

MRS. ROBINSON REVISITED

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CHAPTER I

INTRODUCTION

Objectives

Students of economics often encounter in their studies the work of an economist that demands a thorough and concentrated examination of concepts presented in order to achieve a significant understanding of the economist's contribution to his discipline. Confusion often results when students fail to recognize definitional distinctions or the author fails to present a concept in sufficient detail to permit an understanding of the material. When properly explained in the context of the author, a new light is shed and value to the student, as well as to the discipline, is recognized.

Joan Robinson¹ in her book, The Economics of Imperfect Competition,² presents two digressions, a digression on rent and a digression on four cost curves. These often present a hurdle to complete understanding for some students.

¹Joan Violet Robinson (1903) is Professor of Economics at the University of Cambridge, Cambridge, England. In addition to The Economics of Imperfect Competition, other selected publications include: Essays in the Theory of Employment, Essay on Maxian Economics, Collected Economic Papers, The Accumulation of Capital, Economics: An Awkward Corner, and The Cultural Revolution in China.

²Joan Robinson, The Economics of Imperfect Competition, Second Edition (New York: Macmillan and Co., Ltd., St. Martin's Press, Inc., 1969).

It is the objective of this study to revisit the two digressions of Robinson and, with the aid of appropriate graphs and statements of conditions, use the tools of Robinson to: (1) explain the derivation of industry rent with a heterogeneous input; and (2) develop the appropriate supply curve for an industry in perfect competition. Furthermore, this analysis will be expanded to cover conditions beyond those discussed by the English economist in an effort to present competitive industry situations as they might exist in the economy.

Outline

The remainder of this introductory chapter is devoted to defining terms used in this study. Robinson's concept of efficiency units and economies of large-scale industry are introduced.

Chapter two deals specifically with the digression on rent. The Robinson concept of efficiency units is applied to alternative conditions in the discussion of differential rent when a resource is heterogeneous in quality. A resultant general statement is derived that disagrees with the generally implied quality price per efficiency unit derived by Mrs. Robinson when more than one quality of a resource is used by an industry in the short run.

Chapter three is devoted to a consideration of the four cost curves faced by a firm and an industry in a competitive society. Analysis reveals the appropriate long run supply curve for the firm and industry, the effect of rent on the cost curves, and the relationship of the curves to industries under conditions where combinations of scarcity and economies prevail.

Economic Rent

Rent is traditionally defined as income in excess of that necessary to maintain a resource in its present use.³ Thus, whether one be classical or more modern in his viewpoints on rent, there must be economic value if a resource is to command economic rent. This does not mean, however, that economic rent and total economic value paid for a factor are synonymous.⁴

Modern day economists⁵ recognize that a factor may have an alternative use. Economic rent is a surplus payment above that required to maintain a productive factor in a given use. The cost necessary to keep a factor in a given use is called the transfer price or transfer earnings. It is important to note that a payment made for the use of a factor, commonly called "rent," is the layman's term. Layman's "rent" may or may not include any economic rent. Thus, a farmer paying \$10

³Mark Blaug in his Economic Theory in Retrospect (Homewood, Illinois: Richard D. Irwin, Inc., 1962) summarizes rent concepts of economists from Smith to Keynes. Smith, Ricardo, and Marshall are explored on their concepts of scarcity and differential rent.

⁴The classical economists might offer some objection to this statement. They felt any value offered for a naturally productive resource, originally given to man free, represented economic rent.

The classical economists limited economic rent to earnings of land, a general term for all "free gifts of nature," and assumed all earnings of such land to be rent in the economists' sense. Robinson and the modern economists (See footnote 5) recognize that rent can be earned by factors belonging to the categories of labor, capital, and entrepreneurship.

⁵Considered as the more contemporary English economists by Dean A. Worcester, Jr., in his "A Reconsideration of the Theory of Rent," American Economic Review (June, 1946), Vol. 36, No. 3, pp. 258-277, are H. D. Henderson, Joan Robinson, Kenneth Boulding, Robert Triffin and Albert Meyers.

an acre layman's "rent" for wheat land is paying \$3 economic rent if he must pay at least \$7 an acre transfer earnings to get the land out of oat production. The question of economic rent in the \$7 is ignored by the modern-day theorists.

There are two types of economic rent: scarcity rent and differential rent.

Scarcity rent. Scarcity rent arises when a resource is considered by all users to be homogeneous in productivity but is limited in total supply, i.e., supply is perfectly inelastic. All demanders of the resource will be paying an equal price.⁶ Each industry is supplied according to its demand for the resource at that price. The price paid is the transfer price and may be opportunity cost or some imputed cost by the owner.⁷ As industries increase their demand for a particular resource, price increases as a result of the inelastic supply of the needed resource. Thus, the difference between the new price paid for the quantity of fixed resource and its original price of transfer cost is considered to be scarcity economic rent.

A competitive individual firm or industry will fail to recognize the occurrence of such economic rent given that it is not large enough to independently exert price influence. That is, a particular industry

⁶This price may be a positive value or even be zero.

⁷A worker may be earning \$2 an hour as a bookkeeper but require a transfer price of \$3 an hour to work in a mine. Surplus income in excess of \$3 an hour would be economic rent. Therefore, note that transfer price and opportunity cost (earnings in the next best alternative use) are not necessarily synonymous.

faces a perfectly elastic supply curve for a resource, which indicates a lack of resource scarcity to that industry, but does not imply that the resource is not fixed in total supply to all industries.

Robinson argues that an industry will also fail to recognize scarcity rent when the supply curve for an input is upward sloping but not perfectly inelastic.⁸ As long as a resource is viewed as homogeneous by all industries, even though the industries face a rising supply price for the input as more of it is employed, no rent is paid by the industry for the use of the resource.

Given that $P_x = f(X)$ represents the price of the input X, as the amount of X increases, price increases as shown in Figure 1. If total demand intersects the supply curve, P_1D , at A, then a single competitive industry sees P_2A as its supply curve for X. As demand increases to B, the supply curve to the single industry becomes P_3B . P_2 and P_3 represent the transfer price for the respective demand for X, given the supply relationship. Transfer price is uniform for all industries and changes with a change in demand such that no industry recognizes rent to the limiting factor (Z) in the production of the resource.

Lipsey and Steiner⁹ argue that with price at P_2 , a perfectly discriminating buyer could buy units of X along P_1A , paying a higher price

⁸Robinson, The Economics of Imperfect Competition, pp. 110-111, 141.

⁹Richard G. Lipsey and Peter O. Steiner, Economics, Second Edition (New York, Harper & Row, Publishers, 1969), pp. 396-399.

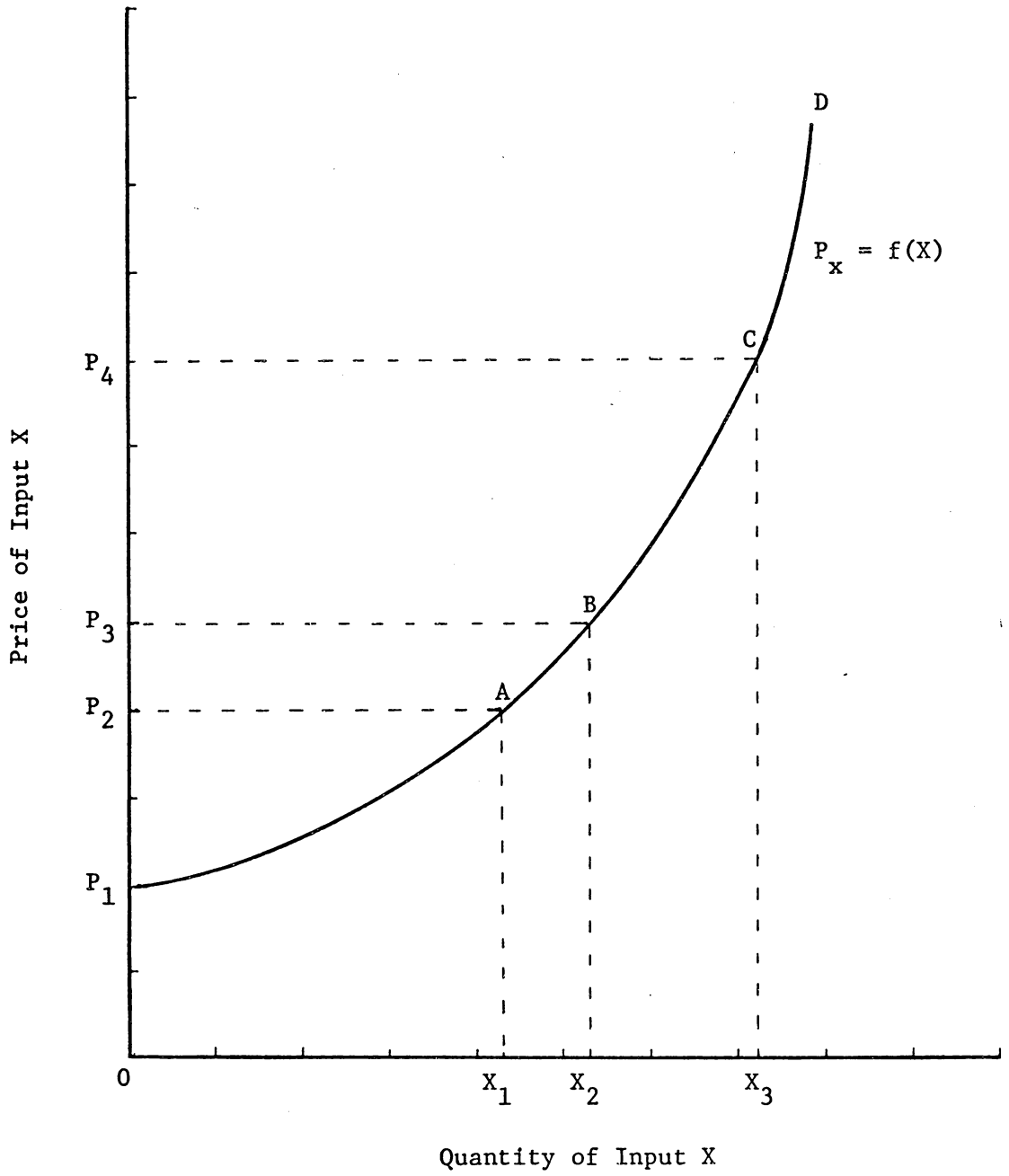


Figure 1. Supply Curve for Input X

for each unit. Total cost equals the area OP_1AX_1 or $\int_0^{X_1} (P_x = f(X)) dx$.

As a competitor, however, the buyer pays the same price for all units or a total of $P_2(X_1)$ or area OP_2AX_1 . The difference is considered economic rent and is paid to the limited or fixed factor (Z) used in the production of X. Had price been P_4 , economic rent would equal area P_1P_4C . A similar argument could be used with a perfectly inelastic input supply curve.

A firm or industry may recognize scarcity rent when it uses a resource that is absolutely fixed, i.e., not responsive in quantity to changes in price.¹⁰ Such resources are able to command, as rent, all surplus receipts for a product beyond the cost of the product. New firms can only enter the industry by obtaining the fixed input from an existing firm. Competition bids the price of the factor higher and higher until no profit results from production using the input. The difference in the competitive price for the input and that price which would have transferred the resource into the industry is scarcity economic rent to the factor. Profit in such a case will in the long run become economic rent.¹¹

¹⁰Each of the n firms is endowed with $1/n^{\text{th}}$ of the fixed quantity of the resource for the industry.

¹¹Richard H. Leftwich, in his The Price System and Resource Allocation (New York: Holt, Rinehart and Winston, 1966), pp. 267-268, argues that all revenue above variable costs accrue to the fixed factor as scarcity rent. This discounts the presence of opportunity cost for the fixed input.

Differential rent. Differential rent results from the heterogeneity of a resource.¹² A factor resource (which may or may not be land) can be in infinite supply, however, a producer using the resource may value units of the resource as more or less productive than other units of the same resource. Quantities of these varying qualities of input may be limited and insufficient to meet the demand at a given price. Scarcity rent arises on each of the limited qualities. The rent, however, is different for each quality of the resource and is therefore called differential rent. In the production of a good or service, producers seek particular qualities of the input resource. Price will continue to rise above the transfer price and rent results. A given quality will be used until it becomes profitable to also employ another quality of the resource in which the efficiency of production differs. As it becomes profitable to add additional units of input intramarginally to various grades of a resource, rent continues to increase.

Efficiency Units

Variation in the quality of a factor is not uncommon as viewed by the single industry, or by all industries. Robinson uses efficiency units as a measure of productivity of varying qualities from sectors or

¹²It was differential rent that was of primary concern to Smith, Ricardo and the classical economists. The only factor or resource considered, however, was land.

For a treatment of the classical approach see: George J. Stigler, The Theory of Price, Third Edition (New York: The Macmillan Company, 1966), Chapter 15, pp. 247-256, or Raleigh Barlowe, Land Resource Economics (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1958), pp. 150-166.

segments of a resource.¹³ Given that a unit of higher quality can be substituted for units of the same resource but of lower quality, keeping all other factors including output the same, the unit of higher quality or grade contains as many efficiency units as the number of lower quality units of the resource replaced. Thus, if applying the same quantity of other factors to two units of a resource or to one unit of the same resource, but of better quality, produces the same output, the single unit is said to contain two efficiency units.

Essentially a producer is dealing with a different resource for each quality, as well as a different production surface. Substitution of equal efficiency bundles is a change in production relationships. Such substitutions result in an equally optimum resource combination when price adjustments compensate for efficiency qualities.

Maximum profit results, under pure competition, when the value of the marginal product of one factor ($VMP_{xi} = \frac{\Delta Y}{\Delta X_i} P_y$) divided by the prices of the input (P_{xi}) is equal to the same ratio for all other factors, i.e.,

$$\frac{\frac{\Delta Y}{\Delta X_1}}{P_{X_1}} = \frac{\frac{\Delta Y}{\Delta X_2}}{P_{X_2}} = \dots \dots \dots \frac{\frac{\Delta Y}{\Delta X_n}}{P_{X_n}} = \frac{1}{P_y}$$

where $X_1, X_2, \dots X_n$ can represent different qualities of a factor, as well as different resource factors, and P_y is the price of product Y.

¹³ See Robinson, The Economics of Imperfect Competition, pp. 331-333 and pp. 109-110.

Economies and Diseconomies

Economies may be defined as benefits gained by a firm as a result of internal or external influences. Negative benefits are called diseconomies and result from internal operations of the firm or conditions external to its operations. Internal-external conditions may also exist in an industry where internal effects are felt by a firm but are in turn external factors to all other firms of an industry.

Internal. McConnell lists several general internal economies or gains resultant from actions of the firm.¹⁴ As a firm increases in size, division of labor is more practical. Labor becomes specialized in efficiently performing particular operations. Internal economies result from better utilization of management as well. As firms enlarge, they can make better use of more efficient productive equipment, as well as better utilize by-products of production. In addition, a firm may enjoy a falling supply price for one or more resources.

The major cause of internal diseconomies is the limitations of effective management and control. As firms grow in size, one man cannot assemble and understand all the information necessary for rational decision making. Delegation of authority is limited as coordination becomes a problem.

¹⁴Campbell R. McConnell, Economics--Principles, Problems, and Policies, Third Edition (New York: McGraw-Hill Book Company, 1963), pp. 451-455. See also for a similar discussion, Richard F. Leftwich, The Price System and Resource Allocation, Third Edition (New York: Holt, Rinehart and Winston, 1966), pp. 143-146.

External. External economies and diseconomies (often referred to as externalities) are more difficult to define in general terms. They may be described as favorable or unfavorable effects on another as the results of actions by someone else. In two dimensions, firms experiencing internal economies or diseconomies move along their long-run cost curve, while firms receiving external influences experience shifts in their cost curves. For example, raising bees in an orchard may aid the production of an adjoining farmer who raises no bees. Pumping excess water out of a mine shaft of one firm may reduce the amount of excess water for other firms. Diseconomies are exemplified in the smoke emitted by a factory on the community, or a farmer spraying weeds on a windy day and also killing the tomatoes of a near-by gardener.

Economies of large-scale industry. In many instances, what is internal to a firm may be external to all other firms. Perhaps the most common relationship, and that used in this study, is the price change experienced by one, which in a competitive society is also experienced by all firms using the resource or producing the output. For example, increased use by a firm of an input from a declining cost industry may reduce price for that firm, but also for the entire industry. The addition of a firm to an industry lowers price to that firm, and to all other firms as well. Some refer to this as an internal-external economy. Joan Robinson calls it economies of large-scale industry.

¹⁵Robinson, The Economics of Imperfect Competition, pp. 340-342.

CHAPTER II

A DIGRESSION ON RENT

To derive an appropriate supply curve for a single industry, all costs must be included. One such cost is the rent that is paid to limited qualities of a variable resource as demand for each quality increases. Joan Robinson's digression on rent explains the occurrence of this differential rent.¹

Mrs. Robinson centers her analysis on a single, multi-firm industry in competition with other industries. The industry operates under conditions of a given fixed, nondivisible resource that may be applied to various qualities of another resource in the production of some output. As more of any one quality is demanded beyond the supply at a given price, rent is paid. In order, however, to present a more general analysis, this study relaxes the assumption of a single fixed factor in favor of a variable resource applied to another resource of varying quality. Optimum resource combination is likewise given consideration.

¹Robinson, "Digression on Rent," The Economics of Imperfect Competition, pp. 102-119.

Case Study

Assume the hypothetical industry production relationships² as given in Figure 2, using standard quality inputs X and W in the production of output Y.³ Both X and W are purchased in the competitive market by this industry such that the industry can obtain X and W at a constant price, i.e., the supply of X and W is perfectly elastic. Furthermore, assume the competitively determined supply price of these two variable inputs is P_x and P_w , where $P_x = P_w$. The slope of CD represents this price relationship. AB represents the least cost combinations of X and W for each level of output and thus serves as the expansion path to be followed in increasing production of Y, given that the price ratio of inputs remains constant at one.

Plotting the expansion path in Figure 3 reveals the presence of all three stages of production in the relationship. Output first increases at an increasing rate until diminishing marginal returns are established. Finally output increases at a negative rate, i.e., total output starts to decline.

AB represents the expansion path in two dimensions when the abscissa measures bundles of inputs X and W according to the number of

²Each of the n firms in the industry exhibit similar relationships. Output of each firm is 1/n of the total output and is produced using 1/n (X) and 1/n (W). This condition will also be true when X' is used as an input.

³Robinson uses a homogeneous production relation, having defined efficiency units under such conditions. The nature of the production relationship, however, is immaterial as the analysis and results are the same.

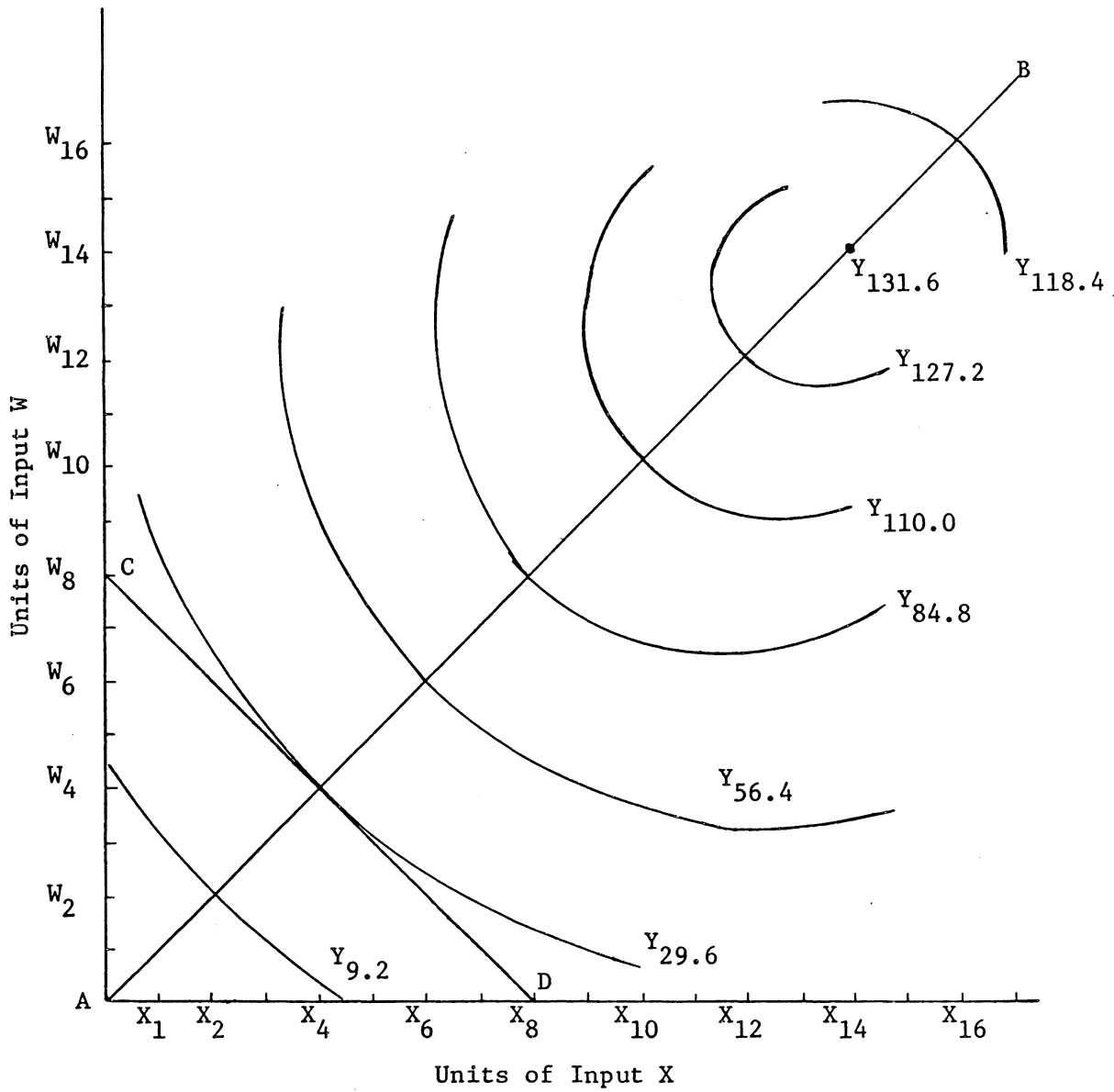


Figure 2. Isoquant Relationships Using Inputs X and W in Production of Output Y.

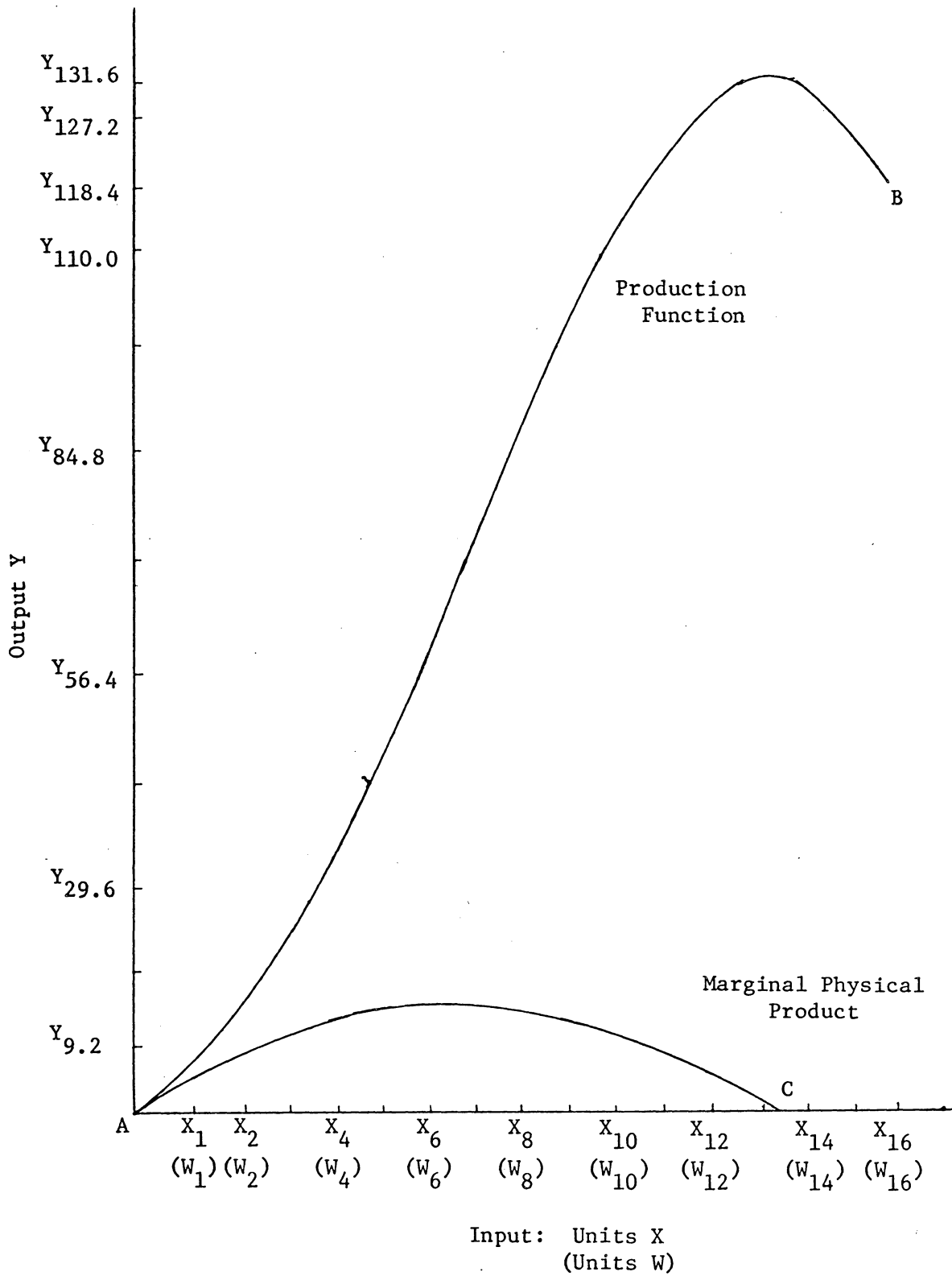


Figure 3. Production Response Using Optimum Quantities of Input.

units of input X. Each group contains the optimum ratio of inputs X and W to be used in the production of a given output Y_1 . AC in Figure 3 represents the marginal physical product (MPP) as an additional bundle of inputs X and W are used.

Transferring the above information to Figure 4, optimum production can be determined in the use of X and W such that profits are maximized. The ordinate axis measures value per efficiency unit. In this instance, the single industry in question views X and W as all other industries view the productivity of the two resources. Each unit of both X and W contains μ efficiency units for all industries.⁴ Further, assuming the price of Y is P_y , the MPP times P_y becomes VMP or value of output for each additional bundle of resources X and W. Each value plotted is equal to VMP/μ .

The additional cost of each unit of X or the marginal factor cost of X per efficiency unit, MXC, equals P_x/μ and is given by AB. CD represents marginal factor cost of each additional group or bundle of resources X and W; hence, the marginal bundle cost (MBC) per efficiency unit of X. Since the given production relationship requires constant proportionality between the quantities of X and W at each level of output, CD is parallel to AB. The difference between CD and AB represents the cost of input W per efficiency unit of X, which in this case equals P_w/μ .

⁴Quality X of the resource shall be considered the standard or base quality. The value of μ will thus be equal to 1.

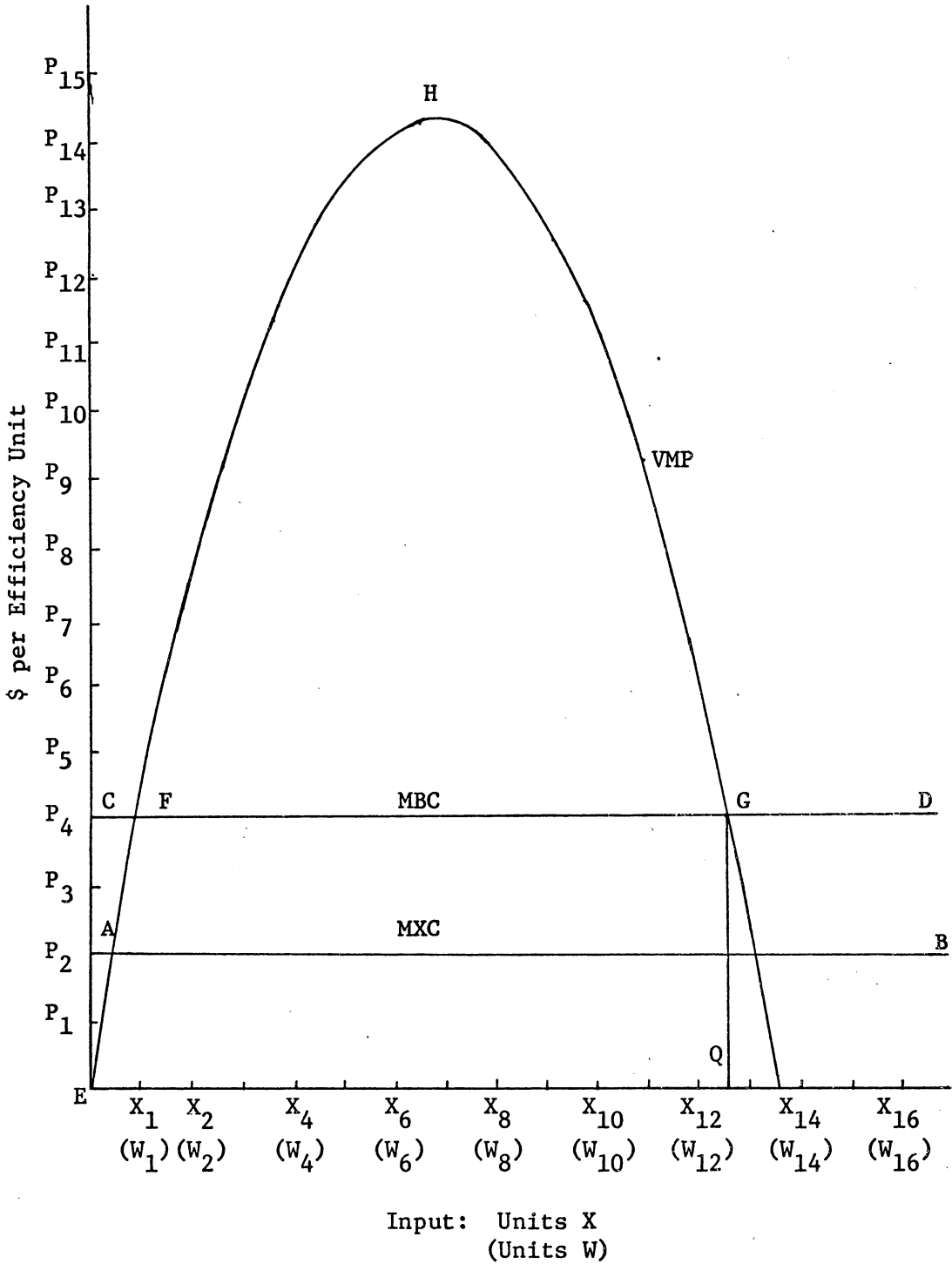


Figure 4. Determination of Optimum Production Using Inputs X and W.

Optimum production occurs when $VMP = MBC$, using bundle Q of inputs X and W in the production of Y. The total revenue derived from output Y equals μ times the area EHGQ. Total cost of production equals μ times ECGQ. Profit in the short run equals the area (EHGQ - ECGQ) times μ , or (FHG - ECF) times μ .⁵

The industry is paying no rent on factor X since the transfer price and the price paid for X are the same. As long as the industry can expand without raising the price of X (long-run constant supply price), there will be no rent on X in the long run.⁶ Short run profits will disipate as more firms enter the industry, increasing supply relative to the present demand for Y, hence lowering the price of Y until profit for all firms is zero.

Heterogeneous quality in a resource. Assume now that a single industry buying resource X views some units of the resource as more productive than other units of the same resource X. All other industries view all units of X as being homogeneous in productivity. Figure 5 shows the productive relationships using the higher quality X' units of the resource. The abscissa measures physical quantities of X' such that $X_1' = X_1, X_2' = X_2, \dots, X_n' = X_n$ where X_1, X_2, \dots, X_n are the physical quantities of X in Figure 2. The ordinate axis is equivalent to that

⁵All calculations are in per efficiency unit terms. Since X contains μ efficiency units, all areas must be multiplied by μ to convert values to absolute terms.

⁶Input W will always be in sufficient supply such that its price, P_w , remains constant to the single industry under consideration.

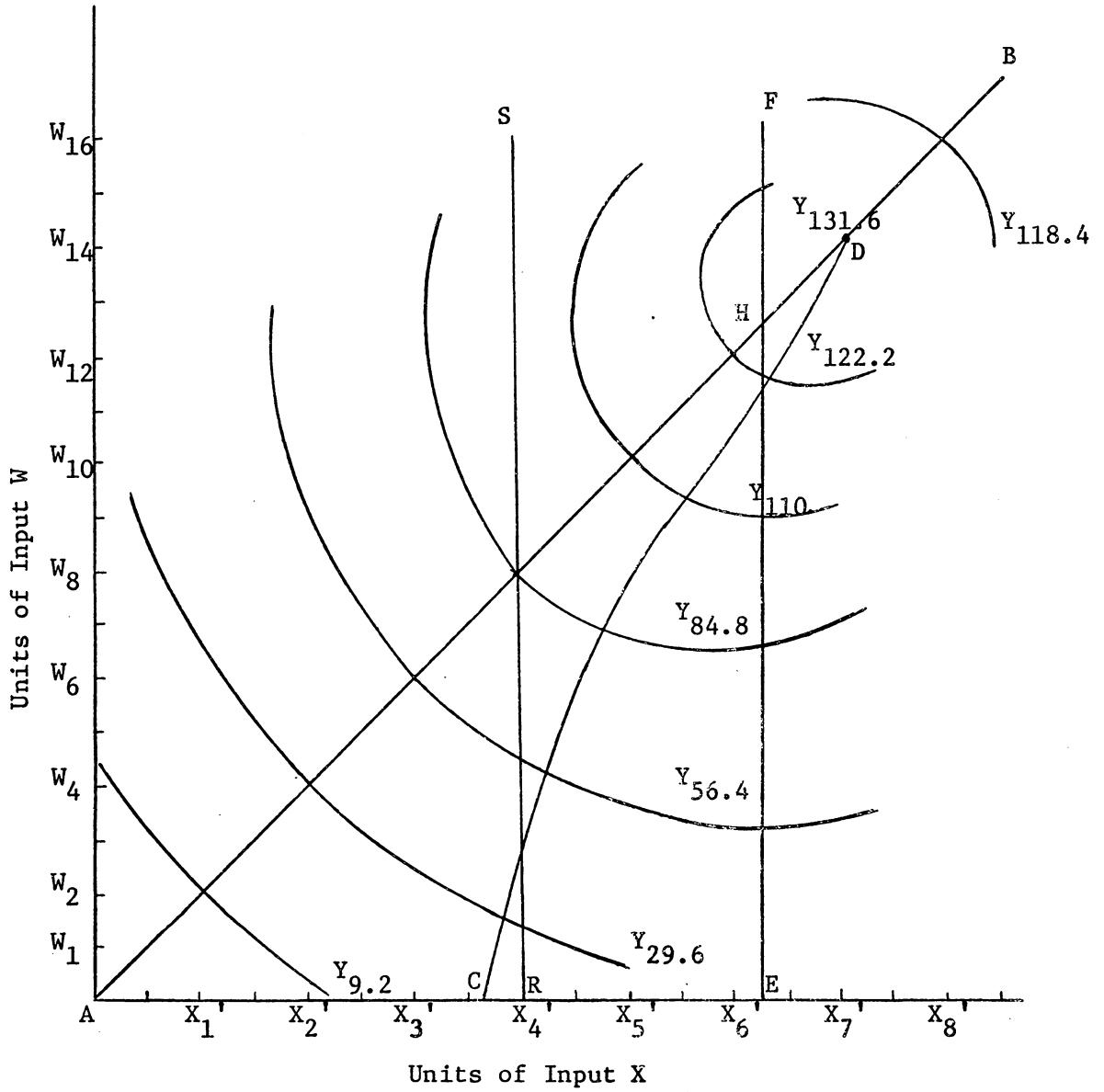


Figure 5. Isoquant Relationships Using Inputs X' and W in Production of Output Y.

in Figure 2 as a measure of physical units of resource W. The relationships expressed reveal that the same quantity of Y can be produced using the same quantity of input W, but one-half the quantity of X when X' is used. Thus, $Y_{29.6}$ can be produced using either bundle $X_4(W_4)$ or $X_2'(W_4)$, where $X_2' < X_4$. One physical unit of X' is thus said to contain λ efficiency units, where $\lambda > \mu$, and is equal to λ units of the standard quality X containing μ efficiency units each.⁷

Maximizing profit, using input X' , would follow the same procedure as when using input X. Producers find the cost per efficiency unit lower for input X' since each unit now contains λ efficiency units. Because the industry presently faces the same $P_{X'}$, as P_X , the optimum combination of inputs would not be in the same proportion as when X was used. One would expect the industry to use input X' since profit is the same using a bundle containing X_0 and W_0 units of X and W respectively, or a bundle containing the same W_0 units of W, plus X_0' units of X' equal to $\frac{1}{\lambda}(X_0)$ with the price of X' equal to $\lambda(P_X)$. The same quantity of output would be produced with either bundle. Since $P_{X'} = P_X$, cost per efficiency unit = $\frac{1}{\lambda}(P_X)$ and the industry will be able to become even more profitable as the more productive resource X' is substituted for X, as well as W.

⁷ Efficiency units per unit of input equal to λ does not say that the better quality input is λ times as productive. If X' were λ times as productive as X, even fewer units of X' would substitute for units of X. The efficiency unit definition stipulates that the same quantity of other factors must be applied to the better quality factor in determining the efficiency of the better quality input and that output be unchanged.

CD of Figure 5 is the expansion path followed for increasing output, given that $P_{x'} = P_w = P_x$. Figure 6 illustrates the determination of optimum output. In this case, the physical quantities $X_1' = X_1$, $X_2' = X_2$, etc., however, $W_2' \leq W_2$, $W_4' \leq W_4$, ... $W_{14}' \leq W_{14}$. The lack of constant proportionality of X' and W indicates the substitution of X' for some of the W input.

MBC and VMP both are in per efficiency unit terms. The variation in the MBC results from measuring the abscissa in unit increases of X' and using W in increasing proportions and then in decreasing proportions. The optimum bundle of inputs is combination Q' producing a total revenue output of λ times $AIEQ'$ at a cost for X' equal to λ times $OFJQ'$ plus a cost for input W of λ times $HCEJ$. Profit is the difference between output value and total cost. In the long run, this will disappear as more firms enter the market, driving P_y down, but $P_{x'}$ up. The difference between $P_{x'}$ in the present short run and $P_{x'}$ in the long run will be economic rent per unit to the limited X' quality.⁸

Input X is still available to the industry. Production of Y would also be occurring using the standard quality, X . Conditions for profit maximization would be met as illustrated in Figure 4. Total value of output equals the sum of μ times EHQ of Figure 4, plus λ times $AIEQ'$ of Figure 6. Total units of X used would equal the number of X units in

⁸The present $P_{x'}$ represents the transfer price for X' since X' can be obtained from other industry users at that price. Any additional price paid as competitors within the industry bid the price higher is surplus and as such is considered economic rent.

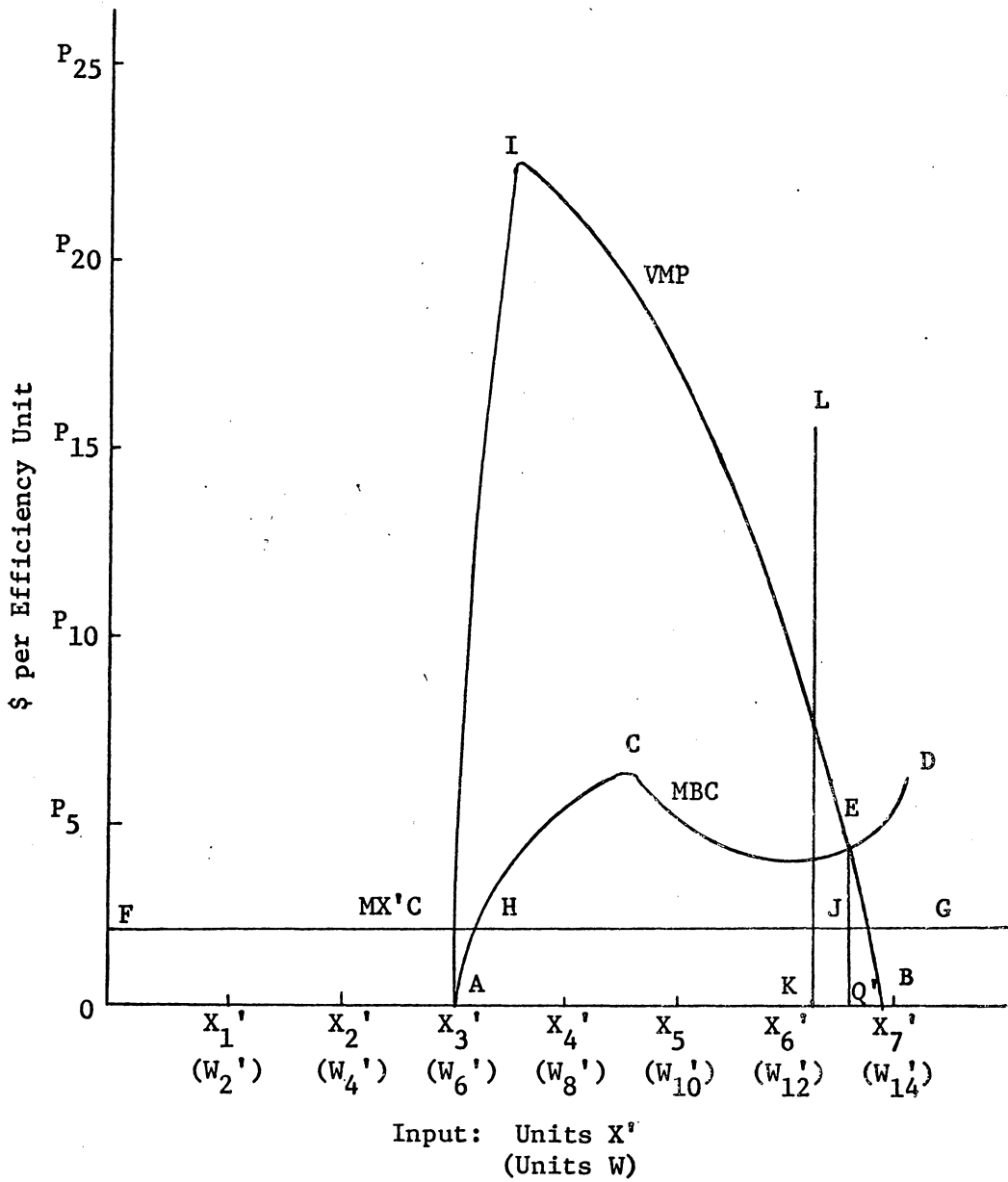


Figure 6. Determination of Optimum Production Using Inputs X' and W .

group Q, while the number of X' units used would equal the number of X' units in group Q'. Units of W equal units of W in group Q plus those in group Q'. The order of application of those units is unimportant to this analysis, however, it is important to recognize the use of marginal analysis.⁹

To be considered presently is the rent that might arise when one quality of a factor is limited, while the other factor remains variable. Under conditions stated for the present analysis, contradiction of Robinson arises as to the generally implied short-run quality price per efficiency unit when more than one quality is used by an industry.¹⁰

Resource quality limited. Thus far, no factor has earned rent in the short run as a result of scarcity to the single industry at the established transfer price. Assume now, however, that units of X' are relatively limited in relation to the availability of X. W shall continue to remain available at a constant price, P_w .

Let the quantity of X' available be equal to $\frac{1}{\lambda}$ the quantity of X units in Q of Figure 4. This fixed quantity of X' is shown in Figure 5

⁹Robinson fails to apply marginal analysis, if in fact her absolutely fixed input is divisible. Profit may be increased by dividing the fixed factor among various qualities of the variable input, rather than combining only one quality with the fixed quantity of input.

¹⁰Robinson would use a quality or bundle of qualities of a resource as long as the price per efficiency unit were less than the price per efficiency of another quality. If the price per efficiency unit of a quality were bid higher to the same level as the next cheapest quality per efficiency unit, no preference between the two qualities would be shown. Thus, when more than one quality of resource is employed, the price per efficiency unit of each quality is equal to the price per efficiency unit of all other qualities used in production. See Robinson, The Economics of Imperfect Competition, pp. 109-110.

by the vertical EF line. As the price of X' varies, the expansion path rotates about point D. With the limitation of X', all expansion paths follow the vertical path once quantity E of X' is obtained and more units of W are applied to the then fixed amount of X'.¹¹ The object is to find that price and quantity of X' and W to fulfill the conditions:

$$\frac{\frac{\Delta Y}{\Delta W}}{P_w} = \frac{\frac{\Delta Y}{\Delta X_1}}{P_{X_1}} = \frac{1}{P_y}, \quad \frac{MPP_w}{P_w} = \frac{MPP_{X'}}{P_{X'}} = \frac{1}{P_y}, \quad \frac{\Delta W}{\Delta X'} = \frac{P_{X'}}{P_w}, \quad X' \leq E$$

KL in Figure 6 is comparable to that of EF of Figure 5. Given the present $P_{X'} = P_x$, there is insufficient supply of X' to satisfy the profit maximizing conditions. Demand exceeds supply, triggering an increase in the price of X' as firms in the industry compete for the available X', and thus changing the least cost combinations of X' and W to produce Y. The expansion path rotates until the profit maximizing point occurs at the intersection of the expansion path and the limiting quantity EF. AHF of Figure 5 is the expansion path when the price of X' equals $\lambda(P_x)$, i.e., let the new price of X' be $P'_{X'} = \lambda(P_x)$.

Information from this expansion path is transferred to Part B of Figure 7, where Part A is from Figure 4. Given that the price of X' equals $P'_{X'}$, P_2 of the figure equals the price per efficiency unit of

¹¹The classical analysis of rent recognizes EF as the only expansion path, assuming quantity E of X' to be absolutely fixed. Optimum production is obtained when the value of the additional output created by adding additional variable input equals the cost of obtaining that increased output. Because of diminishing returns, the difference between total output and total cost could be captured in the long run as rent. Quantity E could be composed of a single unit or many units.

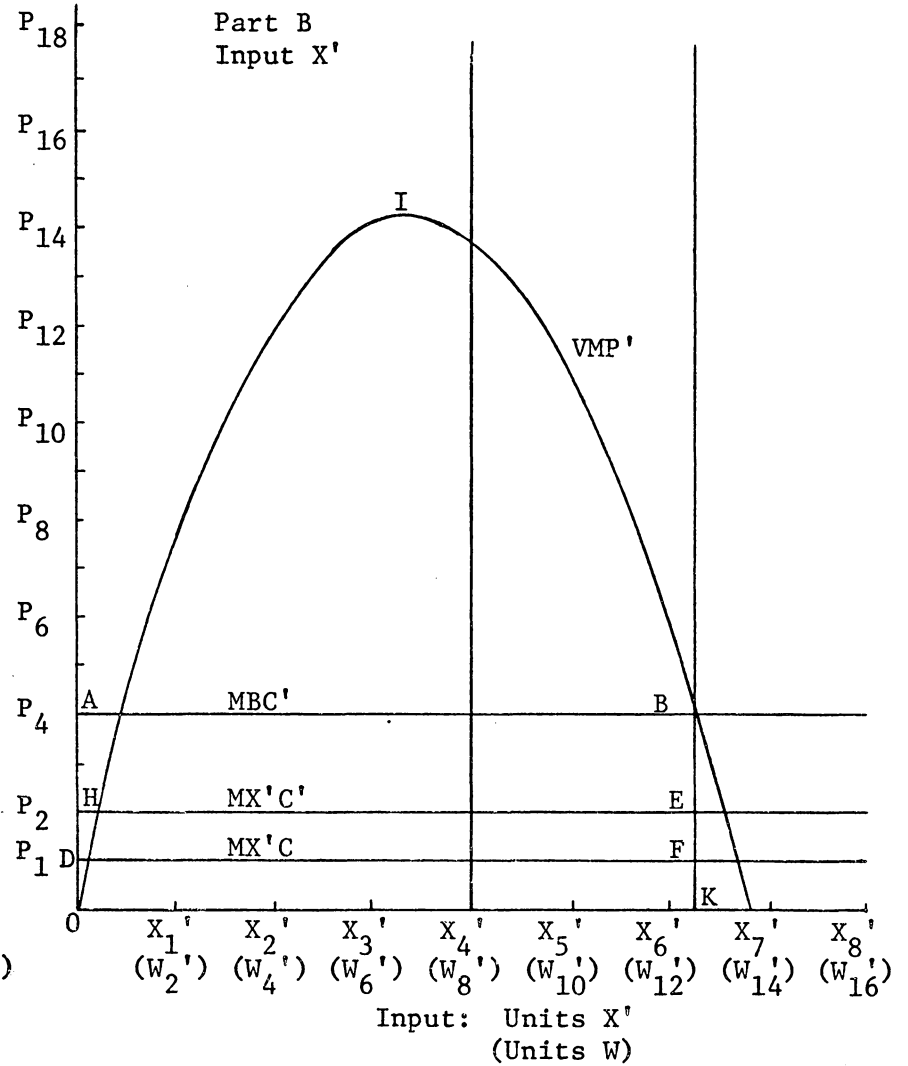
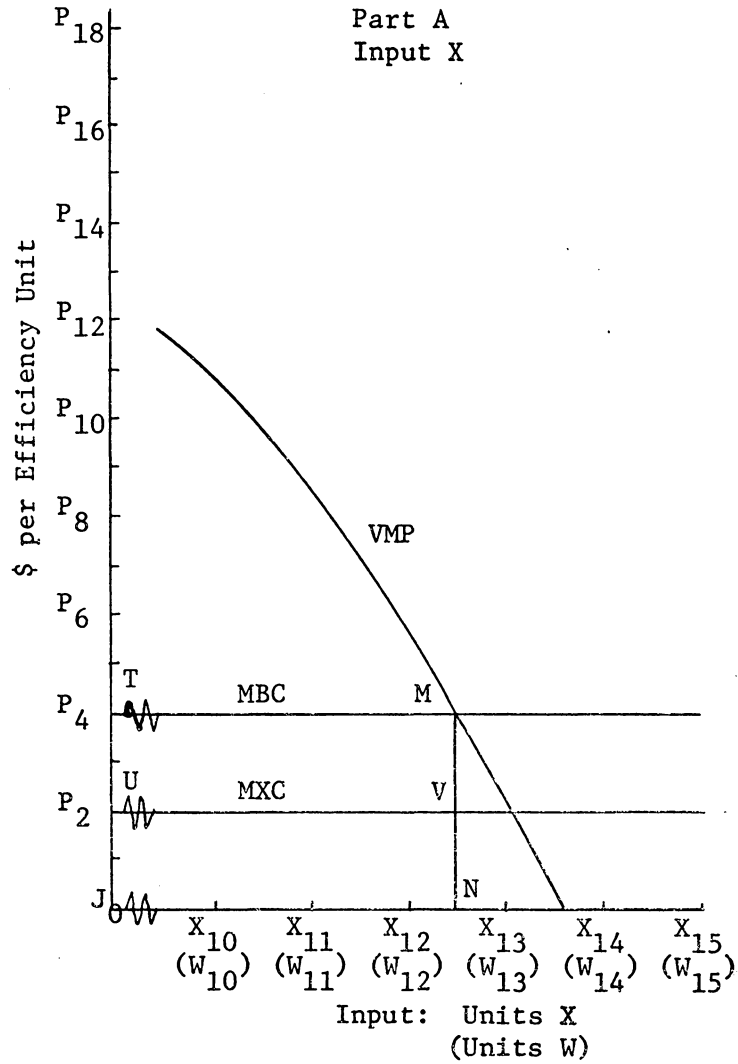


Figure 7. Determination of Optimum Production When Quality X' is Limited.

X' , i.e., $P_2 = P'_{X'}/\lambda$. Notice that the price per efficiency unit for X is also P_2 , i.e., $P_2 = P_X/\mu$. Adding the marginal cost per efficiency unit of W for bundles of inputs using X' in Part B and bundles of inputs using X in Part A to the $MX'C'$ and MXC respectively, MBC' is also equal to MBC . It is under these conditions that the maximum profit combination of X' and W requires the exact amount of X' that is available (KL). In real terms, total output value equals λ times the area OIBK plus μ times the area under VMP. Total cost equals λ times OABK plus μ times the area JTMN.

The new, higher price of X' is $P'_{X'}$, however, the supplier would still be willing to sell X' at $P_{X'} = P_X$. The difference between the new price of X' , $P'_{X'}$, and the transfer price, $P_{X'}$, is considered to be economic rent paid to the limited quality input. For each unit of X' , the rent per efficiency unit is equal to P_2 minus P_1 of Figure 7. Total economic rent per efficiency unit for all units of X' is DHEF and is equal to OHEK minus the transfer earning of X' , ODFK. The total price paid for X is JUVN, which is also the transfer earnings to the X units used. There is thus no rent to units of X .

Contradiction of Robinson. Let the limitation on X' be placed at RS in Figures 5 and 7. In Figure 7, given $P'_{X'}$, demand for X' exceeds supply. Price for X' continues upward increasing the price per efficiency unit of X' above that of X . Figure 8 reveals a new equilibrium position using the maximum X'_4 units of X' and W_8'' of W , but the same amount of X as in Figure 7. With an increasing price of X' , W is substituted for the more efficient resource. Therefore,

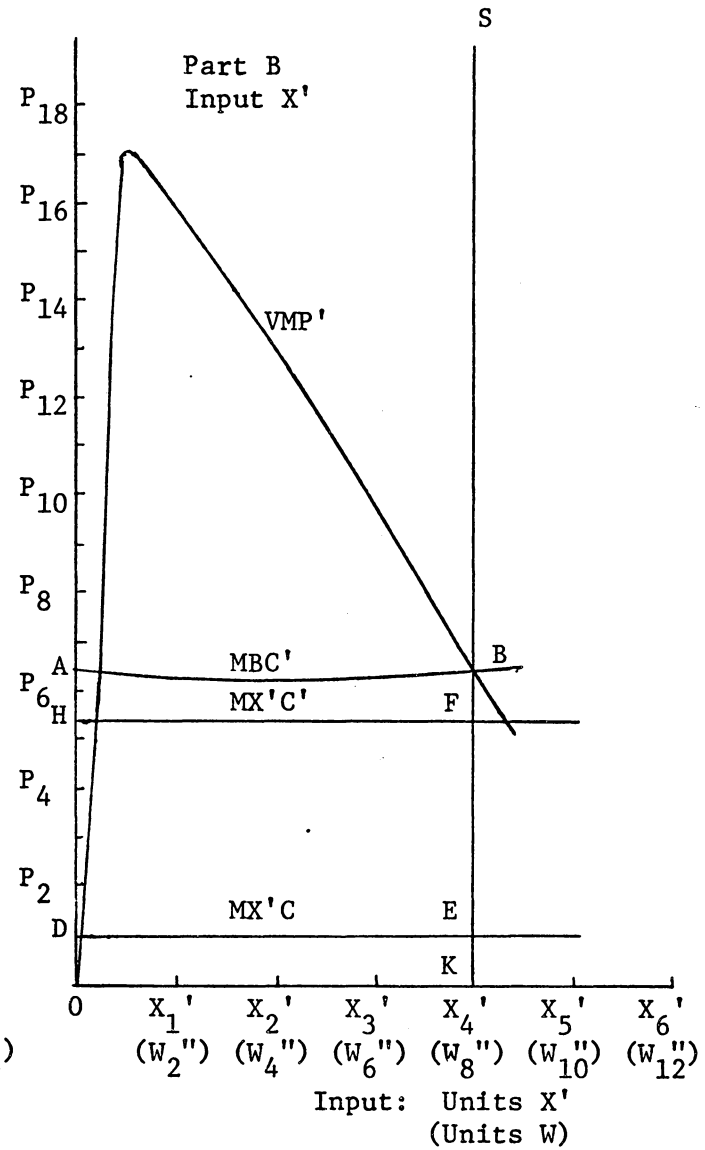
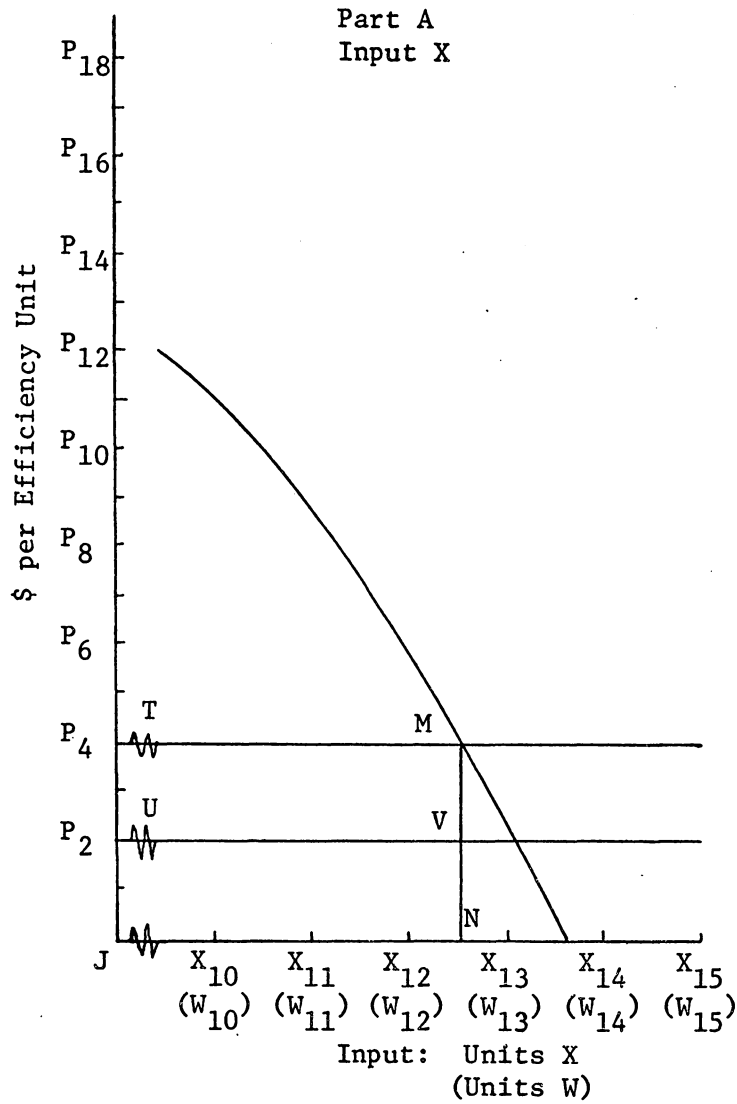


Figure 8. Determination of Optimum Production with Additional Limitation on Quantity of X'.

$W_1'' \geq W_1 \dots W_n'' \geq W_n$ where $W_i'' \geq W_i$ ($i = 1, \dots, n$) are physical units of W .

It is important to notice that the new equilibrium price per efficiency unit of X' , H , is much above the price, $P_2 = P_x/\mu$ per efficiency unit of the standard productive X input. Absolute rent per unit has increased and equals λ times the area DHFE.

The difference in price per efficiency unit for X' and X in the short run proves to be a major contradiction to the generally implied price per efficiency unit relationship using two qualities as presented in the Robinson treatment of rent. Under the conditions of the Robinson analysis, her results are indeed correct. Each firm with a fixed nondivisible input will compete for a limited grade of a factor to the point that price per efficiency unit for the more efficient quality equals that of the next best quality of a factor. Each quality used in production will then have the same price per efficiency unit.

Producers seek to maximize profits. Lower profits from one quality does not mean it should be abandoned and another quality substituted. Given divisible and/or variable inputs profit can be increased by using all qualities despite difference in price per efficiency unit, until revenue added equals the added cost of obtaining that revenue. Total profit is the sum of profits using each quality and is greater than the profit obtained by limiting input to just one quality input.

Figures 7 and 8 show that equal price per efficiency unit for X and X' occurs only when the limited quantity of X' is equal the optimum quantity of X in the production of Y divided by the number of efficiency units in one unit of X' . Any deviation in this quantity

relationship results in a price per efficiency unit differential for the different qualities. Generalization cannot yet be made, however, since P_y has remained unchanged despite a reduction in output because of the quality limitation.

Given the quantity limitation of KL for X' in Figure 7, and a price of X' greater than its transfer price, output is indeed reduced from the point when X' is not scarce to the industry. P_y would in equilibrium be expected to be higher. A higher P_y results in VMP' and VMP shifting upward. The new equilibrium price per efficiency unit of X' would be higher. Output using X' may or may not increase. Shifting VMP using X does increase the use of X and the output of Y . Price of Y will continue to change until, at the equilibrium price of Y , the output of Y is equal to the quantity of output demanded. If an industry in equilibrium, after adjusting for changes in the price of Y , uses a quantity Q_0 of X and Q_0/λ of X' , then price per efficiency unit for X and X' is in fact the same. Quantity of X used is equal to λ times quantity of X' used.

Price per efficiency unit for different qualities is therefore dependent upon the relative scarcity of one quality in relation to the availability of other qualities. Situations where quantity of X used in equilibrium is not equal to λ times quantity of X' used, dictates a different price per efficiency unit for X and X' .

Given a limited quantity of the normal or standard quality units (X) only, price per efficiency unit would remain consistently above the better quality unit. Rent would accrue to the normal units (X) in this case since it is the limiting factor. Where all qualities

are limited, the relative limitation of one to the other would determine price per efficiency unit differentials, as rent would be paid to all segment qualities of the resource.

Up to this point the single industry has been the sole producer viewing the total resource of X as having units of differing quality and has sought the use of the better quality first. It may be that the single industry views a resource as homogeneous while all other users recognize heterogeneity in quality and have arrived at competitive prices recognizing this quality difference. The single industry will seek the standard quality first since its price per efficiency unit is the lowest but will also use the higher quality in addition until all conditions for profit maximization are achieved. Rent earnings and final price per efficiency unit for each quality again depend upon the relative supply and demand of each quality.

Rent will not be paid by the single industry when all industries recognize the heterogeneity of a resource. Competitive conditions among the industries demanding the resource will establish prices proportional to the demand, quality, and supply of each quality of the resource. As long as the single industry can purchase inputs without affecting prices, rent will not result.

It is possible that other industries view a factor as heterogeneous but assign different quality attributes than what the single industry may recognize for the resource. Quality prices differ. However, the presence of rent in the short run to any grade generated by the single industry depends upon relative supply and demand for the various qualities of the factor. Analysis of optimum use and price

of each quality segment would mirror that previously presented. Price per efficiency unit for all segment qualities need not be identical.

In the long run, new firms will enter the industry increasing the demand for X and X' and driving their price up while increasing the supply of Y driving its price down. Each new firm will use both X and X' until the value of the output from an additional unit of either input equals the cost of the additional unit. When the use of one quality is no longer profitable, new firms will enter the industry and use only the profitable quality until it is no longer profitable to produce additional Y. Having defined efficiency units and the production function using X and X' under the definition of efficiency units, price per efficiency unit for X and X' will be the same in the long run.

Regardless of the evaluation by competing industries of quality differences of a resource, rent is a function of scarcity and is price determined. The price is a measure of scarcity and, as shown above, is dependent upon relative supply and demand. In the short run, only in a special case where the quantity of X' is equal to $1/\lambda$ times the quantity of X will rent accrue and reflect a proportional per unit price compensation for the efficiency of different qualities of a resource; i.e., equal price per efficiency unit for each quality. This is the major point of contention between this thesis and Mrs. Robinson.

CHAPTER III

A DIGRESSION ON FOUR COST CURVES

In a second digression, this time on four cost curves,¹ Joan Robinson uses the concept of rent in deriving the appropriate long run industry supply curve for a product produced by that industry. The supply curve is developed for an industry under alternative conditions of scarcity and/or economies of large-scale industry.

Case Study

As a means of illustrating relationships and defending the four cost curves, Robinson presents several case studies. The single industry is competitive with other industries and is composed of firms competitive among themselves. The first case study provides a means of presenting and defining the four cost curves. The remainder of the cases present new circumstances but support Robinson's contention that the industry supply curve is represented by the average cost including rent.

No economies of large-scale industry. Mrs. Robinson illustrates the derivation of, and relationship between, the four cost curves with the numerical example in Table I. Columns one through four imply a production function exhibiting diminishing returns given that production

¹Robinson, "A Digression on Four Cost Curves," The Economics of Imperfect Competition, pp. 133-142. The curves were derived from similar work done by Shove. See G. F. Shove, "Varying Cost and Marginal Net Products," The Economic Journal, June, 1928, Vol. 38, No. 150, pp. 258-266.

Table I. Illustration of Four Cost Curves

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Units of Output	Total Cost Excluding Rent	Average Cost Excluding Rent (2) ÷ (1)	Marginal Cost Excluding Rent Derived from (2)	Total Revenue (1)X(4)	Profit Rent (5)-(2)	Total Cost Including Rent (4) X (1)	Average Cost Including Rent (7)÷(1)=(4)	Marginal Cost Including Rent Derived from (7)
9	\$ 900	\$100	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
10	1020	102	120	1200	180	1200	120	-
11	1144	104	124	1364	220	1364	124	164
12	1272	106	128	1536	264	1536	128	172

Source: Joan Robinson, The Economics of Imperfect Competition, Second Edition (New York: MacMillan and Co., Ltd., St. Martin's Press, Inc., 1969), p. 135, with the exception of columns (5) and (6).

of the output requires an input perfectly elastic in supply to the industry plus an input that is absolutely fixed in quantity to each firm and, therefore, fixed to the industry. Each of the n firms contribute $\frac{1}{n}$ of the total production using $\frac{1}{n}$ of all inputs. Columns three and four represent average and marginal cost respectively for the given quantities of output. No rent is paid to any input at this stage. Therefore, both costs exclude rent.

If the price of the output were equal to \$120, the industry would supply 10 units. Each unit would sell for \$120 for a total revenue equal to \$1200. Cost of producing the 10 units is only \$1020 resulting in a profit of \$180. New firms can enter the industry and obtain the variable input at the same price as existing firms, but must bid away from the established firms the fixed factor for production to occur. Price of the fixed factor will be bid higher by competing firms. No firm can bid a higher price than the obtainable profits using the fixed factor with the price of the output equal \$120. In the long run, however, the entire \$180 would be paid by the industry to the fixed factor. The \$180 is payment in excess of the payment required to obtain the use of the fixed factor in the industry, and is therefore economic rent. Total cost including rent (Col. (7)) is \$1200. Average cost including rent for 10 units output is \$120 which is also marginal cost excluding rent.

If the price of the output were \$124, a profit of \$220 would result for the industry. Again, competition would bid the entire profit away as rent to the owner of the fixed resource. In the long run, marginal cost excluding rent equals average cost including rent.

Marginal cost including rent is equal to marginal cost excluding rent plus the increase in rent of \$40 when 11 units of output are sold rather than 10 units.

In all cases the marginal cost excluding rent will be equal to average cost including rent in the long run. The general relationships of the four cost curves are summarized in graphical form in Figure 9, where average cost excluding rent is $AC_{(r)}$, marginal cost excluding rent is $MC_{(r)}$, average cost including rent is AC_r , and marginal cost including rent is MC_r .² MC_r is marginal to AC_r . $MC_{(r)}$ is marginal to $AC_{(r)}$.

Each firm produces where $MC_{(r)}$ equals the price of the output. $MC_{(r)}$ equals AC_r . Each firm is thus producing according to AC_r also. In the absence of economies AC_r also represents the industry long run supply.

The supply curve has a positive slope. No firm in the industry will rationally produce in stage one of production. Neither will any firm produce according to the MC_r curve. Rent to a fixed factor is not a production cost entering in the decision making process but is a residual determined only after price of the output is known. Firms producing on the MC_r curve would not maximize profit in the short run and would be driven from the industry in the long run.³

²Robinson uses α , β , γ , and δ to equal MC_r , AC_r , $MC_{(r)}$, and $AC_{(r)}$ respectively.

³The curves of Figure 9 represent all points where $MC_{(r)} \geq AC_{(r)}$, or the rational area of production. MC_r is marginal to AC_r even in the irrational area of production where rents are negative.

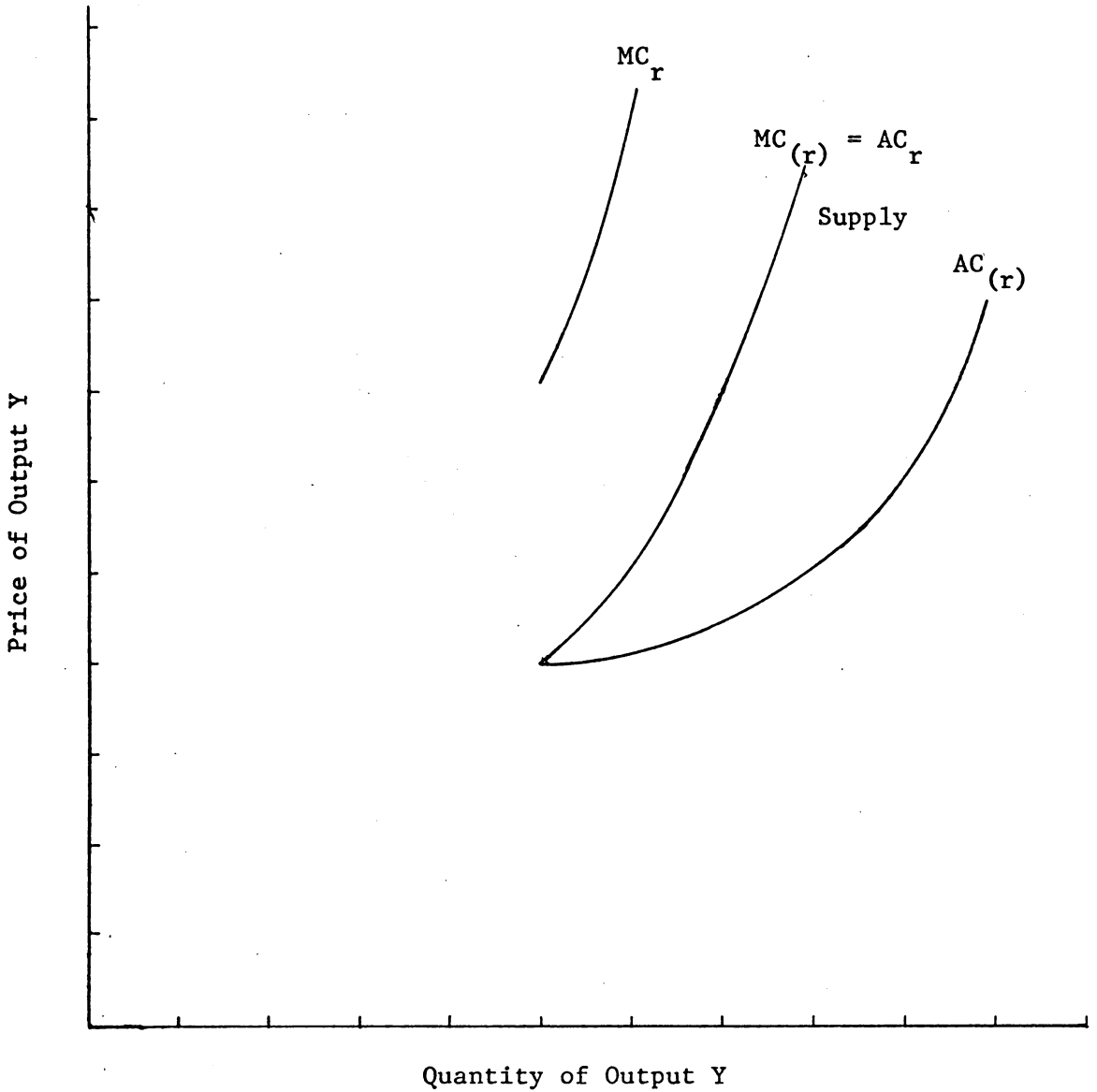


Figure 9. Four Cost Curves for a Competitive Industry with No Economies of Large-Scale.

In more general terms assume an industry production relationship, $Y = f(X_1, X_2)$ where Y is the product of the industry produced with inputs X_1 and X_2 and an absolutely fixed factor, W . The relationship exhibits all three stages of production. The supply curve for X_1 and X_2 is perfectly elastic such that $P_{x_1} = c$ and $P_{x_2} = k$, where c and k are constants. The price of the input is independent of the quantity used.

The competitive industry produces where supply equals demand. Supply, however, is a function of the cost of producing the output. Given the production function the industry seeks to minimize the cost of a given output. From this an expansion path can be derived:

$Y = f(X_1, X_2)$ - production function using input X_1
 X_2 in the production of Y

$\frac{MPP_{x_1}}{MPP_{x_2}} = \frac{P_{x_1}}{P_{x_2}}$ - least cost combination of X_1 and X_2

$Y = g(X_1, X_2, P_{x_1}, P_{x_2})$ - expansion path in the production of
 Y using least cost combinations of
 X_1 and X_2

$TC_y = h(Y) + F$ - total cost function in the production of
 Y using X_1 and X_2 inputs plus some fixed
factor

The cost function is stated in terms of Y , however, the cost of Y is itself a function of X_1 and X_2 and the cost of the inputs (variable cost of $Y = P_{x_1} X_1 + P_{x_2} X_2$) plus the cost of the fixed factor. Average cost of Y , $AC_{(r)}$, equals $\frac{TC_y}{Y} = \frac{h(Y) + F}{Y}$. Marginal cost, $MC_{(r)}$, is the $\frac{d(TC_y)}{dY} = \frac{d(h(Y) + F)}{dY} = h'(Y)$.

The rational entrepreneurs in a competitive industry, seeking to maximize profits, supply Y according to the increasing $MC_{(r)}$ function as P_y increases. When supply equals demand, the industry is in

equilibrium. Demand or average revenue (AR) may be stated as $P_y = f(y)$ and at any point is also equivalent to the marginal revenue curve (MR) for the firms in a competitive industry. Supply equals demand when $MR = MC_{(r)}$ as illustrated in Figure 10. Price for all firms is P_1 and the industry supplies Y_1 of output. $MC_{(r)} = MR = AC_{(r)} = AR$ such that no profit exists.

When demand shifts to D' , $MR' = MC_{(r)}$ at P_3 with output Y_2 . $MC_{(r)} > AC_{(r)}$ and profit in the amount of P_2P_3BC results. In a competitive society other firms seek to gain use of the fixed factor used in the production of Y to also produce Y . The price of this factor (W) is bid higher and higher until it is paid in the long run the maximum available. This maximum is equivalent to the profit when price is P_3 . Such profit is rent to the fixed factor. Rent also equals the amount paid minus the payment to the factor necessary to engage it in the production of Y . The amount of rent is determined once price is determined and not before.

The industry must pay this economic rent to the fixed factor. Including such rent in cost, the average cost curve moves along $MC_{(r)}$. The average cost including rent is AC_r in Figure 10 and equals $MC_{(r)}$ where $MC_{(r)} = MR$.

Were demand D'' , output would equal Y_3 and rent would have increased to P_4P_5ED . AC_r would become AC'_r and again average cost including rent equals marginal cost excluding rent in long-run equilibrium. In equilibrium, the supply curve for quantities of output as price changes, is represented by $MC_{(r)} = AC_r$. Although the declining portion of $AC_{(r)}$ is presented in the figure, no industry would rationally produce

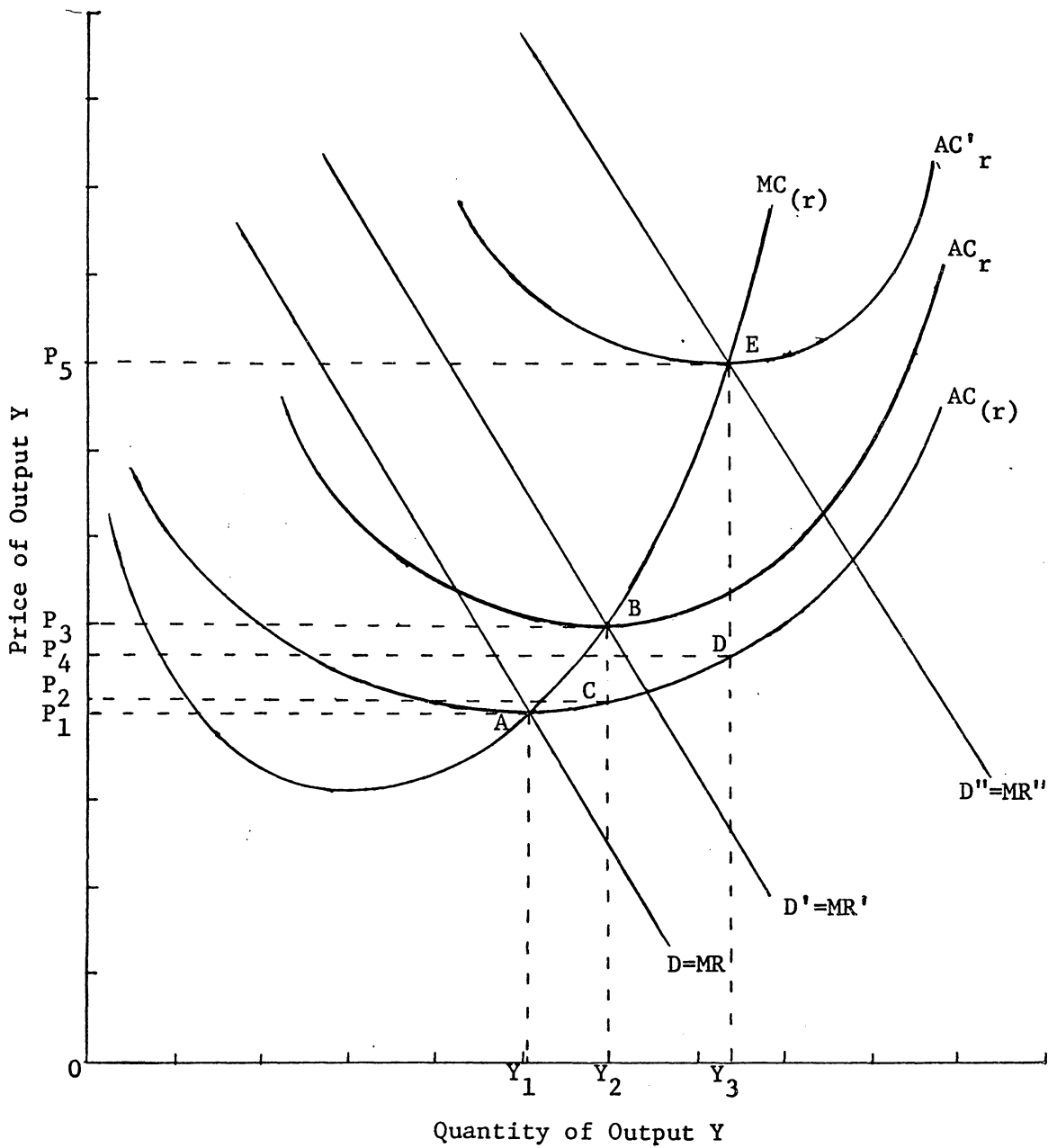


Figure 10. Supply and Demand for a Competitive Industry That Pays Rent to a Fixed Factor.

an output less than minimum average cost, since no firm produces in stage one of production. Positive economic rent does not result until price received per unit exceeds the cost of production per unit.

$AC_r - AC(r)$ is the average rent per unit for a given supply.

$AC_r - MC(r)$ is a measure of induced economies. $MC_r - MC(r)$ is the marginal increment in rent, or the additional rent for each additional unit of output.

No scarce factors and no economies of large-scale industry. A competitive firm using inputs, all perfectly elastic in supply, will in the long run produce where the average cost excluding rent is at a minimum. At this point, competitive equilibrium for the firm dictates that $MC(r) = AC(r)$. There is no rent to any factor used by the firm.

The long-run industry cost curves are the horizontal summation of the firm cost curves. Because of the complete variability of all resources, all four of the industry cost curves are one and the same, as well as perfectly horizontal (Figure 11). Output is produced by firms at their minimum average cost. To increase output, price rises, but as price rises new firms will enter the industry with no external effect on the existing firms. With increased supply, price will be lowered again to the point where all firms, including the new ones, are producing at minimum average cost. Output for the industry has increased, with the additional output being produced at the same price as all previous units. Therefore, the long-run industry supply curve for Y will be perfectly elastic. $MC(r) = AC(r)$. There is no rent, so $MC_r = MC(r)$ and $AC_r = AC(r)$. Thus, $AC_r = MC_r = AC(r) = MC(r)$.

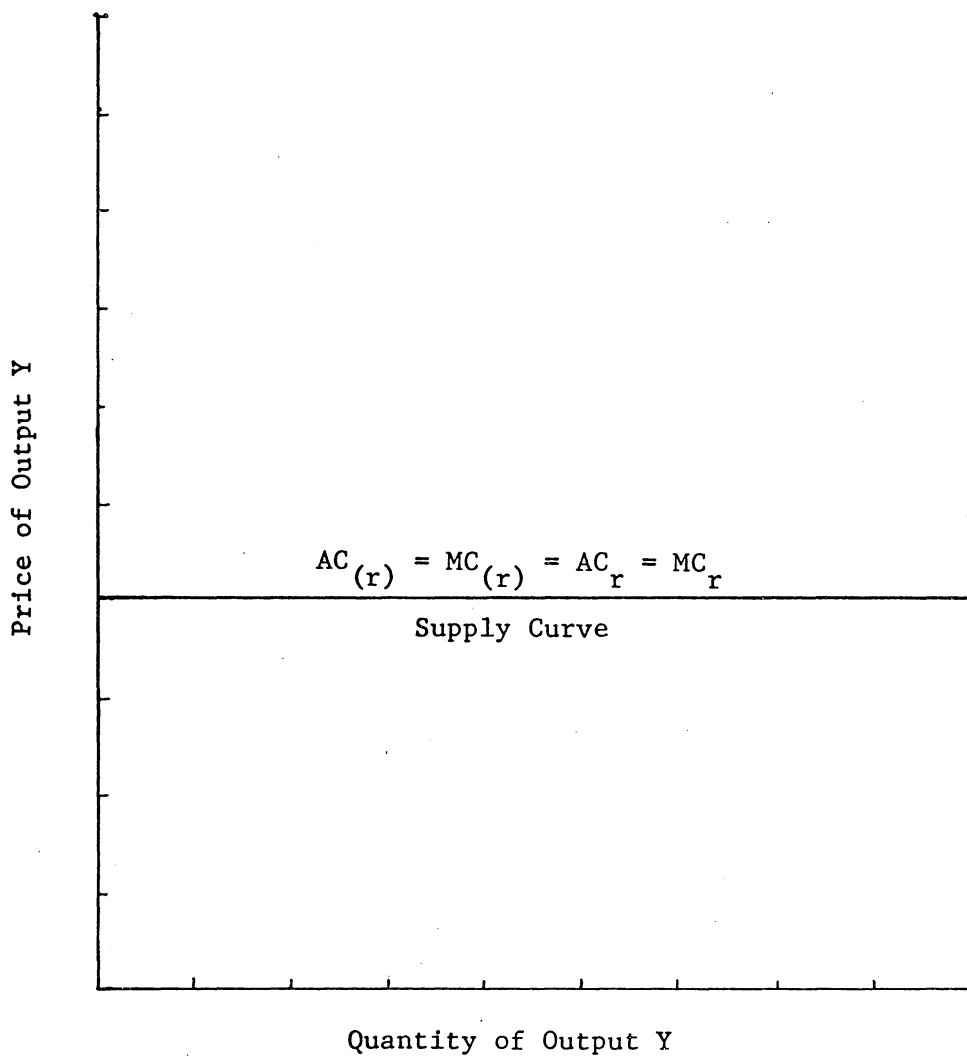


Figure 11. Four Cost Curves for a Competitive Industry with No Scarce Factors and No Economies of Large-Scale.

No scarce factors but economies of large-scale industry. Let economies of large-scale industry be exemplified by a decreasing price of X_1 as increased quantities of X_1 are used, i.e., $P_{X_1} = f(X_1)$ where P_{X_1} and X_1 change in opposite directions. As each firm increases its use of X_1 , the average cost of all units of X_1 decreases. The supply of X_2 remains perfectly elastic. Each firm will produce where minimum long run average cost excluding rent equals $MC_{(r)}$. Since rent is zero, $AC_r = AC_{(r)}$.

A single firm recognizes decreasing average cost of X_1 , as quantity of X_1 used increases, as internal economies. Such internal economies to the firm, however, cause the price of X_1 to decrease for all other firms in the industry. The economies for the firm are magnified for the industry by as many firms as are in the industry. There is no scarcity. For the industry, therefore, $MC_r = MC_{(r)}$ and is located below $AC_r = AC_{(r)}$ as in Figure 12.

Suppose a firm produces an additional unit of Y employing inputs X_1 and X_2 at an additional cost of \$100. In so doing, a decrease of \$1 in the average cost of a unit of X_1 is realized due to a negatively sloped supply curve for X_1 . One hundred other firms, using a total of 50 units of X_1 , also realize a \$1 decrease per unit in the average cost of X_1 . Thus, a marginal cost of \$100 to the firm for the additional unit of Y is, in reality, a \$50 cost to the industry.

Competition assures that each firm will operate at its minimum $AC_{(r)}$. The industry supply price, therefore, for a quantity of Y, is equal to the average cost of the industry and to the $MC_{(r)} = AC_{(r)}$ of each firm. As the industry expands inducing further economies,

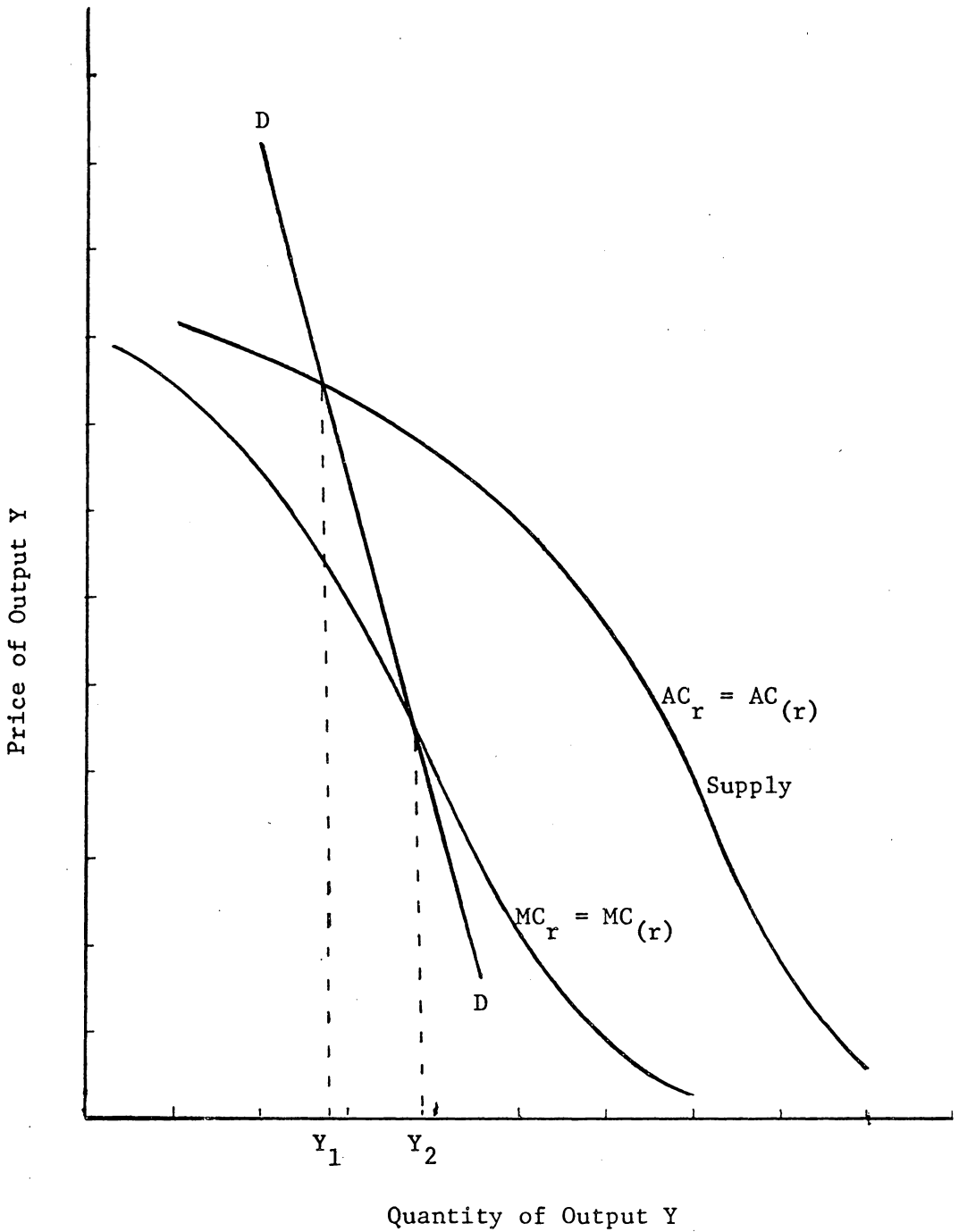


Figure 12. Four Cost Curves for a Competitive Industry with No Scarce Factors but Economies of Large-Scale.

average costs fall. On the assumption there are no scarce factors in the long run, the industry $AC_{(r)} = AC_r$ and $MC_{(r)} = MC_r$.

Note that the industry demand (DD) as drawn in Figure 12 does equal supply. Competitive demand also represents MR for each firm at any point, but MR is not equal to MC for the industry. The industry is therefore not optimally organized according to the traditional marginal analysis, despite the fact that the individual firms are optimally organized. Economists have proposed subsidizing these decreasing cost industries to encourage a more optimal organization where $MC = MR$.⁴ The difference between AC_r and $MC_{(r)}$ is called induced economies but no individual firm recognizes the industry economies. Neither is there incentive for a single firm to increase production when it is in equilibrium.

Scarce factors and economies of large-scale industry. In the previous case the assumption of no economies was abandoned. Now, scarcity is allowed, but there are three kinds of scarcity that must be considered.

The first type of scarcity is shown by a rising supply curve for a factor (X_1) and in Figure 1. Since each industry faces the positively sloped supply curve of the homogeneous input, there is no rent. A rising supply price of an input represents diseconomies of large-scale industry, however, derivation of the industry supply is similar to the analysis of the previous case.

⁴See Howard S. Ellis and William Fellner, "External Economies and Diseconomies," The American Economic Review. September, 1943, Vol. 33, No. 3, pp. 493-511.

The four cost curves will be seen as two distinct curves. $AC_{(r)}$ will equal AC_r and $MC_{(r)} = MC_r$ for the industry. The marginal cost curves will lie above the average cost curves and thus, both have positive slopes. Each firm again produces at its minimum average cost as in the preceding case. Industry supply is represented by $AC_r = AC_{(r)}$. If the supply of X_2 is negatively sloped, the industry supply curve depends upon the relative strength of the economies as compared to the diseconomies when the supply of X_1 is positively sloped, and upon the production function.

The second type of scarcity involves an absolutely fixed resource used by the industry, where each firm controls $\frac{1}{n}$ of the total industry supply of the fixed resource. The individual firm cost curves, even when the firm experiences economies of scale, would be very similar to those depicted in Figure 9. For the industry, however, the four cost curves are distinct individual curves. Economies for the firm are magnified for the industry because of the internal-external relationship effect between firm and industry. Each profit maximizing firm produces according to its marginal cost curve excluding rent which equals AC_r . Because of the internal-external relationship and restricted entry into the industry, it is the AC_r cost curve for the industry that represents the industry supply price of Y for a given quantity of Y. Figure 13 illustrates the cost relationships for the industry.

Diminishing returns because of the fixed factor counteracts the economies. There is no rent, however, until the supply price of a quantity exceeds the average cost of producing that quantity. With increasing returns and economies for a firm, $MC_{(r)}$ lies below $AC_{(r)}$.

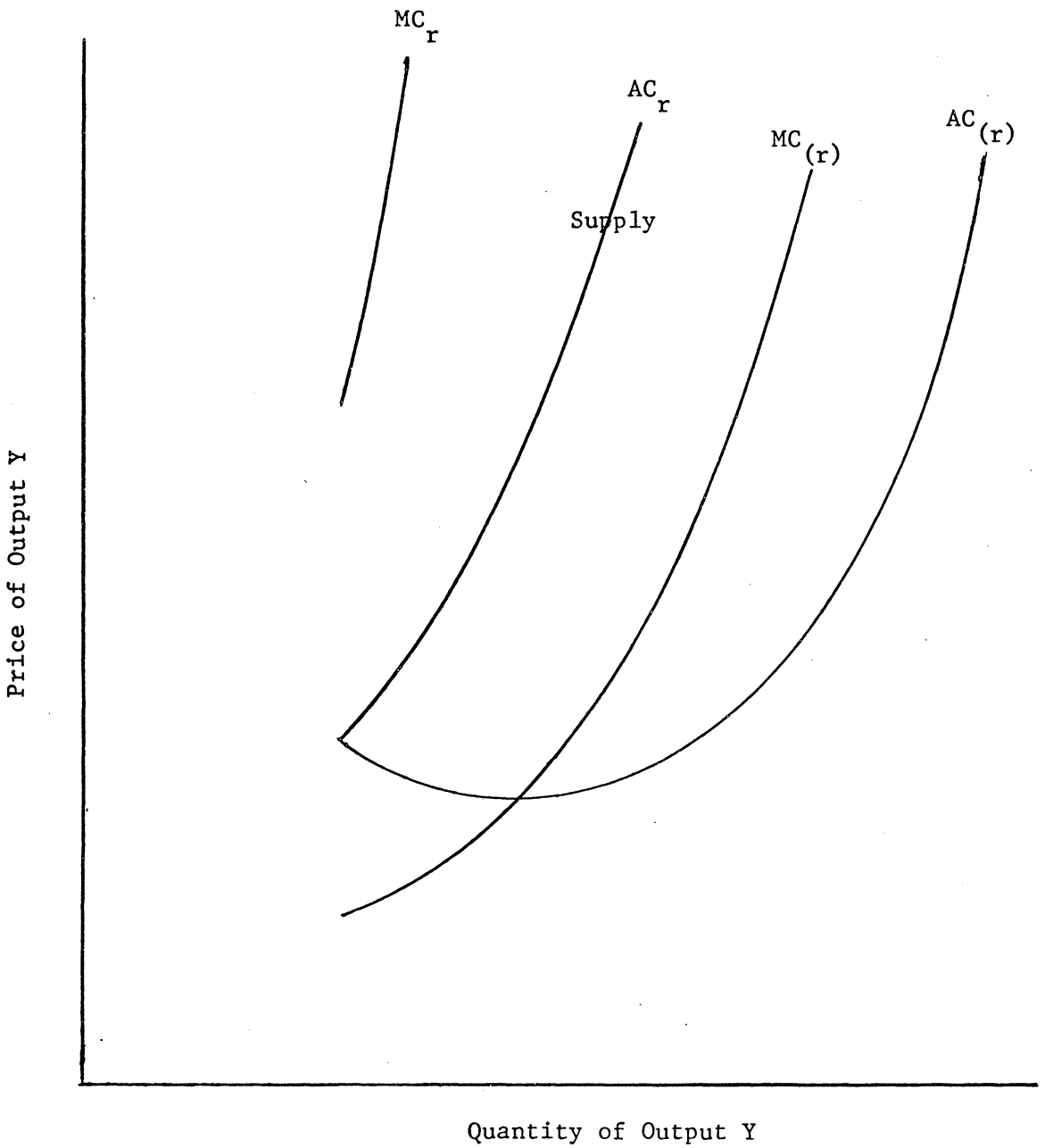


Figure 13. Four Cost Curves for a Competitive Industry with Economies of Large-Scale Industry and an Absolutely Fixed Input.

A firm will not rationally produce in this area. This accounts for the continuously rising industry supply curve AC_r . There is rent once $MC_{(r)}$ exceeds $AC_{(r)}$. The profit realized is transferred as rent to the fixed factor. Profit in the long run is zero.

Rent is the positive difference between AC_r and $AC_{(r)}$. Notice, however, the presence of induced economies, $AC_r - MC_{(r)}$.

The final type of scarcity involves heterogeneous quality evaluations of a factor by an industry. The resource is variable but contains a limited number of units of different quality.

As an additional unit of variable input is added intramarginally to a heterogeneous factor by the firm, the rent on the quality increases. Figure 14 shows the cost relation for a competitive firm having no economies of large-scale industry. The four cost curves are distinct for the firm. AC_r is the supply curve, but it is also the MC curve used by the firm to determine output. Employing heterogeneous resources is similar to factor prices increasing as quantity increases. Because of the heterogeneous evaluation of a resource by the industry as compared to the evaluation by other industries, rent is recognized by the firms of the industry. Competition among firms assures that quality is compensated by higher price, and that each firm pays the same price for all variable units of a given quality. The heterogeneous factor is not fixed. Rent is a cost that must be considered in production decisions. Each quality is variable in quantity according to the total price each unit commands.

The industry supply is also the AC_r curve. Each firm will produce where AC_r is at a minimum for the units of Y it produces. As each firm

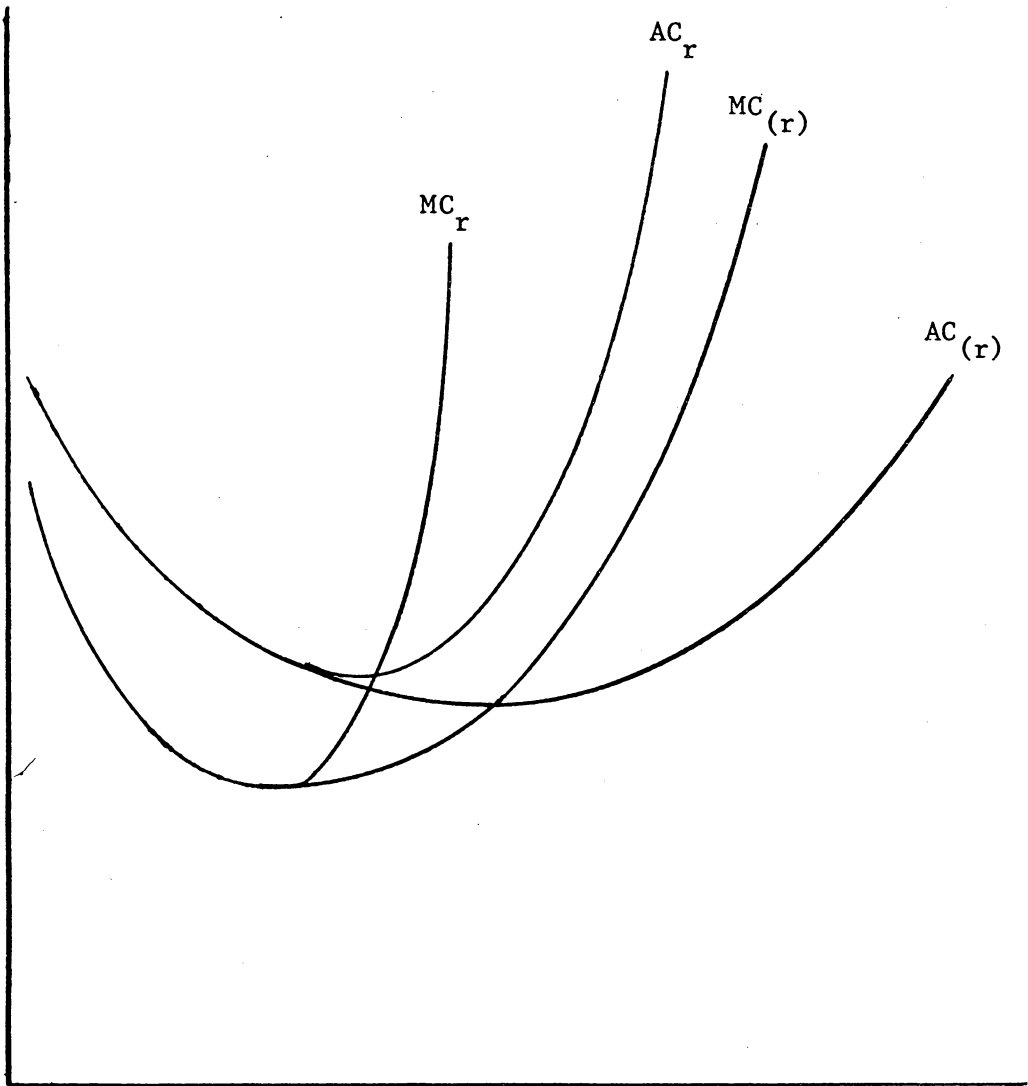


Figure 14. Four Cost Curves for a Competitive Firm with a Heterogeneous Input.

experiences economies, the rent for that firm is increased. As before, what is internal to the individual firm is external to all other firms, so that all firms experience economies as well as the diseconomies of increased rent as more intensive use is made of different qualities. Yet, each firm produces according to its total marginal cost excluding rent to a fixed factor. These marginal costs are, in the long run, the average cost including rent to the firm and to the industry. The question becomes one of whether the rent outweighs the economies.

Figure 15 illustrates three possible shapes of supply curves for Y. In the first segment, the economies are dominant, while with positive sloping curves, the increased rent overcomes the economies. When one is exactly offset by the other, $AC_r = MC_r$ and is perfectly elastic. As usual, $AC_r - AC_{(r)}$ equals rent per unit, $AC_r - MC_{(r)}$ equals induced economies, and $MC_r - MC_{(r)}$ equals the marginal increment in rent. Had there been no economies, the supply of Y would appear similar to the positively sloped AC_r curve of Figure 15, however AC_r would lie above $MC_{(r)}$.

Industry supply is a function of the cost relationships for the firm. Each firm produces in accordance with its individual costs, irrespective of the costs perceived by the total industry as a result of internal-external relationships. Competition assures, however, that in the long run, the marginal cost of the firm will be equal to its average cost including rent. The supply price for the industry in the long run is, therefore, the average cost including rent at the optimum point of production for the firms of the industry. It is

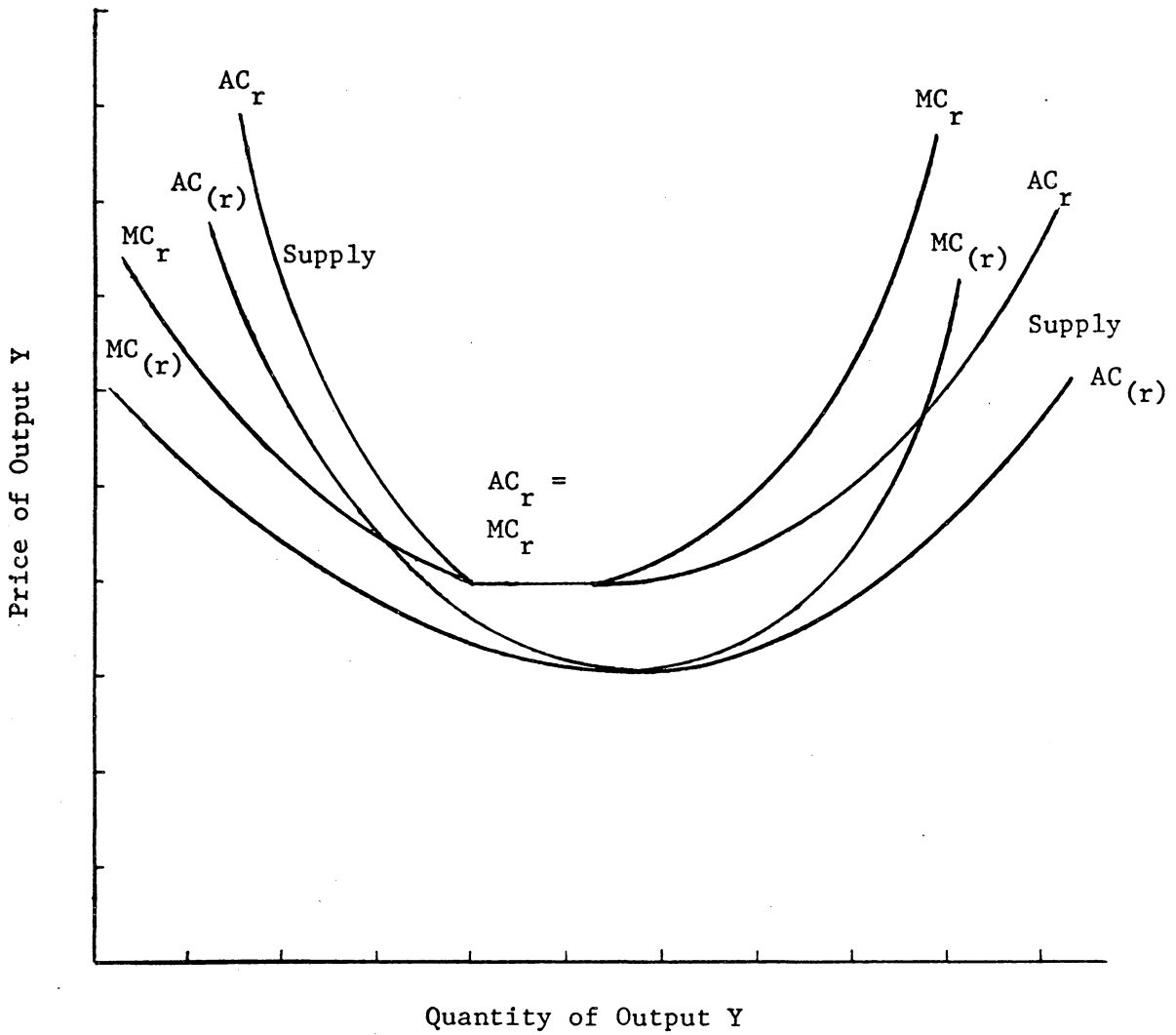


Figure 15. Four Cost Curves for a Competitive Industry with Economies of Large-Scale Industry and a Heterogeneous Input.

therefore, as Mrs. Robinson proposed, the long run industry average cost including rent that represents the industry long run supply curve for the product of the industry.

CHAPTER IV

SUMMARY AND CONCLUSIONS

In her analysis of supply, Mrs. Robinson digresses on rent and on four cost curves for an industry. The digression on rent studies rent as it accrues to a heterogeneous resource when qualities are limited relative to demand. The digression on four cost curves illustrates the effect of rent and economies on the costs of an industry, and discusses the costs by which the industry determines its long-run supply of a product.

The digression on rent is constructed under limited conditions. Production of output in the Robinson analysis occurs using a nondivisible, fixed input in combination with a heterogeneous resource. The present study, however, uses the tools of Robinson, but allows all resources to be variable where one resource is of heterogeneous quality. Rent accrues to a quality when it is in limited supply relative to the demand for the quality.

Recognizing the use of marginal analysis in the application of resources, one with another, the price per efficiency unit of a quality is not limited by the price per efficiency unit of other qualities. Efficiency units act as a measure of quality, yet, it is the relative supply and demand for a quality that determines the price of the quality. Factor price per efficiency unit in the short run may be different for each quality to the extent that even higher quality resources are priced cheaper per efficiency unit than a standard unit. It is additional cost

of a unit of output relative to the additional revenue from the additional unit of output that is important to the firm seeking to maximize profit.

In the digression on four cost curves, the cost curves of industries under conditions of scarcity and/or economies of large-scale industry are examined. Of the four cost curves the industry and each firm faces (i.e., average cost excluding rent, marginal cost excluding rent, average cost including rent, and marginal cost including rent), it is the long-run average cost including rent that represents the competitive industry supply curve.

The individual firm perceives only its own cost curves and produces additional output until the firm's added cost for a unit of output equals the value of the unit of output. Competition assures that in the long run, the marginal cost of the firm will be equal to its average cost including rent. The industry supply price for a quantity of output is, therefore, the average cost including rent at the optimum production for each firm of the industry. Industry supply may thus be represented as the average cost curve including rent.

The four cost curves also provide additional information. The rent per unit of output as well as the increase in rent, as output increases, can be calculated. From the relative positions of the curves, an indication of induced economies is obtained.

The contribution of Joan Robinson to the theory of rent and its part in the development of industry supply may be, and no doubt has been, evaluated differently by different people. Rather than being overly critical, the present evaluation of Mrs. Robinson has sought to provide the student of economics with a clearer understanding and

appreciation of the tools she uses, and at the same time expand the use of those tools into additional situations faced by competitive firms in the economy.

BIBLIOGRAPHY

- Barlowe, Raleigh, Land Resource Economics, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1958.
- Blaug, M. Economic Theory in Retrospect, Homewood, Illinois: Richard D. Irwin, Inc., 1962.
- Cunynghame, Henry, "Some Improvements in Simple Geometrical Methods of Treating Exchange Value, Monopoly, and Rent," The Economic Journal, Vol. 2, No. 5, March, 1892.
- Ellis, Howard S., and William Fellner, "External Economies and Diseconomies," The American Economic Review, Vol. 33, No. 3, September, 1943.
- Henderson, James M., and Richard E. Quandt, Microeconomic Theory--A Mathematical Approach, New York: McGraw-Hill Book Company, 1958.
- Leftwich, Richard H., The Price System and Resource Allocation, Third Edition, New York: Holt, Rinehart and Winston, 1966.
- Lipsey, Richard G., and Peter O. Steiner, Economics, Second Edition, New York: Harper and Row, Publishers, 1967.
- McConnell, Campbell R., Economics--Principles, Problems, and Policies, Third Edition, New York: McGraw-Hill Book Company, 1966.
- Robinson, Joan, The Economics of Imperfect Competition, Second Edition, New York: Macmillan and Co., Ltd., St. Martin's Press, Inc., 1969.
- Samuelson, Paul A., Economics--An Introductory Analysis, Seventh Edition, New York: McGraw-Hill Book Company, 1967.
- Stigler, George J., The Theory of Price, Third Edition, New York: The Macmillan Company, 1966.
- Weintraub, Sidney, An Approach to the Theory of Income Distribution, Philadelphia: Chilton Company, 1958.
- Wolfe, A. B., "Rent Under Increasing Returns," The American Economic Review, Vol. 19, No. 4, December, 1929.
- Worcester, Dean A., "A Reconsideration of the Theory of Rent," The American Economic Review, Vol. 36, No. 3, June, 1946.

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MRS. ROBINSON REVISITED

John Blair Riley

Abstract

In an analysis of supply, Joan Robinson in her book, The Economics of Imperfect Competition, digresses first on the concept of rent to a heterogeneous resource, and secondly on the four cost curves of an industry. This study re-examines these digressions and seeks to provide the student of economics with a clearer understanding and appreciation of the tools Robinson uses, but at the same time it expands the analysis into additional situations faced by competitive firms.

In the digression on rent, recognizing the use of marginal analysis in the application of a variable resource with a variable heterogeneous resource in the production of a product, this study finds that the price per efficiency unit of a quality is not limited by the price per efficiency unit of other qualities of the resource. It is the relative supply and demand for a quality that determines the price per efficiency unit of the quality and, therefore, the quality economic rent.

In the digression on four cost curves, the cost curves of industries under conditions of scarcity and/or economies of large-scale industry are examined. Of the four cost curves the industry faces (i.e., average cost excluding rent, marginal cost excluding rent, average cost including rent, and marginal cost including rent), it is the long-run average cost including rent, as Robinson proposed, that represents the competitive industry's long-run supply curve. Economies and scarcity only serve to change the shape of this supply curve.