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A Case of Factor Price Equalization under Price Discrimination

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This simple paper analyzes trade between a competitive country and a monopoly country in a sector-specific factors model. It is shown that the wage rate rises in the competitive country while both wages and profits fall in the monopoly country when trade is opened up. Workers and the monopoly firm in the latter country may lobby for protection, which causes price discrimination and trade pattern reversal. In contrast to conventional wisdom, factor prices are not equalized under free trade but equalized under price discrimination and dumping caused by a high-tariff.

JEL Classification: F11, F12, F13
Keywords: Tariff protection, Trade pattern reversal, Wage inequality, Factor price equalization

1. Introduction

Developing countries tend to protect manufacturing more than agriculture, using high tariffs and non-tariff barriers. As a result, monopolies are quite common in the manufacturing sector, especially in many formerly socialist economies. Sinoracka (1992) documented that in Poland, 950 of 4500 enterprises were monopolies in 1989, especially in automobile, textiles and housing industries. While in China, many state owned firms were local monopolies, supplying a local market that excluded outside competition. Due to concerns of tax revenue and employment, it was common for local governments to even impose restrictions against products made in other parts of China (see for instance Bai et al., 2002 ; Zhou, 2000). Also, it was reported that in recent years the number of cars smuggled into China far exceeded that imported legally,[1] due to tariffs of about 60%-80%.[2] Li, Qiu and Sun (2003) argue that the inter-

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1.See Guang Zhou Daily (China), March 23, 2000.

2 These tariffs will have to be reduced since China now is a member of the WTO.

regional fragmentation in China is caused by a combination of domestic fiscal decentralization and external trade protection.

With these stylized facts in mind, in this paper, we study trade between a monopoly country in which one sector is monopolized and a competitive country in which perfect competition prevails in both sectors. After trade is opened up, the monopolist competes with imports from the competitive country and behaves as a dominant price leader in the world market.

Naturally the monopoly country has comparative disadvantage in the monopolized sector over the competitive country since it restrains output. In addition, the wage rate is lower in the monopoly country. We show that the wage inequality between the two countries widens farther after trade is opened. As a consequence, there are incentives for protection of the monopoly sector. To obtain high wages and rents, workers as well as the firm in the monopoly country may lobby for higher tariffs, which may reverse the pattern of trade. We demonstrate that a price-discrimination equilibrium can be found, at which factor prices are equalized across countries.

In the standard theory of international trade, factor price equalization (FPE) is achieved under *free trade* and *perfect competition* in both countries (Samuelson, 1948, 1949). Tariff protection then creates inequality in factor prices (Stolper and Samuelson, 1941). Recently, Kemp and Okawa (1997, 1998) show that on the contrary to 'the commonly held view that FPE is less likely if some industries are imperfectly competitive', FPE can be achieved under *free trade and imperfect competition*. Helpman and Krugman (1985) discussed the likelihood of FPE under different market structures.

In the present paper, we introduce a market structure consisting of a dominant monopoly with many competitive fringes into a simplified sector-specific factors model. We demonstrate that in the presence of monopoly in one country, FPE is *not* achieved under free trade *but* can be achieved under price discrimination. This is a result in stark contrast to those in the literature.

Our results are interesting in that in reality, wages differ across countries not only before trade, but also after 'near-free' trade. The wage inequality is maintained under the presence of monopoly and high trade barriers, as is the case in some developing countries and formerly socialist economies. However, if labor is able to organize itself and obtain a share of the monopoly rents, then it is possible to equalize all factor prices in the two countries.

While previous authors such as Corden (1967), Pursell and Snape (1973), Rieber (1981), Stegemann (1984) made important contributions to study the behavior of monopoly in an open economy, they abstract from investigating the issue of factor prices due to the partial equilibrium nature of their analyses. General equilibrium models such as Melvin and Warne (1973), Markusen (1981) and Fujiwara and Shimomura (2004) assume symmetry so that domestic monopolies become duopoly after trade is opened up.

The rest of the paper is organized as follows. Section 2 describes the structure of the basic model. Section 3 demonstrates the inequality in wages under free trade. Section 4 presents an equilibrium of factor price equaliza-

tion and trade pattern reversal. Finally, section 5 contains concluding remarks.

2. The Basic Model

Consider two countries consisting of two sectors of production, and one representative consumer who owns inelastically supplied factors of production. The two countries are assumed to be identical in every respect, including factor endowments, technology, and homothetic preferences of consumers except the presence of monopoly owned by the state in one country. The first sector produces good X with labor only and the second sector produces good Y with labor and capital. Neither good is Giffen, and we assume that there exists a differentiable inverse demand function for X. For the sake of analytical simplicity, the first sector has an input-output ratio of one by choice of units.

The production function of the second sector is assumed to be linear homogeneous and continuously twice differentiable. Marginal products of labor and capital are positive. The law of diminishing marginal product of labor holds because capital is specific to the second sector. Thus,

$$X = L_X, \tag{1}$$

$$Y = F(L_Y,\ K), \quad F_L,\ F_K > 0, \quad F_{LL}, < 0, \quad F_{LL}F_{KK} - F_{LK}F_{KL} > 0, \tag{2}$$

where L_X is labor used in the first sector, L_Y is labor used in the second sector, K is capital, and subscripts of F denote partial derivatives.

Labor is mobile between the two sectors and fully employed.

$$L_X + L_Y = L, \tag{3}$$

where L is the total labor endowment.

We assume that Y serves as the numeraire good in both countries, such that

$$P = P_X / P_Y, \tag{4}$$

where P is the relative price of good X.

The inverse demand function for good X is approximated by the utility maximization behavior of the representative consumer :

$$P = \Phi(\mathrm{C}_X,\ M), \quad \Phi_C < 0, \quad \Phi_M < 0 \tag{5}$$

where C_X is the consumption of good X, M is the level of income for the representative consumer and subscripts of Φ denote partial derivatives.

2.1 The Competitive Country

In the competitive country, all economic agents share technology in the

production of good X. The use of technology is free, and free entry and exit drive industry profits down to zero under perfect competition in both sectors. Thus,

$$P = WL_X/X = W, \tag{6}$$

$$1 = (WL_Y + rK)/Y, \tag{7}$$

where W is the competitive wage rate and r is the rent for capital. Also, the total income of the competitive country can be written as

$$I = PX + Y = WL + rK. \tag{8}$$

Competitive firms maximize profits so that the value marginal product of labor in the second sector is equal to the wage rate,

$$F_L(L_Y, K) = W. \tag{9}$$

Using equations (1), (3) and (6), we can relate the output of the first sector to the relative price as follows:

$$P = F_L(L - X, K). \tag{9'}$$

The right hand side is the marginal cost of producing good X. As more X is produced, the opportunity cost of labor increases, and as workers move from the Y sector to the X sector, the marginal product of labor increases. Thus additional competitive firms in the X sector must pay higher wages. Since one unit of labor produces one unit of good X, the relative price is always equal to the wage rate under perfect competition. Therefore the relative price P is positively related to output X as in (9').

In Figure 1a, the vertical axis on the left measures the relative price of good X and the right axis measures the wage rate. The horizontal axis measures the output of X $(= L_X)$ from the left origin and the employment of the Y sector L_Y from the right origin. The downward sloping curve represents the inverse demand given by equation (5), and the upward sloping curve is the marginal cost of producing good X, which is equal to the value marginal product in the Y sector.[3] In autarky, the relative price in the competitive country is determined at the intersection between the inverse demand curve and the marginal cost curve, that is, point E^*. Sector X produces the amount $O_x^*X_a^*$, and the resulted wage rate is equalized to the price of good X at $P_a^*W_a^*$.

2.2 The Monopoly Country

In this country, we assume there exists a state monopoly. Only the state

3 For clarity, the diagrams are drawn based on linear demand. However, our qualitative results hold even if demand is nonlinear.

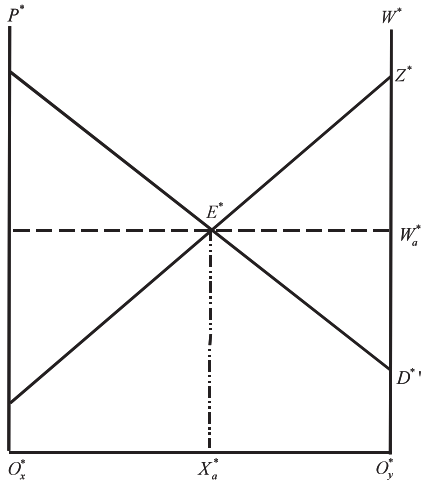

Fig. 1a : Autarky equilibrium in the competitive country

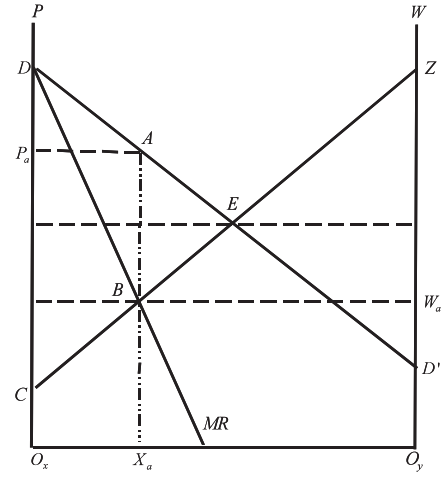

Fig. 1b : Autarky equilibrium in the monopoly country

monopoly possesses the technology of producing good X. Such state monopolies are common in many developing countries and also in many formerly socialist economies.

The monopolist maximizes monopoly rent,[4]

$$\text{Max. } R = (P - W)X. \tag{10}$$

As usual, the optimal output is determined at the intersection between the marginal revenue curve and the marginal cost curve denoted by point B in Figure 1b. The price set by the monopoly firm is given at P_a, which is higher than the competitive price. The monopoly firm does not discriminate against workers. Once it determines the level of employment from rent maximization behavior, the wage rate is also determined. In Figure 1b, the autarky equilibrium wage is denoted by W_a. The competitive firms in the other sector take this wage as given.

Due to the existence of the monopoly rent, the income of consumers in the monopoly country may be lower than that in the competitive country. We thus assume that the total national income includes also the monopoly rent, and that the state distributes all or parts of the monopoly rent to domestic consumers, so that the incomes in the two countries are equal (in fact under balanced trade, incomes in the two countries would remain equal even when trade is opened up). This assumption guarantees that the demand curves in the two countries are identical.

2.3 Autarky Equilibrium

The presence of monopoly restrains output and creates comparative dis-

4 In the context of utility maximization, one could assume that the state monopoly consumes only the numeraire good. Thus utility maximization is realized by maximizing the monopoly rent.

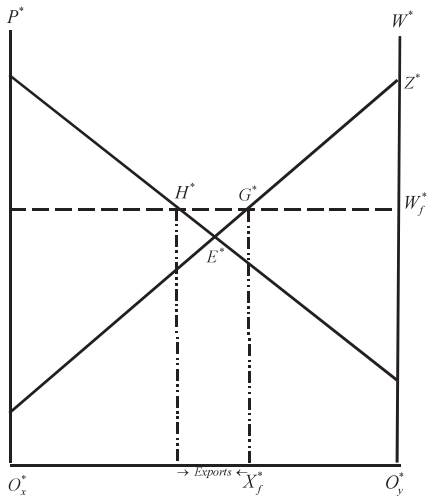

Fig. 2a : Free trade equilibrium in the competitive country

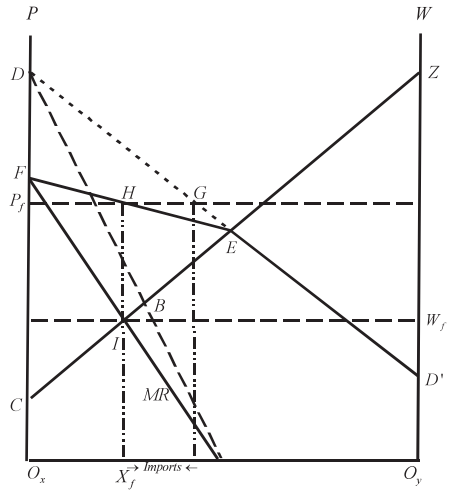

Fig. 2b : Free trade equilibrium in the monopoly country

advantage in producing good X relative to good Y over the competitive country. If the two countries do not trade, then the autarky relative price of good X is lower in the competitive country than in the monopoly country, while the wage rate is higher in the competitive country than in the monopoly country, as one can see from Figures 1a and 1b. This arises because the monopoly sector produces too little output and demands too little labor. As a consequence, more labor has to be employed in sector Y, which in turn drives down the wage rate in the monopoly country. In the same manner, the rent for capital is higher in the monopoly country than in the competitive country.

3. The Free Trade Equilibrium and Wage Inequality

Suppose that international trade is opened up between the monopoly country and the competitive country. The monopolist is no longer able to choose the price on the demand curve because it faces free flow of imports from the competitive country, i.e., the monopoly power is reduced under free trade. The monopoly firm acts as the dominant firm in the world market and becomes the price leader with many competitive fringes.[5] The original demand curve is no longer the choice set of the monopoly firm. The new choice set is on the line *EF* in Figure 2b. This line is derived by subtracting the amount of imports from the original demand curve *DD'*. Corresponding to line *EF* we can find a new marginal revenue curve, *MR,* which is flatter and lies to the left of the original one under autarky. The optimal production of good X by the dominant firm under free trade is determined at the intersection between the new marginal revenue curve and the marginal cost curve, i.e., point *I*. Then the

5 See Schenzler, Siegfried and Thweatt（1992）for a detailed review of the standard dominant firm model.

free trade price is given at P_f. The monopoly country imports the amount *HG*, which is equal to the amount of exports H^*G^* from the competitive country in Fig. 2a. The new wage rate in the monopoly country is W_f, while that in the competitive country is W_f^* in Figures 2b and 2a.

We are now ready to present the first proposition.

Proposition 1: *The wage inequality between the competitive country and the monopoly country is larger under free trade than under autarky.*

Proof: (1). By comparing Figure 1a and Figure 2a, one sees that in the competitive country, the wage rate under free trade is always higher than under autarky: $W_a^* < W_f^*$; (2). By comparing Figures 1b and 2b, we find that in the monopoly country, the wage rate under free trade is always lower than under autarky. Because to the left of point E in Figure 2b, the new marginal revenue curve under free trade (curve *MR*) always lies to the left of the original marginal revenue curve under autarky, point I must lie to the southwest of point B with the upward sloping marginal cost curve. Thus, $W_f < W_a$. And recall that in autarky, $W_a < W_a^*$ from Figures 1a and 1b. We therefore establish:

$$W_f < W_a < W_a^* < W_f^*. \tag{11}$$

QED

In this model, the wage rate increases as the production of good X increases because the Y sector suffers from diminishing marginal product of labor due to the fixed amount of capital. The competitive country produces more X under free trade than under autarky to in order to export. On the other hand, in the monopoly country, the monopoly loses some of its monopoly power due to import competition so that it produces less, resulting in a lower wage rate in this country. This is a case that workers may well be hurt by free trade.

4. Trade Pattern Reversal and Factor Price Equalization

Since both the wage rate and the monopoly rent are lower under free trade than under autarky, the monopoly firm and workers in the monopoly country may lobby for protection. The monopoly firm naturally prefers autarky to any trading equilibrium because the monopoly rent is the largest in the absence of import competition. However, workers in the monopoly country may ask for an even higher tariff than the prohibitive one in order to raise wages, which we shall demonstrate below.

Suppose that workers in the monopoly country organize a union to determine wages and the monopoly firm determines employment as in the "monopoly union-wage model" in the labor literature (see, for instance, Brander and Spencer, 1988, McDonald and Solow, 1981, Mezzetti and Dinopoulos, 1991, and Oswald, 1985). They also successfully lobbied the government to impose a tar-

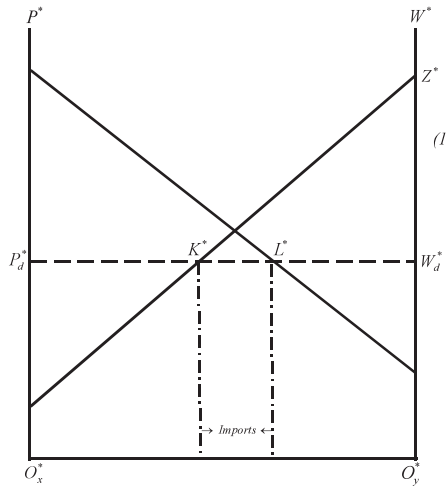

Fig. 3a: Price discrimination equilibrium in the competitive country

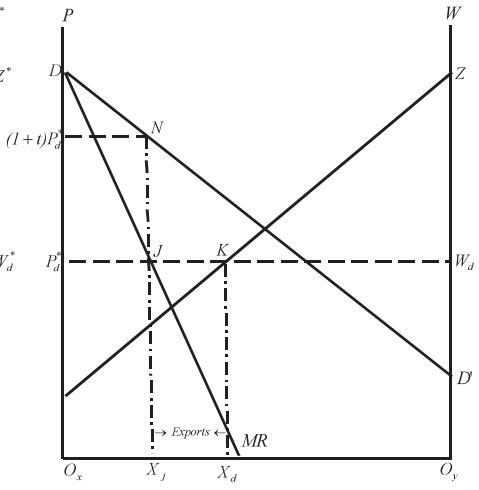

Fig. 3b: Price discrimination equilibrium in the monopoly country

iff on imports.[6] Then a price discrimination equilibrium demonstrated in Figure 3b is possible. In this equilibrium, the wage rate is determined at W_d by organized labor. The monopoly firm takes this wage as given and determines the level of total employment in sector X at point K and produces the amount X_d. Under a high tariff rate t, the monopoly firm can charge a high domestic price $(1+t)P_d^*$ and generate monopoly rent, i.e., area $NJP_d^*(1+t)P_d^*$.

More specifically, the monopoly equates its domestic marginal revenue to the marginal cost (the union wage W_d) at point J, and sells X_j for domestic consumption. Since domestic demand is reduced by the high tariff, the monopoly firm exports the amount X_jX_d at the price P_d^*. This price is taken as given by the competitive fringes in the competitive country. The competitive country now imports the amount of K^*L^*, which is equal to the amount JK, from the monopoly country.

We have just obtained an equilibrium in which the pattern of trade is reversed from that under free trade. The monopoly charges different prices for home and foreign sales. This is a generalization of a partial equilibrium result in Rieber (1981). In his case, the domestic high price is supported by a higher than prohibitive tariff imposed by the home government. In our model, because both labor and the firm are hurt by free trade as shown in the previous section, they may lobby for such a high tariff in order to raise the wage rate and profits. As is the case in some developing and formerly socialist economies, high tariffs are imposed to maintain domestic employment and wages.

More surprisingly, at this price discrimination equilibrium, the wage rates are completely equalized in the two countries, at $W_d = W_d^* = P_d^*$. Also, the

6 We describe the result, not the details of the lobbying process, which are abstracted in this simple model.

rents for capital are equalized; that is, area $ZKW_d = \text{area } Z^*K^*W_d^*$.

Summarizing the results above, we can state the following proposition.

Proposition 2 : *Under a sufficiently high import tariff, if workers in the monopoly country organize to determine the wage, then the pattern of trade is reversed and factor prices are equalized between the monopoly country and the competitive country under balanced trade.*

The implications of our results should be clear. Workers as well as the firm in the monopoly country may be hurt by free trade and thus lobby for protection. Under a high tariff, then the trade pattern can be reversed. More surprisingly the wage rate can be equalized to the level in the competitive country. The monopolist charges a higher price for domestic sales and exports at marginal cost to the other country. This type of trade practice may be criticized as dumping, i.e., selling at a lower price abroad.

5. Concluding Remarks

This paper has studied a simple general equilibrium model of international trade incorporating monopoly. The monopoly behaves as a dominant firm after trade takes place. Unlike under perfect competition, factor prices are not equalized under free trade in our market structure. Workers and the firm in the monopoly country may lobby for high tariffs to raise the wage and profits, which induces the monopoly firm to conduct price discrimination. Surprisingly factor prices are equalized at such an equilibrium.

Our results are obtained based on the sector-specific factors model. Also, compared with those in developed countries, labor unions in many developing countries are weak (such as those in China), but there are exceptions, such as those in Poland. The point we want to make is, under plausible conditions, it can be shown that FPE is not achieved under perfect competition, but achieved under monopoly and price discrimination. In other words, due to concerns of wages and employment, developing countries are reluctant to liberalize certain key but monopolized industries.

The model can be extended further to analyze the case where the competitive country may retaliate by an anti-dumping duty. In such a case, the two countries may play a policy game. These represent avenues for future research.

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