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The Microeconomics of Monopoly Power

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The Microeconomics of
Monopoly Power

by
Thomas Karier

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The Microeconomics of Monopoly Power

Thomas Karier
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During the 1930s, a number of distinguished economists attempted to inject the concept of monopoly power into the conventional theory of the firm. The most notable efforts were by Chamberlain (1934), Robinson (1934), Lerner (1933), Kaldor (1934,1935), and Kalecki (1938). In response to this intellectual assault, conservative microeconomists largely refused to revise their competitive models to reflect the changing nature of the average corporation. Their single concession was to include the classic monopoly model in most textbooks, but only then with the excessively restrictive condition that prohibits all substitutes. In this form, the model is so qualified that it is only marginally relevant to the vast majority of actual enterprises.

But the early theorists were pioneering a more general role for monopoly power in the theory of the firm. The idea was evolving that all firms have varying degrees of monopoly power which in turn determine economic behavior. The role of monopoly power in the real economy is probably even more pervasive today than it was in the 1930s, but the content of microeconomic theory shows little evidence of adapting to this growing reality. Perhaps out of frustration, many of these early scholars literally abandoned the microeconomic

implications of their ideas and instead directed their work towards the more enlightened and still evolving fields of macroeconomics and industrial organization.

The purpose of this paper is to outline a consistent microeconomic theory of the firm based on the concept of monopoly power. It builds on the heritage of Post Keynesian authors, Robinson, Kaldor, and Kalecki, but literally extends the theory in several directions. First, monopoly power is defined formally in terms of substitution. In this way, monopoly power is recognized as a fundamental characteristic of a firm which in turn affects other aspects of its behavior. Also in this theory, the relationships between monopoly power, demand elasticities, markups, total profits, and the distribution of profits, are traced systematically.

Before turning to the theory it is important to point out that I have benefited as much from the mistakes of my predecessors as from their genuine insights. Kriesler (1987), for example, noted that Kalecki created considerable confusion by failing to clearly distinguish between the degree of monopoly and the markup. This problem is resolved here by defining monopoly power in terms of substitution and identifying it as one of several determinants of the markup. It is always easier to recognize a problem like this one and propose a solution when someone else has stumbled across it first.

Substitution

A fundamental proposition in this theory is that all firms face the threat of substitution from other producers but in varying degrees. The sum of these substitution possibilities indicate the level of monopoly power; firms with few close substitutes exercise far more monopoly power than those with many. But how does one measure the degree of substitution between two commodities?

The traditional measure is the cross price elasticity (CPE) which measures how the output of one firm or industry responds to the price change of another. If two goods are close substitutes, a small change in the price of one is expected to cause a large increase in the consumption of another. This is calculated by dividing the percentage change in the consumption of product y by the percentage change in the price of x. By definition the cross-price elasticity is,

$$\text{CPE} = \frac{\text{Percentage change in consumption of } y}{\text{Percentage change in price of } x} = \frac{dy}{dP_x} \cdot \frac{P_x}{y}$$

There is, however, a deficiency in this measure because y may be an excellent substitute for x even though the CPE is very small. The problem is that when the supply of y is relatively fixed, the price of y will simply increase without greatly changing the consumption of y.

This shortcoming suggests that a better measure would be based on revenue because it includes both output and price responses. When the price of x increases, consumers reduce their total expenditure on that product and reallocate their savings among a variety of goods or services.¹ By measuring these flows, we are essentially measuring the degree of substitution. The index that incorporates these principles is the cross revenue elasticity (CRE). The denominator is still the percentage change in the price of x but the numerator is now the percentage change in revenue of y (R_y). This can be written as,

$$\text{CRE} = \frac{\text{Percentage change in revenue of y}}{\text{Percentage change in price of x}} = \frac{dR_y \cdot P_x}{dP_x \cdot R_y}$$

A large value for CRE implies that y is a good substitute for x because a small price increase will induce a relatively large transfer of revenue from x to y.² But even CRE is not entirely satisfactory since we would like our measure of substitution to correctly rank the products that stand the most to gain from a price increase in x. The

1 The exception is when the price elasticity for x is less than one which is quite improbable for the output of a single firm. This case is therefore excluded in the following analysis.

2 When CRE is zero, y is unrelated to x because both its price and output are unaffected by changes in the price of x. When y is a complement for x, CRE will be negative.

reason CRE fails to do this is because it measures the percentage change in revenue relative to the revenue of each substitute. For substitutes with small initial revenue, the CRE may greatly exaggerate its relative importance.

The Substitution Index

This problem is corrected in a related measure, the substitution index (SI), which measures the percentage change in y's revenue relative to x's initial revenue. The substitution index is defined as,³

$$SI_{xy} = \frac{\frac{\text{Change in revenue of } y}{\text{Total revenue of } x}}{\text{Percentage change in price of } x} = \frac{dR_y \cdot P_x}{dP_x \cdot R_x}$$

The substitution index is a far better measure of substitutability because it includes both output and price responses without being unduly influenced by the initial revenue of y. A high substitution index between x and y implies that a price increase in x will cause consumers to transfer significant amounts of expenditures from x to y.

It is also important to point out that the substitution index is not symmetric and that SI_{xy} does not have to equal SI_{yx} . Although the two values are likely to be related, they are not necessarily identical. It is therefore

³ The substitution index (SI) is related to the cross revenue elasticity as indicated by the following equation, $SI_{xy} = CRE_{xy}(R_y/R_x)$.

important to specify the variable with the price change as the first subscript.

Monopoly Power and Substitution

It was mentioned previously that monopoly power depends on the availability of substitutes, or more precisely, on the number and strength of those substitutes. The definition of monopoly power (M) can now be stated more formally as a function of the sum of substitution indices (SI_{xi}) for all n other products related to x. This can be stated as,

$$M = \frac{1}{1 + \sum_{i=1}^n SI_{xi}}$$

According to this definition, when there are many good substitutes, the sum of SI's in the denominator will be large, and monopoly power will be close to zero. As substitutes decrease in number or strength, the sum decreases and monopoly power rises. If there were no substitutes whatsoever then monopoly power would take its maximum value of one.

A firm can increase its monopoly power by decreasing the number or strength of its substitutes and the most direct way to accomplish this is to buy one or more

competitors. In this way, the revenue that once dissipated to competitors can be reduced by also raising the price of the substitute acquired by the firm. The five major car divisions of General Motors serve as a useful example of this principle. If Chevrolet were an independent car company, an increase in its price would cause sales to spillover to all other substitutes including other divisions of GM, such as Pontiac, Buick, Oldsmobile, and Cadillac. But as part of GM, a general price increase by Chevrolet and other GM divisions results in a much smaller spillover. There is no question here that Chevrolet exercises more monopoly power as part of GM than as an independent auto manufacturer.

Price Elasticity of Demand

Now that monopoly power is defined, the next step is to show how it is related to demand, in particular, the price elasticity of demand (PE). This elasticity measures the responsiveness of the quantity demanded to price changes and is defined as,

$$PE = \left| \frac{\text{Percentage change in quantity demanded of } x}{\text{Percentage change in price of } x} \right| = \left| \frac{dx \cdot P_x}{dP_x \cdot x} \right|$$

Values of PE, greater than one are referred to as elastic and indicate a relatively large change in quantity for a

given change in price. The opposite case, when PE is less than or equal to one doesn't apply to the case of a single firm.⁴ All firms prefer to have a low elasticity because this implies that a price increase will cause a relatively small decrease in revenue.

The relationship between monopoly power and elasticity is derived in Appendix A but the results can easily be summarized; for any firm, monopoly power is inversely related to its elasticity of demand. This simple relationship is written as:

$$(1) \quad M = \frac{1}{PE}$$

High levels of monopoly power are associated with low price elasticities.

Markup and Profits

The final step is to show that monopoly power is related to the markup (m), defined as the relative difference between price (P) and marginal costs (mc), often referred to as the Lerner Index.⁵

⁴ If the elasticity was less than or equal to one then a firm could increase its price and revenue would stay the same or increase. This is extremely unlikely in the price range relevant for most firms.

⁵ Marginal cost is equal to the additional cost of producing one more unit.

$$(2) \quad m = \frac{P - mc}{P}$$

The markup is equal to the profit on the last unit of production relative to the price. While a firm is free to set any markup it chooses, there is always one that maximizes current profits. Determining this markup (m^*) is quite simple because it is exactly equal to monopoly power (M). This fact is also derived in Appendix A and can be written as,

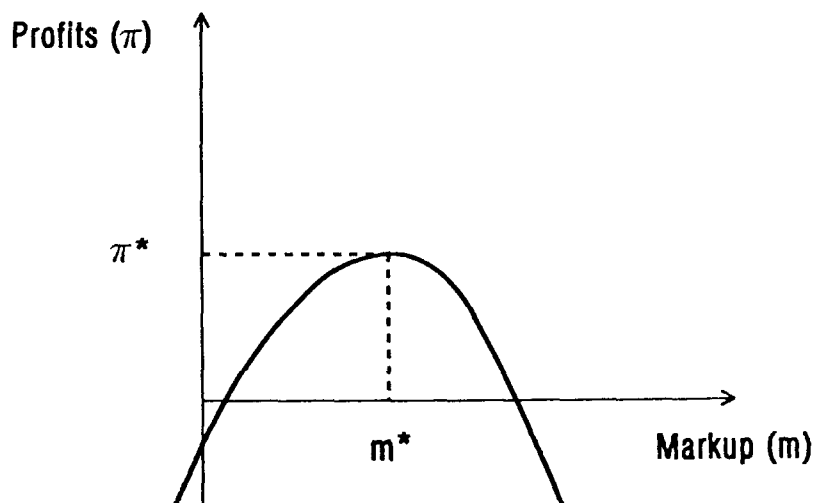
$$(3) \quad m^* = M = 1/PE$$

Remember that monopoly power ranges from zero to one which means that the optimum markup has the same range. This establishes the first important result; the particular markup which maximizes current profits is exactly equal to the value of monopoly power.

A producer is always free to select a markup different from m^* but then profits would be less than the maximum Π^* . This point is illustrated in Figure 1. For values of m less than or greater than m^* , profits fall short of their potential. There are occasions when firms intentionally select a markup different from m^* such as during periods of increasing or decreasing demand or when firms choose to forgo current profits with the hope of increasing their monopoly power through price competition. If price competition becomes particularly severe, markups and profits

could fall well below their optimum values and even become negative. But barring either of these conditions, it is reasonable to expect firms to generally maximize current profits and set markups at the optimum point, m^* .

Figure 1
**The Relationship Between
Markups and Profits**



Choosing the Correct Demand Elasticity

The key variable in determining both monopoly power and the profit maximizing markup is the price elasticity of demand. If each firm had a single price elasticity then it would be a simple matter to calculate the other variables.

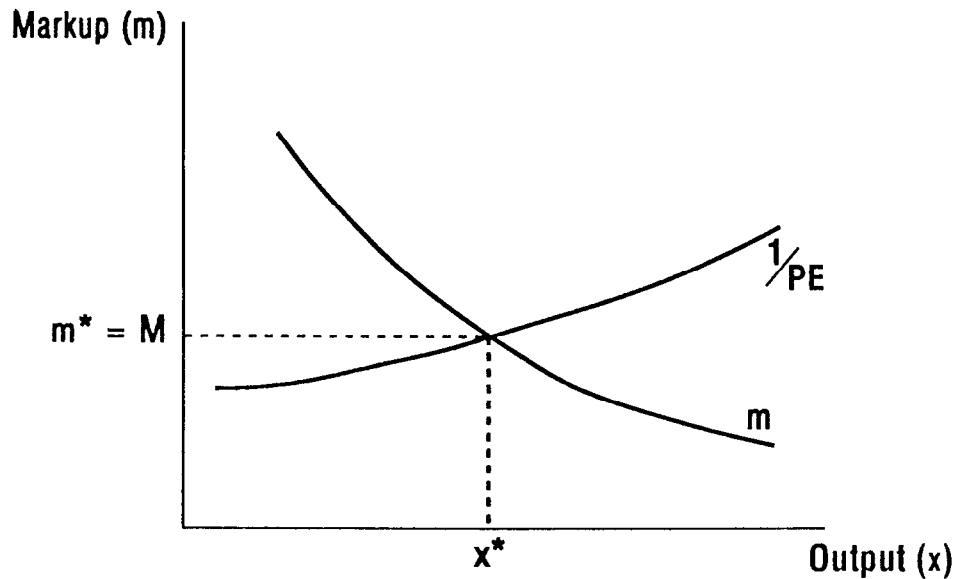
But in reality, there is usually more than one price elasticity. Economists have long been aware that price elasticity may depend on the level of output. In fact, only under rather special circumstances would one expect the price elasticity to be entirely independent of output. This raises an interesting question, if the elasticity is variable, how does this affect the definition of monopoly power and the profit maximizing markup?

Although a variable price elasticity increases the complexity of the model, it doesn't alter the basic relationships. It does mean that instead of monopoly power determining the optimum markup (m^*), the two are jointly determined. This is illustrated in Figure 2 where the inverse of the price elasticity (PE) is drawn as a positive function of output.⁶ The markup is also related to output since the firm sells more at lower markups than it does at higher ones.

One of the conditions for profit maximization specified in Equation 3 is that the markup (m) must equal the inverse of the price elasticity (PE). This occurs at output x^* in Figure 2, where the two curves intersect. This point

⁶ This implies that PE is inversely related to output. Although this is true for most demand curves, including linear ones, an exception may occur if consumers have a strong preference for some minimum quantity of the good. This is not, however, especially likely.

Figure 2
The Case of Variable Price Elasticity (PE)



determines both the profit maximizing markup (m^*) and the level of monopoly power (M).

In the previous discussion, the price elasticity of demand was assumed to be constant which determines a single value for monopoly power and the optimum markup. This case would be represented in Figure 2 by a horizontal line for $1/PE$. In either case, whether $1/PE$ is horizontal or upward sloping, the profit maximizing markup is determined by the intersection of the two curves.

A more complex problem is presented by the fact that the elasticity of demand tends to change over time. The

more time one allows after a price change, the easier it becomes for new firms to enter the market or for consumers to make substitutions. Therefore demand can be expected to be more elastic in the long-run than the short-run. Once again there is the question of which elasticity to choose in calculating monopoly power and the profit maximizing markup.

If the firm is concerned with maximizing the present value of current and future profits, neither elasticity is entirely appropriate. The short-run elasticity (PE) can be used to calculate a markup that maximizes short-run profits but ignores the effect of current decisions on future profits. Similarly, a lower markup based on the long-run elasticity will maximize future profits at the expense of current profits. There is, however, an adjusted price elasticity which determines a markup that maximizes the present value of all profits and it is likely to lie somewhere between the short-run and long-run elasticities. It is essentially found by increasing the short-run elasticity to account for the effect of changes in current output on future prices. A more detailed mathematical description of the adjusted price elasticity is contained in Appendix C. If changes in current output have no effect on future demand or the discount rate is very high, the adjusted and short-run price elasticities will be equal.

The Distribution of Monopoly Profits

Monopoly power may be a great source of profits but there is no guarantee that they will be entirely captured by the firm. As soon as it becomes known that a firm is extremely successful, claims on its surplus are likely to arise from diverse sectors. Among the most visible claimants are unions which typically adjust their demands for higher wages and benefits in accordance with firm profitability. To the extent that they are successful, unions stand to capture a share of the profits arising from monopoly power. Foreign producers may also be induced to increase their exports to those markets where profits are particularly high. And under certain conditions, these producers may also capture a share of profits. Monopoly power only creates the profits, it doesn't necessarily determine how they are allocated.

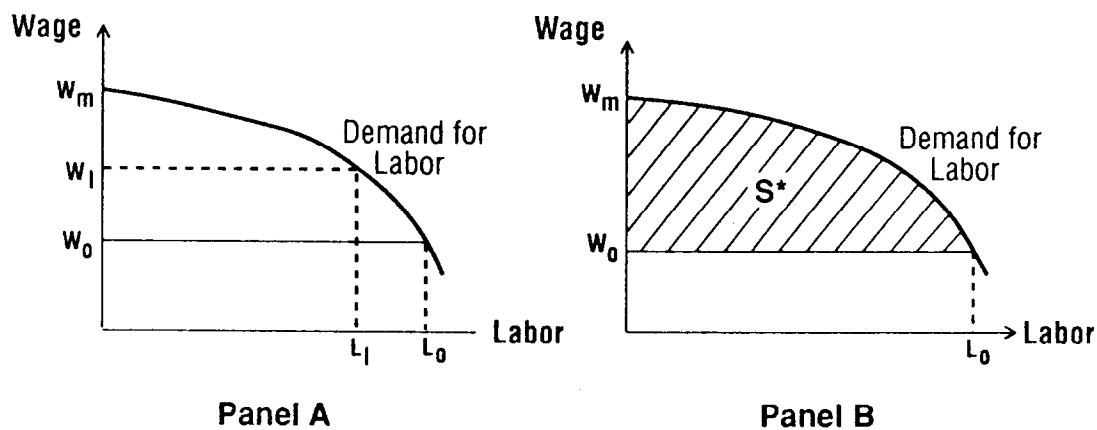
The model of monopoly surplus developed in this section shows how profits can be distributed among firms, unions, and imports. Although the recipients of monopoly profits are not limited to these three sectors, in most cases they probably account for the largest shares. The possibility of extending the model to other sectors is discussed later.

The starting point for the theory of monopoly surplus is the labor demand curve which shows the amount of labor a firm would employ at various wage levels.¹ The shape of

¹ Wages are used in this context as total hourly compensation which includes benefits.

this curve, presented in Figure 3, shows that firms will hire more workers as the wage rate declines. The rationale behind this is that firms won't pay any more for a unit of labor than it contributes in additional revenue. And each additional worker contributes less in revenue, not because the worker is necessarily less productive, but because additional units of output must be sold at lower prices.² Consequently the firm hires additional workers only at lower wage rates.

Figure 3
The Definition of Monopoly Surplus



² It is assumed that all factors are variable which makes figure 6.1 a long-run demand curve for labor. It also means that diminishing returns are less relevant.

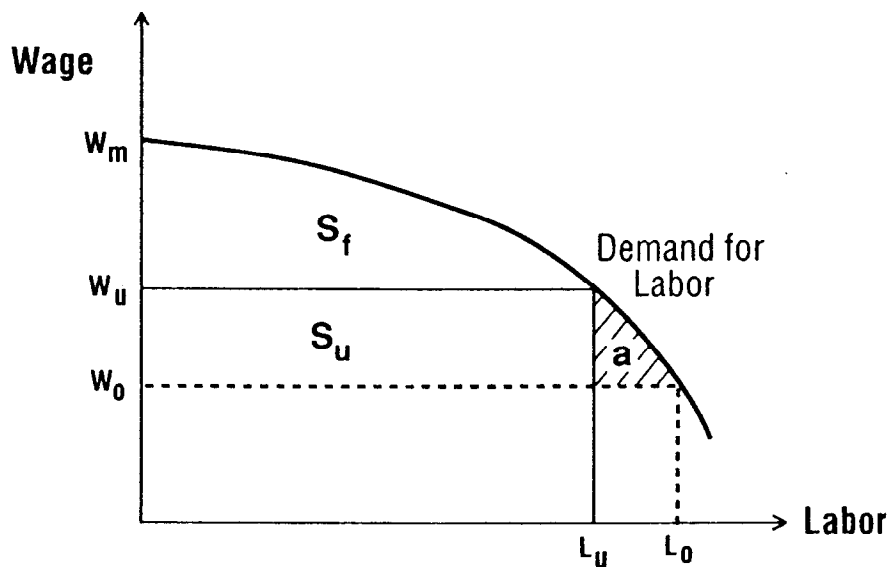
There is another way to explain the labor demand curve which is more relevant for the theory of monopoly surplus. The demand curve in Figure 3 represents the the maximum wage that a firm is willing to pay for each unit of labor. For example, the most the firm would be willing to pay for a worker at L_1 is a wage of W_1 . As long as the firm pays W_1 or less, it will make a positive profit on this particular worker. If the current wage is W_0 then the profit per worker is indicated by the vertical distance between the labor demand curve and the current wage W_0 . The firm effectively breaks even on its last worker when employment reaches, L_0 . Also, the wage W_m in the figure indicates the profits on the first unit of labor ($W_m - W_0$) as well as the maximum wage which would cause the firm to cease production.

Because of the nature of the labor demand curve, the profits made on each unit of labor are cumulative. The fact that the last worker is barely profitable does not detract from the much greater profits generated by previous ones. Therefore the total profits of the firm is equal to the area bounded by the labor demand curve and the current wage, designated by the shaded area in panel b of Figure 3. This area, defined as **monopoly surplus** (S), is equal to the firm's maximum profits (Π^*). For any profit maximizing producer, monopoly surplus and profits are equivalent. This result is also derived in appendix B and can be written as, $\Pi^* = S^*$.

Unions and Monopoly Surplus

This model is particularly useful for illustrating the effect of unions on profits. When successful, unions can force a firm to pay a higher wage, W_u , as illustrated in Figure 4. The monopoly surplus from the previous example is now divided into three parts. The upper area is equivalent to the firm's monopoly surplus (S_f) which is again bounded by the labor demand curve and the union wage rate. The firm's surplus and profits shrink in direct proportion to the increase in the union wage.

Figure 4
The Distribution of Monopoly Surplus:
Firms and Unions



As one would expect, the union gain (S_u) is equal to the total additional income accruing to union workers. It is represented by the rectangle in Figure 4 directly below the firm's profits and can be calculated by multiplying the length of one side, the union wage increment ($W_u - W_0$), by the other, union employment (L_u). In general, the magnitude of the union gain is determined by the size of the union wage increment and the shape of the labor demand curve.

Area a in the figure represents a net loss resulting from reduced employment under higher union wages. The wage increase causes the firm to cut production, raise prices, and reduce employment in order to maximize its own share of profits. The sum of all the components associated with the firm, the union, and the net loss are equivalent to the surplus that would have been available in a nonunion setting (S^*).

Imports and Monopoly Surplus

Unrestricted imports can potentially ignite a round of cutthroat competition between domestic and foreign producers which, would eliminate the surplus altogether. However, even with substantial imports, price competition can often be avoided if foreign firms face explicit or implicit quotas, or some other trade restriction. Rather than eliminating the surplus, foreign producers in this situation are more likely to capture a share of it.

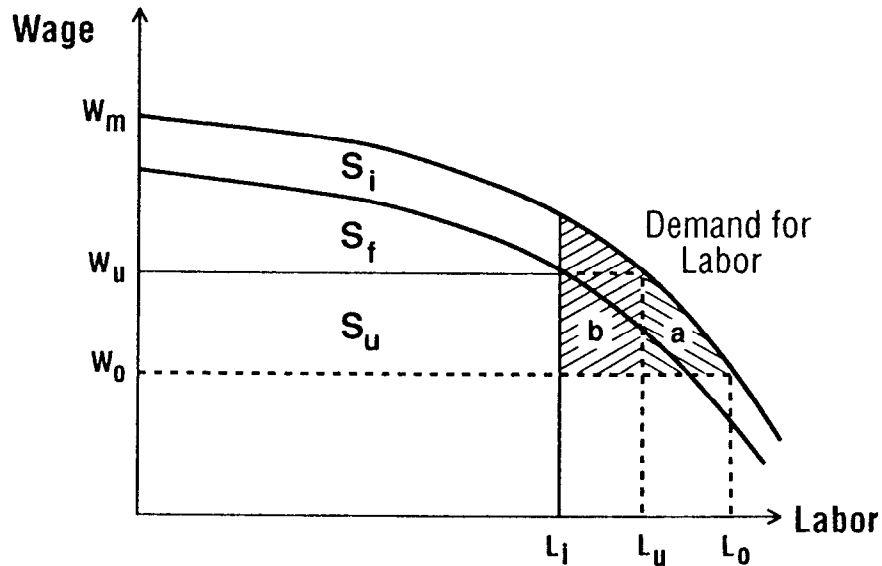
To demonstrate this, it is assumed that foreign producers, under an import quota, capture a predetermined quantity of a firm's sales. This has the effect of shifting the demand curve for the domestic firm to the left by this set amount. The decrease in product demand is followed by a decrease in the firm's demand for labor since the two are so closely related.

Figure 5 shows the effect of imports on the distribution of monopoly surplus. First it should be noted that employment drops from the union case (L_U) to a lower level associated with both unions and imports (L_i). Even assuming that wages remain the same, unions lose part of their surplus (S_U) because of employment losses.³ The firm's surplus (S_f) also declines because imports have the effect of uniformly decreasing the amount of profit that it makes on each unit of labor. The loss to both unions and the firm is represented by area b in the figure.

The surplus associated with imports (S_i) represents the firm's loss but does not necessarily equal the gains made by foreign firms. To calculate this would require more information about their costs and prices than is apparent from this simple figure. Nevertheless, we would expect

³ Under such conditions it is not inconceivable that the union wage would eventually fall, causing a redistribution in the remaining surplus between firms and unions.

Figure 5
**The Distribution of Monopoly Surplus:
 Firms, Unions and Imports**



foreign producers to be better off when they are challenging domestic firms which have significant monopoly power and persist in maximizing short run profits. In this situation, foreign firms have the potential to make considerable profits.

The Distribution Equation

From Figure 5 it is clear that both unions and imports can reduce the surplus and consequently the monopoly profits actually captured by a firm. It is also evident from the

figure that the sum of all the various components should equal the original surplus (S^*). To simplify matters, it is convenient to combine the union surplus with its net loss (a) and imports with its loss (b). The distribution of monopoly profits can now be condensed into the following equation.

$$(4) \quad \Pi^* = S^* = S_f + (S_u+a) + (S_i+b)$$

According to this equation, the monopoly profits of a firm are distributed among firms, unions, imports, and net losses. It is often necessary to refer to the fraction or share of profits (s) captured by each sector. This can be defined as the surplus associated with each sector divided by the original surplus or profits.

$$(5) \quad \begin{array}{ll} \text{Firm's Share:} & s_f = S_f/S^* \\ \text{Union Share:} & s_u = (S_u+a)/S^* \\ \text{Import Share:} & s_i = (S_i+b)/S^* \end{array}$$

And finally, the share of any one sector can be calculated in terms of the other by the following distribution identity.

$$(6) \quad 1 = s_f + s_u + s_i$$

This identity is a useful tool for showing the relationship between each sector's share of monopoly profits. If the

other shares must decrease. For example, an increase in the import share, must come at the expense of either the union or firm's share or some combination of the two. It is impossible for any sector to gain without causing comparable reductions for other sectors.

In reality, the beneficiaries of monopoly power do not have to be limited to firms, unions, and imports. These particular ones are useful for illustrating the theory and in many cases, may actually represent the most important sectors. However, in some cases, managers and other nonproduction workers may also claim a significant share through inflated salaries, benefits, bonuses, or perquisites. The government may also tap into the surplus as a source of financing for the public sector.

Summary

This completes the theory of monopoly power from substitution to distribution. Implicit in this presentation are the assumptions that demand is stable and that firms generally eschew price competition. While these conditions are necessary to establish the basic definitions and relationships, they can easily be relaxed to analyze more general situations.

It turns out that the concept of monopoly power is in fact essential for exploring these more realistic conditions. For example, the probability that any firm will choose to practice price competition should be related to

its monopoly power. Similarly, the possibility that a firm will cut its price during periods of slack demand should also depend, among other factors, on monopoly power. Consequently, the concept of monopoly power provides a promising tool for exploring other important economic topics.

Appendix A

The specific relationships between substitution, monopoly power, price elasticity, and markups are derived in this appendix. The following definitions are written in terms of prices (P), revenue (R), and marginal costs (mc), for two distinct commodities (x and y).

The Price Elasticity (e_x):

$$e_x = \left| \frac{dX}{dP_x} \cdot \frac{P_x}{X} \right|$$

The Cross Revenue Elasticity (r_{xy}):

$$r_{xy} = \frac{dR_y}{dP_x} \cdot \frac{P_x}{R_y}$$

The Revenue Elasticity (r_x):

$$r_x = \frac{dR_x}{dP_x} \cdot \frac{P_x}{R_x}$$

The Substitution Index (SI_{xy}):

$$SI_{xy} = (r_{xy}) \frac{R_y}{R_x} = \frac{dR_y}{dP_x} \cdot \frac{P_x}{R_x}$$

In the first step, it is assumed that the revenue lost by x when it increases its price is completely captured by n other commodities.¹ Or,

$$(1) \quad \frac{dR_x}{dP_x} + \sum_{i=1}^n \frac{dR_y}{dP_x} = 0$$

Multiplying both sides of (1) by P_x/R_x we have the result that,

$$(2) \quad \frac{dR_x}{dP_x} \cdot \frac{P_x}{R_x} + \sum_{i=1}^n \frac{dR_y}{dP_x} \cdot \frac{P_x}{R_x} = 0$$

¹¹ It is assumed that some fraction of the revenue lost by x will be saved. Therefore one of the i commodities must represent savings.

And based on the definitions, this can be simplified to,

$$(3) \quad r_x = - \sum_{i=1}^n SI_{xy}$$

This states that the revenue elasticity of x , is equal to the negative of the sum of the substitution indices. It is assumed that r_x ranges from zero to negative infinity. Using the definition of monopoly power (M) in the text, we have,

$$(4) \quad M = \frac{1}{1 - r_x}$$

If we expand r_x we find the following result.

$$(5) \quad r_x = \frac{dR}{dP_x} \cdot \frac{P_x}{R_x} = \frac{d(P_x X)}{dP_x} \cdot \frac{1}{X} = (X + P_x \frac{dX}{dP_x}) \frac{1}{X} = 1 - e_x$$

Finally, substituting (5) into (4) we have the result:

$$(6) \quad M = \frac{1}{e_x}$$

In order to show the relationship between monopoly power and the markup, we must assume that firms maximize profits. We can then use the pricing rule for a monopolist which states that marginal cost is a function of the price and price elasticity.

$$(7) \quad mc = (1 - 1/e_x)P_x$$

This can be rearranged to show that,²

$$(8) \quad \frac{1}{e_x} = \frac{P_x - mc}{P_x} = \text{Markup}$$

Combining (8) and (6) we have the final result that,

$$(9) \quad M = \frac{P_x - mc}{P_x}$$

² Lerner (1934) may have been the first to derive the relationship in equation 8.

Appendix B

We begin with the standard definition of profits (Π) based on price (P), output (X), wage (w), labor (L), capital costs (i), and capital stock (K).

$$(1) \quad \Pi = PX - wL - iK$$

The total differential of this equation is,

$$(2) \quad d\Pi = P(1 - 1/e_X)dX - Ldw - wdL - idK - Kdi$$

where e_X is the elasticity of product demand. We assume that capital costs are constant so the last term is zero.

In order to simplify this equation we need three more equations. The first is the total differential of the production function.

$$(3) \quad dX = \frac{\partial X}{\partial L} dL + \frac{\partial X}{\partial K} dK$$

The others are the familiar conditions for cost minimization.

$$(4) \quad w = P(1 - 1/e_X) \frac{\partial X}{\partial L} \quad \text{and} \quad i = P(1 - 1/e_X) \frac{\partial X}{\partial K}$$

Substituting equations 4 into 3 we find,

$$(5) \quad P(1 - 1/e_X)dX = wdL + idK$$

And substituting 5 into 2 we have the desired result,

$$(6) \quad -d\Pi = Ldw$$

This means that an incremental change in the wage rate multiplied by employment will equal the decline in profits.¹

Based on the labor demand curve, L can be written as a function of the wage, $L(w)$, and equation 6 implies that Π is also a function of the wage, $\Pi(w)$. At wage w_0 profits are

¹² This result applies to the long run case since capital is treated as a variable. It is also important to note that this is the same result as simply taking the partial derivative of equation 1 with respect to wages but the interpretation is different. The partial derivative holds all other variables constant while the total derivative in (6) allows all variables to change except for the price of capital. The fact that the two are the same is an interesting result in itself.

defined as Π_0 and Π_1 at w_1 . We can therefore integrate equation 6 as w increases from w_0 to w_1 .

$$(7) \quad \int_{w_0}^{w_1} -d\Pi(w) = \Pi_0 - \Pi_1 = \Delta\Pi = \int_{w_0}^{w_1} L(w) dw$$

The integral on the right side of the equation is the definition of monopoly surplus. Therefore the change in profits as wages rise from w_0 to w_1 is equal to the change in monopoly surplus. When w_1 equals the shutdown wage w_m , Π_1 is zero and the initial profit (Π_0) is equal to the total monopoly surplus. This corresponds to panel b in Figure 3.

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