Monopsony and Two-Part Tariffs

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Abstract

In his classic article, Walter Oi (1971) analyzed two-part tariffs by a monopolist. We adapt his analysis to the case of monopsony. We show that the resulting offer is that the seller pays its producer surplus as an access fee in exchange for the buyers promise to buy everything that the seller wants to sell when price equals marginal cost. In addition, we show that this is equivalent to the surplus that the buyer captures with first-degree price discrimination as well as an all-or-nothing offer. We also extend this analysis to the case of uncertainty for a risk-averse monopsonist.

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1 Introduction

Joan Robinson (1933) provided the first comprehensive analysis of monopsony. Most—if not all—economists dismissed this market structure as being empirically irrelevant since single buyers were even scarcer than single sellers. In recent decades, however, academic interest in monopsony power has been rekindled, which has resulted in systematic considerations of buying power. This renewed interest extends to both output markets and input markets, especially labor markets. In this paper, we add to this literature by extending Walter Oi’s analysis of two-part tariffs (Oi, 1971) to monopsony.

If a monopsonist maximizes profit by simply reducing its purchases of the monopsonized product, it will leave some producer surplus on the table and lose some producer surplus through allocative inefficiency. In contrast, we show that a distributor with monopsony power can require slotting allowances (i.e. access fees) that extract the entire producer surplus that is generated by purchasing the quantity that equates the derived demand with the producer’s supply. We also show that this strategy is economically equivalent to monopsonistic first-degree price discrimination and all-or-nothing offers. Finally, we extend our analysis to the case of uncertainty.

2 Economic Analysis

We begin with the standard monopsony model with linear pricing. We then consider two-part pricing with linear demand and supply.

\footnote{Zabel (1970) seminal paper introduces uncertain demand to the case of monopoly. Blair and DePasquale (2010), Wong (2012), and Wong (2014) discuss two-part pricing and uncertain demand in the case of a monopolist.}
**Profit-Maximizing Monopsony under uniform pricing**

Consider a firm that produces output according to the following, twice-differentiable production function:

\[
Q = Q(x_1, x_2, \ldots, x_n)
\]  

where \(Q\) is the output and \(x_i\) is the quantity of input \(i\). Without loss of generality, we assume that the firm is a monopsonist in employing \(x_1\) but is competitive in all other input markets. The monopsonist’s profit function is

\[
\Pi(x_1, x_2, \ldots, x_n) = P(Q(x_1, x_2, \ldots, x_n)) - w_1(x_1)x_1 - \sum_{i=2}^{N} w_i x_i
\]  

where \(P(Q)\) is the output price and \(w_1\) is the input price of \(x_1\), which of course is a function of the amount of input \(x_1\). The first-order condition of interest is:

\[
\frac{\partial \Pi}{\partial x_1} = \left( P + Q \frac{dP}{dQ} \right) \left( \frac{\partial Q}{\partial x_1} \right) - w_1 - x_1 \frac{dw_1}{dx_1} = 0
\]  

The monopsonist will employ \(x_1\) such that the marginal revenue product of \(x_1\) is equal to the marginal expenditure of \(x_1\). These results can be illustrated in Figure 1. In order to maximize profits with linear pricing, the distributor will purchase \(x_m\) where the marginal expenditure (ME) is equal to the firm’s marginal revenue product (MRP). The price paid will be \(w_m\). In contrast, the competitive solution would be found where MRP equals supply (S). In that event, the sum of buyer (i.e. consumer) surplus and producer surplus would equal area \(abc\). The monopsony solution results in buyer surplus equal to area \(adew_m\). The monopsonist leaves producer surplus of \(w_m ec\) on the table and surplus of \(dbe\) is lost due to allocative inefficiency. The monopsonist can capture the entire surplus through a two-part offer.
Two-part pricing

The monopsonist can earn more profit by engaging in nonlinear pricing as a buyer. The monopsonist will demand a payment for the privilege of selling to the distributor. This payment may be a slotting allowance or an ex ante rebate. This arrangement alters the profit function to

$$\Pi(x_1, x_2, \ldots, x_n) = P(Q)Q(x_1, x_2, \ldots, x_n) + \delta(x_1) - w_1x_1 - \sum_{i=2}^{N} w_i x_i$$ \hspace{1cm} (4)$$

where $\delta(x_1)$ is the slotting allowance or rebate. Suppose further that within input market for $x_1$ the monopsonist faces the following linear supply curve of the input:

$$w_1 = \alpha_s + \beta_s x_1,$$ \hspace{1cm} (5)$$

and correspondingly the following equation for producer surplus:

$$\delta(x_1) = \frac{1}{2}(w_1 - \alpha_s)x_1 = \frac{1}{2}(\alpha_s + \beta_s x_1 - \alpha_s)x_1 = \frac{1}{2}(\beta_s x_1^2)$$ \hspace{1cm} (6)$$

where $\alpha_s$ is the intercept and $\beta_s$ is the slope of the supply curve. Substituting equations 5 and 6 into equation 7, we get:

$$\Pi(x_1, x_2, \ldots, x_n) = P(Q)Q + \frac{1}{2}(\beta_s x_1^2) - (\alpha_s + \beta_s x_1)x_1 - \sum_{i=2}^{N} w_i x_i$$ \hspace{1cm} (7)$$

The monopsonist profit-maximizes over $x_1$, yielding the following first-order condition:

$$\frac{\partial \Pi(x_1, x_2, \ldots, x_n)}{\partial x_1} = \left( P + Q \frac{dP}{dQ} \left( \frac{\partial Q}{\partial x_1} \right) + \beta_s x_1 - \alpha_s - 2\beta_s x_1 = 0 \right)$$ \hspace{1cm} (8)$$
Re-arranging equation 8 gives us:

\[ (P + Q \frac{dP}{dQ}) \left( \frac{\partial Q}{\partial x_1} \right) = \alpha_s + \beta_s x_1 \] (9)

The left-hand side of equation 9 is the marginal revenue product (MRP) of input \( x_1 \). The right-hand side of the equation is the supply curve for \( x_1 \) that we first saw in equation 5. Therefore, the profit-maximizing monopsonist chooses \( x_1 \) so that the MRP equals supply, i.e. the competitive quantity.

This can be illustrated in Figure 2. With the nonlinear strategy, the monopsonist agrees to buy the competitive quantity, \( x_c \) at the competitive price, \( w_c \). This price and quantity maximizes the surplus. The producer surplus, which is equal to area \( w_c bc \), is the access fee or rebate. Consequently, the monopsonist extracts the entire surplus. For a calculation of the access fee for nonlinear MRP and Supply, see Appendix A.

### 3 Comparison to other pricing strategies

There are economically equivalent alternatives to the two-part pricing strategy. In this case, first-degree price discrimination by the monopsonist is economically equivalent to two-part pricing. In addition, all-or-nothing offers are also economically equivalent. All three strategies put the entire surplus in the monopsonist’s pocket.

**First-Degree Price Discrimination**

A monopsonist that practices first-degree price discrimination buys each unit at its reservation price. In other words, the monopsonist will buy along the supply curve. It stops when the marginal revenue produce equals the reservation price of the marginal unit.

Specifically, suppose the firm pays a per-unit price equal to \( P_n = S(x_n) \) where \( n \) is the
nth unit sold (Small, 1999). This monopsonist faces a total cost \( C \) of:

\[
C (x^*) = \int_0^{x^*} S (x) \, dQ
\]  

(10)

In this case, there is no slotting allowance or rebate but the monopsonist still enjoys the same consumer surplus as the two-part pricing monopsonist.

**All-or-nothing Supply**

Another way of extracting the entire producer surplus is through an all-or-nothing offer to the producer. In the usual exchange, buyers buy as much as they want and sellers sell as much as they want depending on the price terms. In an all-or-nothing offer, the buyer offers to buy a specific quantity at a specific price per unit. If that offer is rejected, the buyer buys nothing at all. Therefore, this approach only works if there is a credible threat to buy nothing at all, i.e. there must be an alternative source of supply.

The total surplus is maximized when the monopsonist buys the quantity at which marginal revenue product (MRP) equals supply (S), \( x_1^* \) in Figure 3. With traditional exchange, the resulting price would be \( w_1^* \). The buyer surplus would be \( w_1^*bc \) and the producer surplus would be \( w_1^*bc \). In a profit-maximizing all-or-nothing offer the monopsonist will offer to buy \( x_1^* \) at a price below \( w_1^* \). That price is found on the all-or-nothing supply curve, \( (S_A) \). Each point on the all-or-nothing supply curve is a price-quantity combination that leaves no producer surplus.\(^2\) At a surplus maximizing quantity of \( x_1^* \), the price will be \( w_1^{**} \). At this price and quantity, the supplier realizes no producer surplus because area \( w_1^{**}ac \) is exactly offset by area \( bda \).\(^3\) As a result, the entire producer surplus will have been extracted by the monopsonist. Although this exchange looks very different from first-degree price discrimina-

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\(^2\)See, for example, Layard and Walters (1978). Assuming a linear supply curve, the all-or-nothing supply will have half the slope of the regular supply curve.

\(^3\)The all-or-nothing analysis has been used by Blair and Harrison (2010), Blair and Durrance (2013) and Herndon (2002).
tion it is economically equivalent in the sense that the competitive quantity, \( x_1^* \) is exchanged and the monopsonist ends up with all of the surplus.

4 The Influence of Uncertainty

Suppose the monopsonist faces an uncertain supply curve. We can express this supply curve as

\[
\tilde{w}_1 = \alpha_s + \mu + \beta_s x_1. \tag{11}
\]

where \( \mu \) is a random variable and an expected value of zero. That is:

\[
E[\mu] = \int_{-\alpha_s}^{\infty} \mu f(\mu) d\mu = 0 \tag{12}
\]

where \( f(\mu) \) is the probability density function of \( \mu \) and \(-\alpha_s\) is the lower bound that makes certain \( w_1 \) is greater than or equal to zero. Random profit can be written as:

\[
\tilde{\Pi} = P(Q)Q + \delta(x_1) - \tilde{w}_1 x_1 - \sum_{i=2}^{N} w_i x_i \tag{13}
\]

Substituting in equations (6) and (11) for \( \delta(x_1) \) and \( \tilde{w}_1 \), respectively, we get:

\[
\tilde{\Pi} = P(Q)Q + \frac{1}{2} (\beta_s x_1^2) - (\alpha_s + \mu + \beta_s x_1) x_1 - \sum_{i=2}^{N} w_i x_i \tag{14}
\]

Since profit is a random variable, the firm cannot maximize profit. Consequently, we consider the firm’s goal to be the maximization of the expected utility of profit. The monopsonist’s objective function can be written as:

\[
\max_{x_i} E \left[ U \left( \tilde{\Pi} \right) \right] = E \left[ U \left( P(Q)Q + \frac{1}{2} (\beta_s x_1^2) - (\alpha_s + \mu + \beta_s x_1) x_1 - \sum_{i=2}^{N} w_i x_i \right) \right] \tag{15}
\]
where $U$ is a Von-Neumann Morgenstern utility function. The first-order condition of interest is:

$$\frac{\partial \mathbb{E}\left[U\left(\tilde{\Pi}\right)\right]}{\partial x_1} = \mathbb{E}\left[U'(\tilde{\Pi})\left(P + Q\ast \frac{dP}{dQ}\right)\left(\frac{\partial Q}{\partial x_1}\right) - (\alpha_s + \mu + \beta_s x_1)\right] = 0 \quad (16)$$

where $\alpha_s + \mu + \beta_s x_1 = \tilde{w}_1$. Taking expectations and using the definition of covariance, we can re-write equation (16) as:

$$\mathbb{E}\left[U'(\tilde{\Pi})\right]\left(P + Q\ast \frac{dP}{dQ}\right)\left(\frac{\partial Q}{\partial x_1}\right) - \mathbb{E}[\tilde{w}_1] - \text{cov}\left(U'(\tilde{\Pi}), \tilde{w}_1\right) = 0 \quad (17)$$

or

$$\left(P + Q\ast \frac{dP}{dQ}\right)\left(\frac{\partial Q}{\partial x_1}\right) = \mathbb{E}[\tilde{w}_1] + \frac{\text{cov}\left(U'(\tilde{\Pi}), \tilde{w}_1\right)}{\mathbb{E}\left[U'(\tilde{\Pi})\right]} \quad (18)$$

**Risk Neutrality**

A risk neutral monopsonist has a linear utility function. In this case, $U'(\tilde{\Pi})$ is constant. The covariance between a constant and a random variable is zero, simplifying equation 18 to:

$$\left(P + Q\ast \frac{dP}{dQ}\right)\left(\frac{\partial Q}{\partial x_1}\right) = \mathbb{E}[\tilde{w}_1] \quad (19)$$

This says that the monopsonist will purchase where MRP is equal to the marginal expenditure, i.e. the competitive quantity, $x_c$. The access fee is equal to the would-be surplus. This is the stochastic equivalent to the results laid out in section 2.

**Risk Aversion**

A risk averse monopsonist has a utility function that is strictly concave. In other words, the utility function increases at a decreasing rate, $U' > 0$, $U'' < 0$. Additionally, $U'(\tilde{\Pi})$
will depend upon the random supply curve the monopsonist faces ($\tilde{w}_1$). If there is a random increase in $\mu$, then $w_1$ will rise, profit will fall, and therefore, the $U'\left(\tilde{\Pi}\right)$ will increase. In other words, the covariance term in the numerator of equation 18 would be positive. Given that $E\left[U'\left(\tilde{\Pi}\right)\right]$ is always positive, equation 18 indicates that a risk averse monopsonist would purchase fewer units than the competitive quantity. As a result, the monopsonist will pay a lower per unit price and charge a lower access fee. All else equal, a risk averse monopsonist will enjoy lower realized profits than if it were risk neutral.

**Risk Taking**

A risk taking monopsonist has a utility function that is strictly convex. Consequently, as $w_1$ increases, profit decreases, $U'\left(\tilde{\Pi}\right)$ decreases, and the covariance in equation (18) is therefore negative. This negative covariance acts as a decrease in the expected wage and, thus, a risk taking monopsonist agrees purchase more units than the risk neutral monopsonist. This firm pays a higher per unit price and charges a higher access fee. In this case, the risk taking firm will make a lower profit than a risk neutral firm from paying a price above their marginal revenue product.\(^4\)

5 Discussion

Previous literature has discussed the idea of “slotting allowances” (Shaffer, 1991; Shaffer, 2005; Marx and Shaffer, 2010). Some retailers require payments from their suppliers to buy shelf space. These are inherently the product of monopsony power—that is retail stores face more demand for their shelf space than they have supply of such space. In essence, a slotting

\(^4\)An increase in purchases beyond the point where $MRP = E[w_1]$ increases the total expenditure by $E[w_1] + x_1 * dw/dx_1$. The increase in the access fee will be equal to the increase in the producer surplus, which is equal to $x_1 * dw/dx_1$. The net increase is then equal to $E[w_1]$. Therefore, if the MRP exceeds the expected wage, this behavior must reduce expected profit.
allowance is a form of second-degree price discrimination. This business practice raises two distinct questions: (1) do slotting allowances act as a form of two-part pricing and extend monopsony power; or (2) do slotting allowances actually extend monopoly power? In this paper we have analyzed the results of two-part pricing by a monopsonist. Shaffer (2005) shows that large firms may purchase shelf space as a way to exclude rivals. If both the buyer and the supplier exhibit simultaneous market power, we experience a bilateral monopoly and subsequently, efficient allocation.

6 Conclusion

In this paper we adapt the traditional two-part pricing model to the case of monopsony. We show that a monopsonist can extract the entire producer surplus by purchasing the competitive quantity and the competitive price and charging a lump-sum access fee to the supplier. This result is similar to the idea of “slotting allowances” where suppliers secure shelf space by paying the retailer a lump-sum fee.

We extend our analysis by introducing uncertainty and show that, all else equal, a risk-averse monopsonist realizes lower profits than a risk-neutral monopsonist by purchasing a smaller quantity and charging a lower access fee.
References


Appendix

A Generalized Access Fee

The results can be generalized to nonlinear Marginal Revenue Product and Supply (S). Suppose we have the following general equations for MRP and Supply:

\[
MRT : W_d(x_1); \quad Supply : W_s(x_1).
\]  

(20)

There exists some \( x_1^* \) such that \( W_D(x_1) = W_S(x_1) \). Again, the monopsonist will purchase and pay a per-use fee equal to where supply intersects MRP and an access fee equal to the would-be producer surplus. More specifically, the access fee will be the difference between the total price paid for the goods purchased and the area under the supply curve. This isolates the would-be producer surplus.

\[
Access \text{ Fee} = w_1 \ast x_1 - \int_0^{x_1^*} W_S(x_1) \, dQ
\]  

(21)

where \( w_1 \) is the per-unit price paid for \( x_1 \).
Figure 1
Standard Monopsony Model

Price

Marginal Expenditure (ME)

Supply (S)

MRP = Demand

Quantity

\[ \text{Quantity} \]

\[ \text{MRP} = \text{Demand} \]

\[ x_m \]

\[ x_C \]
Figure 2
Two Part Pricing

Quantity

MRP = Demand

Price

Supply (S)

Access fee/rebate

MRP = Demand

Quantity

w_c

b

X_c
Figure 3
All-or-nothing Model