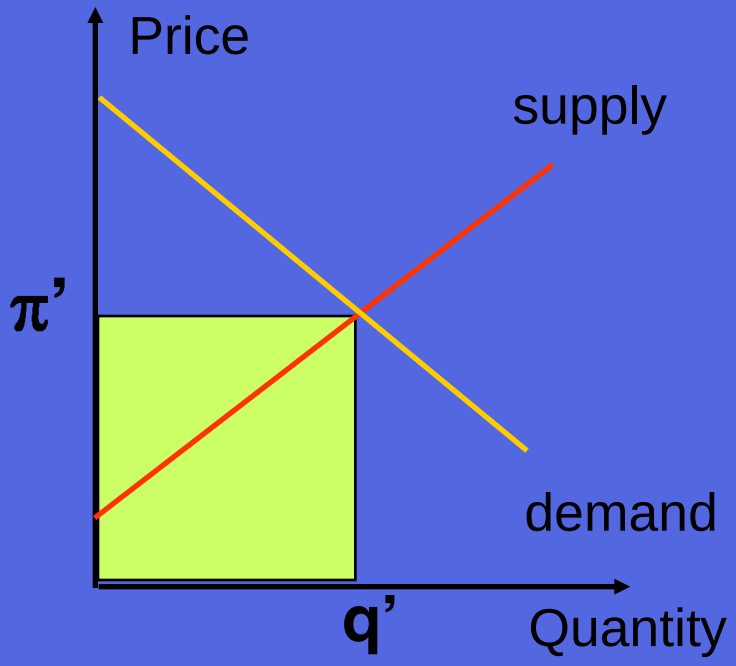


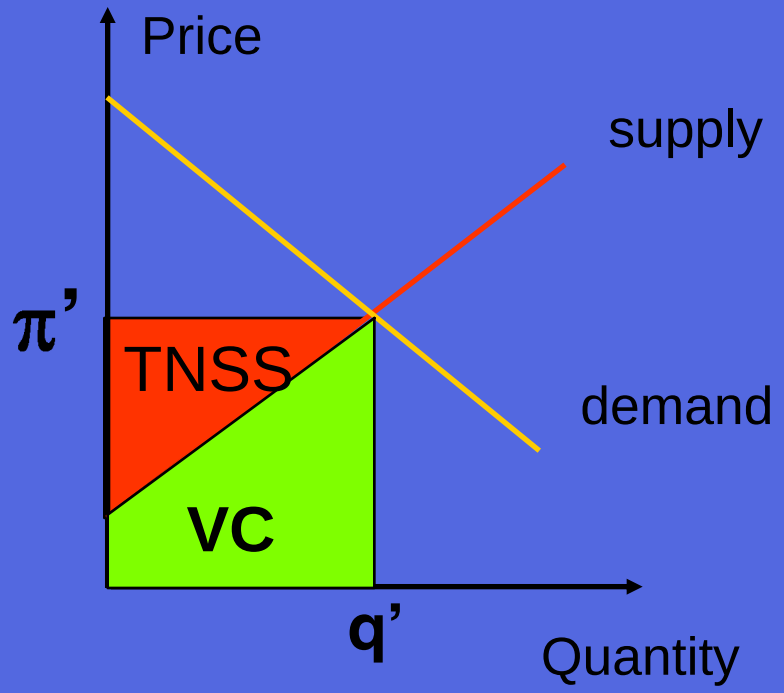
Total Net Buyer Surplus (TNBS):

- Suppose one or more buyers purchase 5 bushels of apples at $10/bushel
- VC (Avoidable Costs) = $50
- With this trade the buyers get bushels at $10/bushel for which they would have been willing to pay more.
- ***Total Net Buyer Surplus (TNBS)*** = Buyers total willingness to pay minus their avoidable costs
- Yellow triangle measures the buyers' TNBS from the purchase of 5 bushels of apples at $10/bushel



Total Net Seller Surplus (TNSS):





Seller Revenue = π' x q'

- *Avoidable Costs (VC)* for sellers include their variable costs of producing q' plus all avoidable fixed costs
- TNSS = [Seller Revenue – VC]

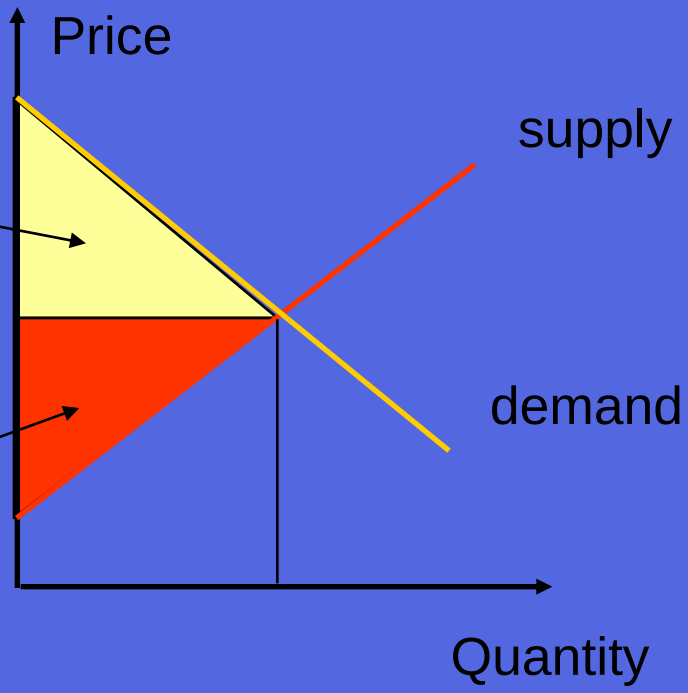
Total Net Surplus (TNS):

Total Net Buyer Surplus

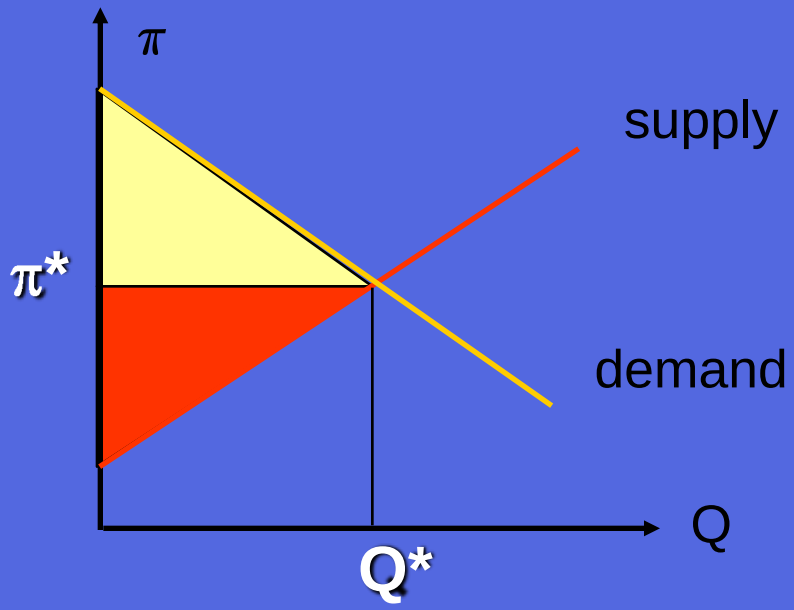
+

Total Net Seller Surplus

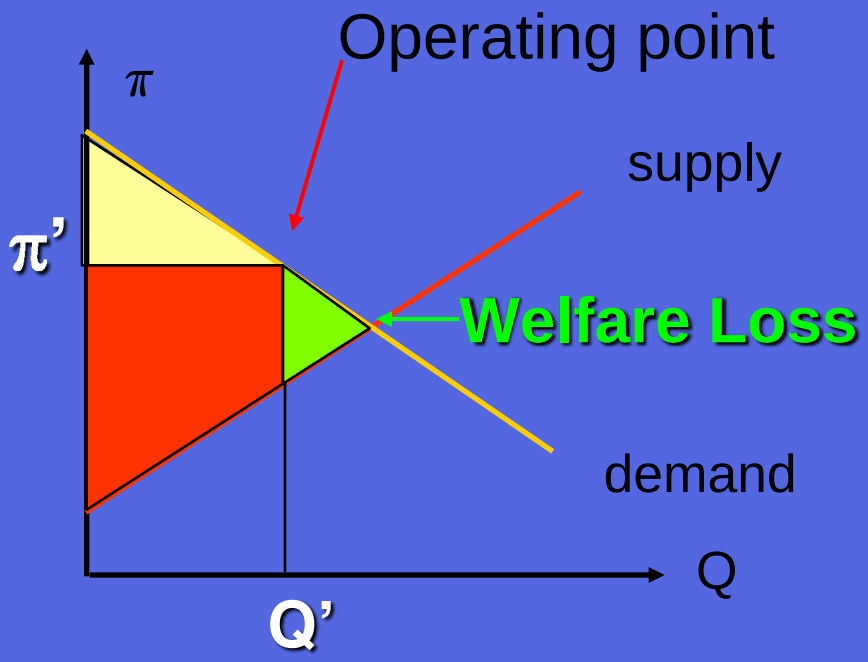
= Total Net Surplus



Competitive Market Equilibrium and Trader Welfare:



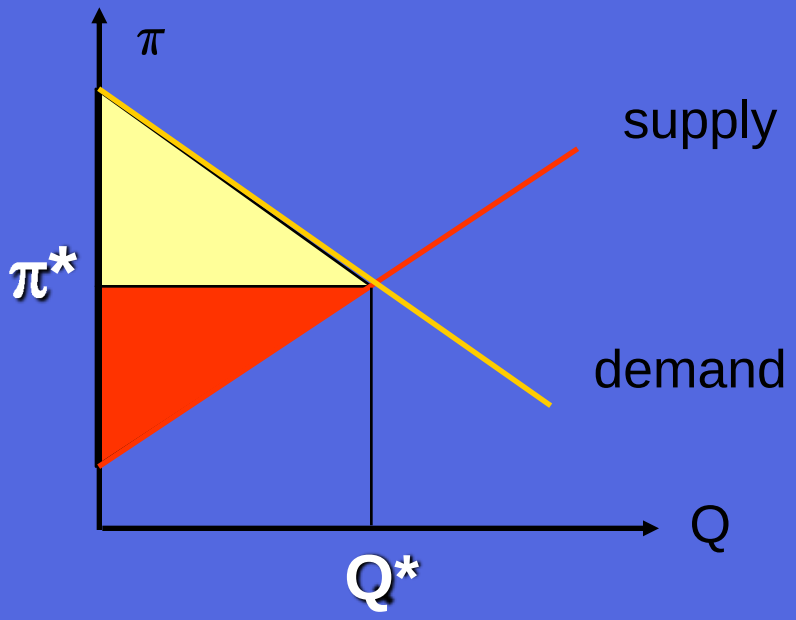
Market equilibrium at the *uniform* price π^* (all units sell at same price)



At ***higher*** uniform price π':

- larger total net seller surplus
- smaller total net buyer surplus
- smaller TNS

Competitive Market Equilibrium and Trader Welfare:



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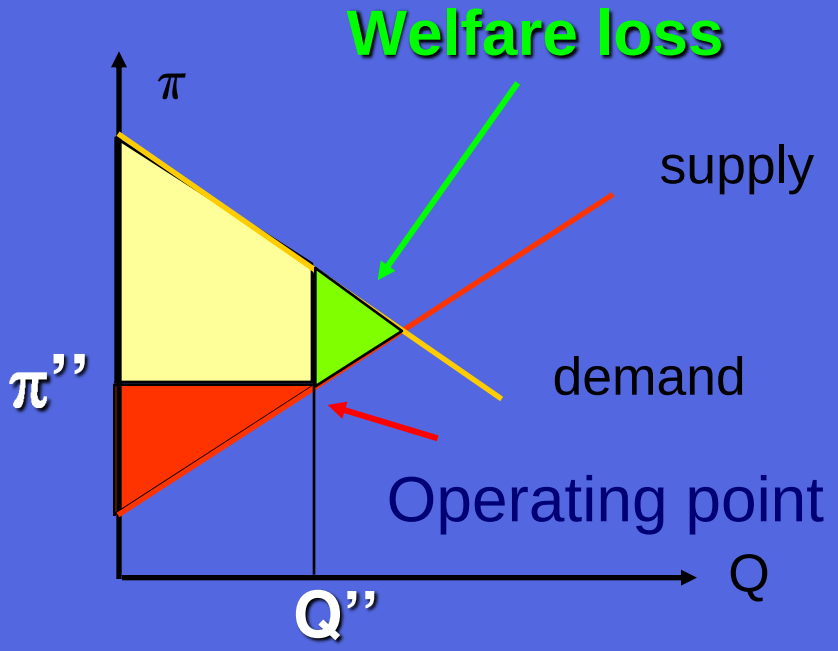


At ***lower*** uniform price π'' :

- Smaller total seller surplus
- Higher total buyer surplus
- Smaller TNS

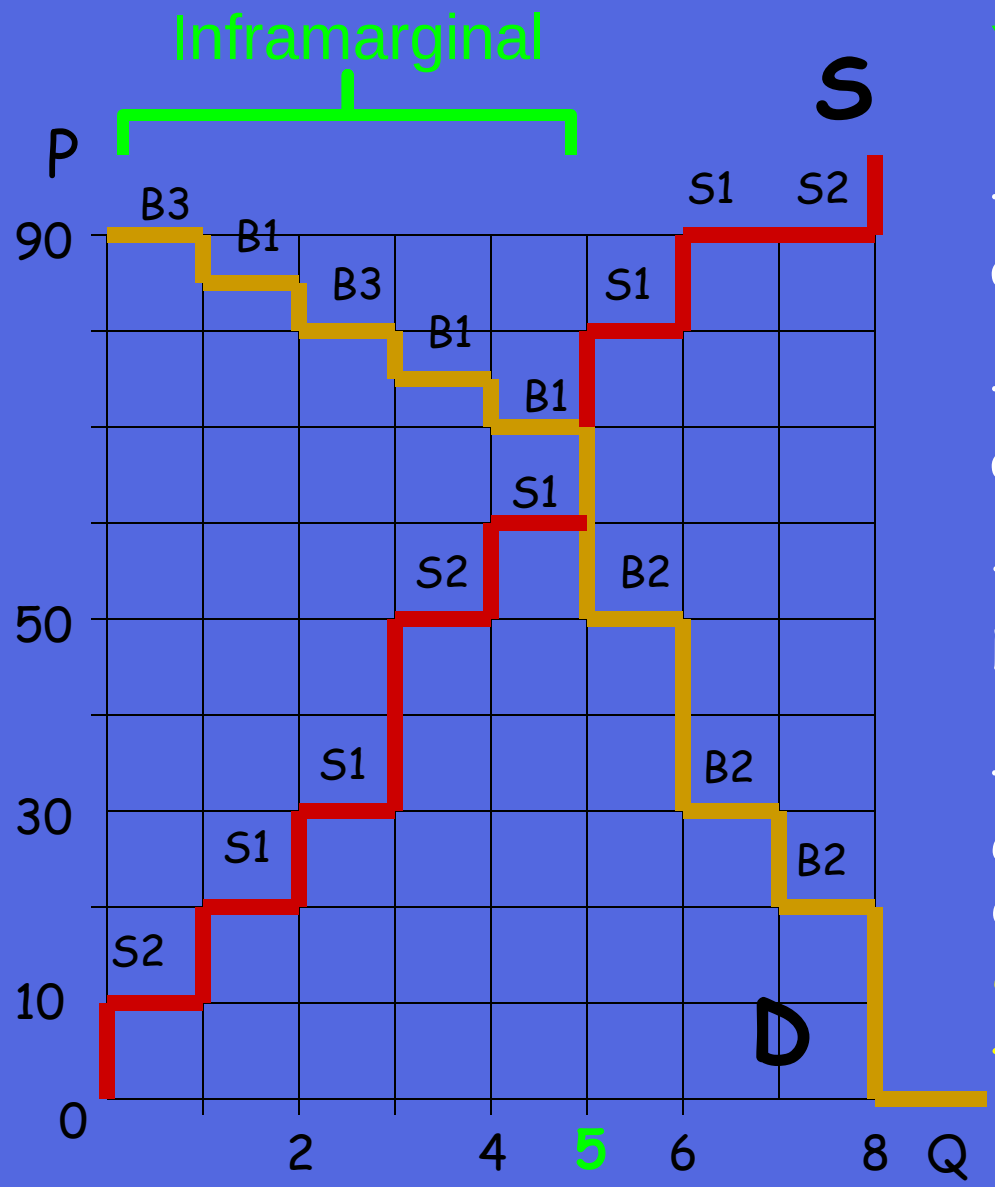
Efficient Market:

- A market is ***efficient*** if traders extract maximum possible Total Net Surplus (TNS)
- Maximum possible TNS is extracted at competitive market clearing (CMC) points
- Factors favouring market efficiency
  - Large numbers of buyer and sellers ("liquid" or "thick" markets)
  - Standardized commodity units
  - Buyers and sellers have access to good market information (prices, locations of all buyers/sellers,…)

A *Uniform*-Price Market is Not Necessary for Market Efficiency:

- Consider a “bilateral trade” market consisting of sellers and buyers who trade directly and independently with each other (no intermediaries)
- Sellers and buyers “shop around” for the best deal
- Sellers (buyers) check the prices offered by rival sellers (buyers) to avoid being “undercut” (“outbid”)
- **The market is efficient (maximum TNS is extracted) if all inframarginal buyers and sellers manage to trade, so Q = Q* (competitive volume), regardless of the exact pairings and regardless of the exact prices charged.**
- In this case the prices redistribute surplus among sellers and buyers but do not affect the TNS extracted at Q*.

Market Efficiency with "Discriminatory Pricing"

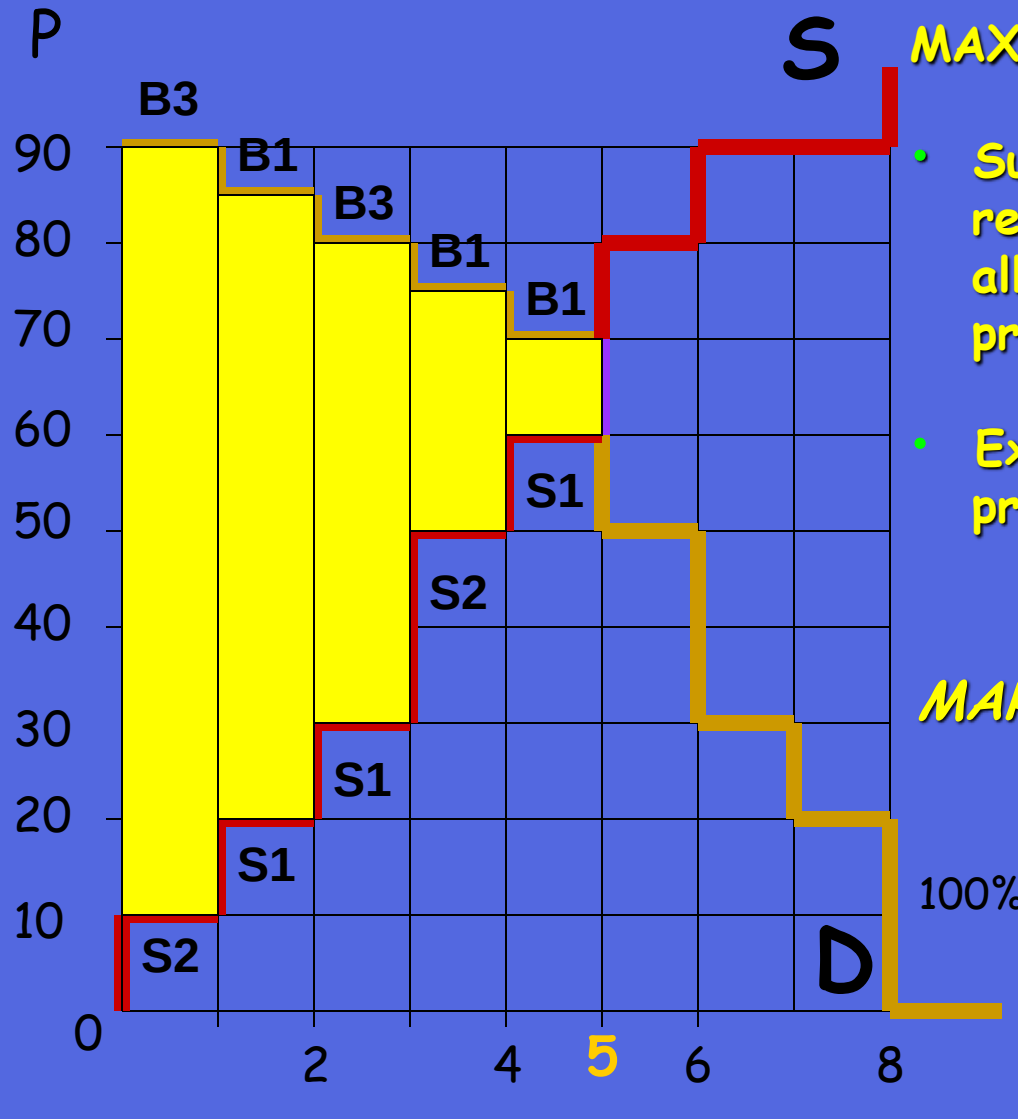


You Do:

Check that the maximum total net surplus is extracted as long as B1 buys three units, B3 buys two units, S1 sells three units, S2 sells two units, and no other units are traded.

This is true regardless of how B1, B3, S1, S2 are matched in pairs to carry out these trades, and regardless of the exact purchase/sale prices decided on in these matches *as long the seller receives the same price as the buyer pays – no third party "extractions".*

Market Efficiency:



MAX TOTAL NET SURPLUS: $230

- Sum of all inframarginal buyer reservation prices minus sum of all inframarginal seller reservation prices at CMC quantity Q*=5
- Exact buyer-seller pairings and prices *charged* do not matter

MARKET EFFICIENCY (ME) =

$$100\% \times \frac{\text{Actual Extracted Surplus}}{\text{Max Possible TNS}}$$

Examples:

- Efficient markets
  - Corn available at a farmers' market ?
  - Chicago mercantile exchange ?

- Inefficient markets
  - Used cars ?
  - Financial market for Collateralized Debt Obligations (CDOs) constructed on the basis of subprime residential mortgages ?