

# Production Topic List

## Factors, Production Sets and Functions (MWG 5.B)

- Factors of Production: Land, Labor and Capital
- Production plans, production sets
- Production functions

## Properties of Technologies (MWG 5.B)

- No free lunch, possibility of inaction, free disposal, convexity, returns to scale
  - Nice treatment of returns to scale in Varian 1.10
- Isoquants, isoquant versions of above properties
- Marginal product, “law” of diminishing marginal product
- Marginal Rate of Technical Substitution (MWG) / a.k.a. Technical rate of substitution (Varian)
- Marginal rate of transformation
- Elasticity of substitution (Varian 1.9, Jehle & Reny p. 129-131)

## Cost

- Opportunity cost of owned factors
- Entrepreneurial ability and normal profit
- Short versus long run (end of MWG 5.D)

## Cost minimization—long run (MWG 5.C)

- In math and in pictures (isoquant and iso-cost line)
- SOC: need hypothesis of diminishing marginal rate of technical substitution
- As necessary condition for profit maximization
- Lagrange multiplier as marginal cost of production
- Prop 5.C.2 (find proofs in MWG Section 3.E, 3.G because of analogy to Expenditure Function; or Varian Ch. 5)
- Solution function: conditional factor demand correspondence/function  $z(w, q)$

- Value function: cost function  $c(w, q)$ ; some properties are only in Varian Section 5.4
- Shephard's Lemma

Profit maximization—long run (earlier in MWG 5.C)

- We assume throughout that markets are competitive, i.e. price-taking behavior / price vector are parameters
- Convex production set implies FOCs necessary *and* sufficient
- Marginal revenue product = marginal cost + relationship to cost min problem
- Caveats: corner solutions, CRS may lead to no profit-maximizing plan
- Solution function(s): factor demand  $z(p, w)$  and supply function  $y(p, w) = f(z(p, w))$ 
  - Law of supply
- Optimal value function: profit function  $\pi(p, w) = p \cdot y(p, w) - w \cdot z(p, w)$ 
  - Hotelling's lemma
- Properties of factor demand and profit function in MWG Proposition 5.C.1, supplemented by Varian

Production duality (Varian Chapter 6, MWG Prop 5.C.1iii and 5.C.2ii)

- Uses of duality
- Essential idea: if you have factor demand behavior, you can recover production function; if you have production function, you can derive factor demand behavior / cost function
  - Caveat: what if  $f(z)$  is not convex?
- Recoverability Theorem (I prefer Varian's on page 84; J&R Theorem 3.5 is a more restrictive version)
- Integrability: Varian section 6.3
- Weak Axiom of Cost Minimization (WACM): Varian, pg. 61
- Weak Axiom of Profit Maximization (WAPM): Varian, Section 2.6

Total / Average / Marginal Cost (Varian 5.1 and 5.2, MWG 5.D)

- Fixed vs. sunk costs (see Journal of Economics Ed. article)
- Average cost:  $C(q)/q = c(\bar{w}, q)/q$ 
  - Short-run typically assumed to be U-shaped; can be in long-run as well if long-run fixed factor

- Implications of returns to scale on average cost curve
- Marginal cost:  $C'(q) = \frac{\partial C(q)}{\partial q}$ 
  - Relationship to average cost curve, see especially MWG 5.D
  - Properties in MWG Proposition 5.C.2 parts viii and ix

#### Short run (MWG 5.D)

- Complications with fixed cost terminology (JEE article)
- U-shaped short run average cost curve (Varian p. 68)
- Short run versions of total, average, marginal cost
- Cost minimization
  - Relationship between short run and long run cost functions (total, marginal, average)
- Profit Maximization and Supply
  - Same problem as long-run profit max, just separate out sunk costs
  - Define short-run analogs to profit, supply and factor demand
  - All properties go through, except HOD 1 in variable factor prices for profit function
  - See Jehle and Reny p.153 for short run shut down condition