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Price-Taking Monopolies in Small Open Economies

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Abstract

The export sector of a small open economy is assumed to be a price-taking monopoly with increasing long-run average cost and positive profit. Under such conditions, demands for productive factors are shown to slope downward in the general equilibrium of an otherwise competitive economy. Comparative static effects of changing prices and factor endowments are weaker than with a competitive export sector. The comparative static effects involving monopoly profit and outputs are examined.

There are monopolies in exporting sectors, especially in nationalized natural resource industries in smaller economies. Such monopolies are price takers on the world market. The present article widens the scope of factor-proportion models of production and trade to include such price-taking monopolies in small open economies. The monopoly searches for output to maximize profit. Comparative static effects of changing prices and factor endowments are examined. The present model is an alternative to a monopolist in general equilibrium facing less than perfectly elastic demand, developed, for instance, by Melvin and Warne (1973).

1. A monopoly exporter

The monopolist is a price taker in the world market with profit $\pi_1 = (p_1 - c_1)x_1$, where p_1 is the exogenously given world price, c_1 is monopoly average cost, and x_1 is output. The first-order condition for profit maximization is

$$0 = \delta\pi_1/\delta x_1 = p_1 - c_1 - x_1\delta c_1(x_1)/\delta x_1 = p_1 - c_1 - x_1 c_1'. \quad (1)$$

The term $\delta c_1(x_1)/\delta x_1 = c_1'$ introduces a general equilibrium link between average cost and output. Thompson (1998) introduces a similar general equilibrium link between cost and output for a sector producing many products.

Total cost of the monopolist is x_1c_1, and its marginal cost is $c_1 + x_1c_1'$. The value of c_1' is determined in the general equilibrium. The output decision of the monopolist has an impact on endogenous factor prices in the economy, implying a sort of general equilibrium monopsony power.

Facing perfectly elastic demand, monopoly profit is maximized at the output where marginal revenue equals marginal cost, $p_1 = c_1 + x_1c_1'$ implying $x_1 = (p_1 - c_1)/c_1'$. Profit $\pi_1 = (p_1 - c_1)x_1 = (c_1 + x_1c_1' - c_1)x_1 = x_1^2c_1'$ is positive if average cost increases in output, $c_1' > 0$. The monopolist lowers cost by restricting output relative to what a competitive industry would produce. The relative demand for the input the monopoly uses intensively and average cost are low relative to competition. Negative c_1' and $\pi_1 < 0$ are inconsistent with a long-run model given variable inputs and market clearing.

2. The comparative statics of a small open monopoly

Profit is a component of national income along with total payments to capital and labor. The focus of the present article is on the comparative static characteristics of production, and consumption is not modeled explicitly. Residual claimants of profit are assumed to spend it on current consumption. Trade is balanced, constraining consumption.

Differentiate the profit-maximizing condition $x_1 = (p_1 - c_1)/c_1'$ to find $dx_1 = [(dp_1 - dc_1)c_1' - (p_1 - c_1)dc_1']/c_1'^2$. Write the term dc_1' as $c_1''dx_1$, since c_1' would change due to changes in x_1. Changes in cost $c_1 = ra_{K1} + wa_{L1}$ are $dc_1 = a_{K1}dr + a_{L1}dw$, given the cost-minimizing envelope result. Combining these results,

$$dx_1 = (dp_1 - a_{K1}dr - a_{L1}dw)/\alpha, \tag{2}$$

where $\alpha = [c_1'^2 + (p_1 - c_1)c_1'']/c_1'$. Given u-shaped long-run average cost, $c_1'' > 0$. Assuming profit is positive, $c_1' > 0$, $p_1 > c_1$, and $\alpha > 0$. Equation (2) becomes part of the comparative static system (4) (see below).

Changes in profit are written $d\pi_1 = (p_1 - c_1)dx_1 + x_1dp_1 - x_1dc_1 = (\pi_1/x_1)dx_1 + x_1dp_1 - x_1a_{K1}dr - x_1a_{L1}dw$, which implies

$$dp_1 = a_{K1}dr + a_{L1}dw - \left(\pi_1/x_1^2\right)dx_1 + (1/x_1)d\pi_1, \tag{3}$$

linking monopoly profit to the general equilibrium in the last equation of the comparative static system (4).

Otherwise, the factor proportions model developed by Jones (1965) and Jones and Scheinkman (1979) applies. Full employment of capital and labor lead to the first two equations in (4). Substitution terms summarize how firms substitute between capital and labor: $s_{KK} = \Sigma_j x_j \delta a_{kj}/\delta r < 0$, $s_{LL} = \Sigma_j xj\delta a_{Lj}/\delta w < 0$, and $s_{KL} = \Sigma_j x_j \delta a_{KJ}/\delta w = \Sigma_j x_j \delta a_{Lj}/\delta r = s_{Lj} > 0$. Own substitution terms s_{KK} and s_{LL} are negative due to concavity of the cost function. By Shephard's lemma and Taylor's formula, $s_{KL} = s_{LK}$. Assuming linear homogeneity, $s_{KK} + s_{KL} = s_{LK} + s_{LL} = 0$.

Endogenous variables in the model are r, w, x_1, x_2, and π_1. Exogenous variables are factor endowments K and L, and world prices p_1 and p_2. Competitive pricing in the import competing sector leads to the fourth equation in (4). The Comparative static system (4) is given below:

$$\begin{pmatrix} s_{KK} & s_{KL} & a_{K1} & a_{K2} & 0 \\ s_{LK} & s_{LL} & a_{L1} & a_{L2} & 0 \\ a_{K1} & a_{L1} & \alpha & 0 & 0 \\ a_{K2} & a_{L2} & 0 & 0 & 0 \\ a_{K1} & a_{L1} & -\pi_1/x_1^2 & 0 & 1/x_1 \end{pmatrix} \begin{pmatrix} dr \\ dw \\ dx_1 \\ dx_2 \\ d\pi_1 \end{pmatrix} = \begin{pmatrix} dK \\ dL \\ dp_1 \\ dp_2 \\ dp_1 \end{pmatrix}. \tag{4}$$

For simplicity, rescale factors so that $a_{K1} = a_{L1} = 1$ and goods so that $s_{KK} = -1$. It follows that $s_{KL} = 1 = s_{LK} = -s_{LL}$. Factor intensity is summarized by the term $b = a_{K1}a_{L2} - a_{K2}a_{L1} = a_{L2} - a_{K2} > 0$. The determinant of the system matrix in (4) is $\Delta' = (b^2 + c^2)/x_1 > 0$, where $c \equiv a_{L2} + a_{K2}$. For notation, $\Delta \equiv b^2 + \alpha c^2 = x_1\Delta' > 0$.

3. Comparative statics of the monopoly factor proportions model

The comparative statics of factor demand are

$$\begin{aligned} \delta r/\delta K &= -\alpha a_{L2}^2/\Delta < 0, \\ \delta r/\delta L &= \delta w/\delta K = \alpha a_{K2}a_{L2}/\Delta > 0, \\ \delta w/\delta L &= -\alpha a_{K2}^2/\Delta < 0. \end{aligned} \tag{5}$$

Each factor demand slopes downward in the general equilibrium. An increase in an endowment raises the other factor price due to a positive on effect marginal productivity.

Factor price equalization does not hold, relaxing a central proposition of factor proportions trade theory. Labor-abundant countries would maintain lower wages with free trade when factor price equalization would hold with a competitive export sector. Trade would be less than a perfect substitute for international factor mobility in the presence of a monopoly.

Changes in prices of outputs affect factor prices in Stolper–Samuelson and symmetric Rybczynski effects:

$$\begin{aligned} \delta r/\delta p_1 &= \delta x_1/\delta K = a_{L2}b/\Delta > 0 \\ \delta r/\delta p_2 &= \delta x_2/\delta K = (\alpha c - b)/\Delta \\ \delta w/p_1 &= \delta x_1/\delta L = -a_{K2}b/\Delta < 0 \\ \delta w/\delta p_2 &= \delta x_2/\delta L = (\alpha c + b)/\Delta > 0. \end{aligned} \tag{6}$$

The signed partial derivatives in (6) are scaled down from the model with a competitive export sector. For instance, $\delta r/\delta p_1$ in the competitive model is a_{L2}/b. Using cross multiplication, $a_{L2}/b > a_{L2}b/\Delta$ because $c^2 > 0$. Similarly, $\delta w/\delta p_1$ and $\delta w/\delta p_2$ are smaller in absolute value than in the competitive model.

The $\delta r/\delta p_2$ term can switch from negative with a competitive export sector to positive in the present monopoly model. A higher price in the competitive sector has the potential to raise both input prices in the present model. Nevertheless, the increase in w would be larger than the effect on r, and the Stolper–Samuelson result holds in the sense that w/r rises with an increase in p_2.

The $\delta x_1/\delta K$, $\delta x_1/\delta L$, and $\delta x_2/\delta L$ results conform to the Rybczynski sign pattern. While $\delta x_2/\delta K$ may be positive, it would be smaller than $\delta x_2/\delta L$. A marginally labor-abundant country would produce relatively more of the labor-intensive product. With one qualification, the Heckscher-Ohlin theorem holds as developed by Ruffin (1978). Empirical tests or applications of factor proportions theory do not have to not assume competition in the export sector.

The production frontier is concave to the origin:

$$\begin{aligned} \delta x_1/\delta p_1 &= 4a_{L2}a_{K2}/\Delta > 0 \\ \delta x_1/\delta p_2 &= \delta x_2/\delta p_1 = -2c/\Delta < 0 \\ \delta x_2/\delta p_2 &= 3/\Delta > 0. \end{aligned} \tag{7}$$

An increase in the export price causes an increase in monopoly output as resources are pulled from the import competing sector. A tariff reduces output of the monopoly exporter.

Monopoly profit is affected by changing endowments and prices according to

$$\begin{aligned} \delta\pi_1/\delta K &= a_{L2}b(\alpha x_1 + \pi_1)/\Delta > 0 \\ \delta\pi_1/\delta L &= -a_{K2}b(\alpha x_1 + \pi_1)/\Delta < 0 \\ \delta\pi_1/\delta p_1 &= (\alpha c x_1 + \pi_1(a_{K2}c + 2a_{L2}))/\Delta > 0 \\ \delta\pi_1/\delta p_2 &= -2c(\pi_1 + \alpha x_1)/\Delta < 0. \end{aligned} \tag{8}$$

An increase in the endowment of intensive capital raises profit for the monopoly exporter. Output and revenue increase while average cost falls. The change in cost is $dc_1 = a_{K1}dr + a_{L1}dw = dr + dw$. With a change in K, $\delta c_1/\delta K = \delta r/\delta K = -\alpha a_{L2}b/\Delta < 0$. An increase in the labor endowment causes output and revenue to fall and cost to rise, $\delta c_1/\delta L = \alpha a_{K2}b/\Delta > 0$.

A higher price of exports increases output and revenue, but also raises cost, $\delta c_1/\delta p_1 = b^2/\Delta$. Profit nevertheless increases. A tariff lowers monopoly output and revenue and raises cost according to $\delta c_1/\delta p_2 = 2\alpha c/\Delta > 0$, lowering profit of the monopoly exporter.

4. Conclusion

In the presence of a capital-intensive monopoly exporter in a small open economy, a tariff raises the wage and monopoly average cost, and lowers profit.

The effect on the return to capital is ambiguous. A higher export price increases output and profit of the monopoly exporter, as the price of capital rises and the wage falls. An increased capital endowment lowers the price of capital but raises the wage and the profit of the monopoly exporter. An increase in the labor endowment has opposite effects: a higher capital price, lower wages, and lower profit for the monopoly exporter.

The present model introduces a price-taking monopoly into a factor-proportions model of production and trade and can be extended to the situation of a labor-intensive monopoly exporter as well as a monopoly competing with imports. It can be also be extended to include many products, international capital mobility, specific factors of production, intermediate products, and so on. Computable general equilibrium models can be modified to include such monopoly trade sectors.

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