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Trade Policy in International Oligopoly - Theory and Application.

Introduction

The purpose of this paper is to formulate a modernized traditional theory of trade and protectionism (tariffs and subsidies effects) with regard to imperfectly competitive markets. There will be shown the different effects of trade policy instruments concerning international oligopoly than perfectly competitive market. I will outline the new area of tariffs and subsidies effects, which are based on the Cournot model analyzes. There will be also shown results of trade policy instruments with regard to national and world welfare improvement.

Secondly, I will point out the available anti-import activity and some ways of export supporting. I will proof, that there is no matter, which tariffs government uses, the effects in rent-shifting is comparable. The same case is done with regard to the subsidy. There is no need to use direct export subsidy (which are prohibited), the similar result is seen in the case of R&D subsidies or any public aid given to national producer, which is the player in the international oligopoly.

Finally, there will be calculated tariffs and subsidies effects made in Scientific Workplace 4.0. I will use previously formulated model (presented in ETSG 2004 conference) for presenting the impact of import tariffs and export subsidies on welfare.

Trade policy on imperfectly competitive market

As empirical evidence shows, classical models of international trade, based on perfect competition assumptions, do not comply with the modern international markets. Nowadays, many firms are forced to compete globally, instead of nationally. They are stressed to become stronger and bigger in order to survive as important players. This constant pressure of concentration has its obvious results on the market. Many industries (consumer goods, food, pharmaceuticals, automobiles, and aircrafts) as well as services (banks, entertainment, and communication) become typical concentrated markets, with no features of perfect competition. Most of them can be called international oligopolies, because they are created by a few players, which are interdependent. An important issue is that national producer competing in the international oligopoly is often supported by its government. In spite of liberalization and anti-dumping law, national governments are interested in creating its own global leader in any industry, which, they believe, will accelerate national welfare at suffer of foreign competitors.

Before the market intervention, all of the producers sell their products on the world price p_0 . The firm from country A (domestic firm) can produce and sell x_0 . Domestic consumers, according to their preferences, may purchase w_0 . It is shown on the figure 1, that the market demand is not fulfilled by the domestic firm, so there is a volume of goods, which has to be imported. This market situation lasts as long as the consumer preferences or market price is not changed. It is completely different if only government impose import tariff in order to limit the volume of foreign goods, which are sold on the domestic market (country A). When government decides to introduce the import tariff, market price will increase by the value of the tariff.

When import tariff is imposed, the new market situation is illustrated by the point R in figure 1. Due to the price increasing, consumers are forced to reduce their needs, so that the domestic demand on the good shall decline from w_0 to w . Accordingly, domestic producer will gain because of the higher price, produce x volume of goods and get a new marginal revenue MR . The import of the good in country A will be limited to the value of I on the figure 1.

Measuring the effects of the government intervention, consumer surplus has been limited by the value of area pR_0Rp_A on the figure 1. This is the sum of the areas a , c , d . They illustrate the consumers' loss resulted by the import tariff. Meanwhile, there are some gains from the tariff on the market. First of all, area a and b represent the producer surplus. Area a is called as redistribution effect, which is the gain due to the production increase as a result of higher price. Area b represents additional profit, what can be received because of the foreign competitor market loss. It is the illustration of the profit shift, which was not detected on the perfectly competitive market. Area c also shows the national gains and it is the budget income due to the tariff payments.

If only the firm's profit is evaluated before the market intervention, it can be shown as follows:

$$\Pi_0 = px_0 - MCx_0 \quad (1)$$

The profit of the domestic firm increases after government imposes the tariff. So that, the new function of firm's profit rises from Π_0 to Π after price and volume of production changes.

$$\Pi = p_A x - MCx = (p + t)x - MCx = px + (t - MC)x \quad (2)$$

Comparing to the model of perfectly competitive market, there is no protection effect. If only there are competitors form different countries, and marginal cost is common and equal, the domestic producer gains and the foreign competitor suffers. That is the rent shifting. On the perfectly competitive market area b was so-called Harberger triangle, and was considered as a net loss.

Giving the summary of the tariffs gains and losses resulted by the import tariff provided by the government, the net effect is as follows.

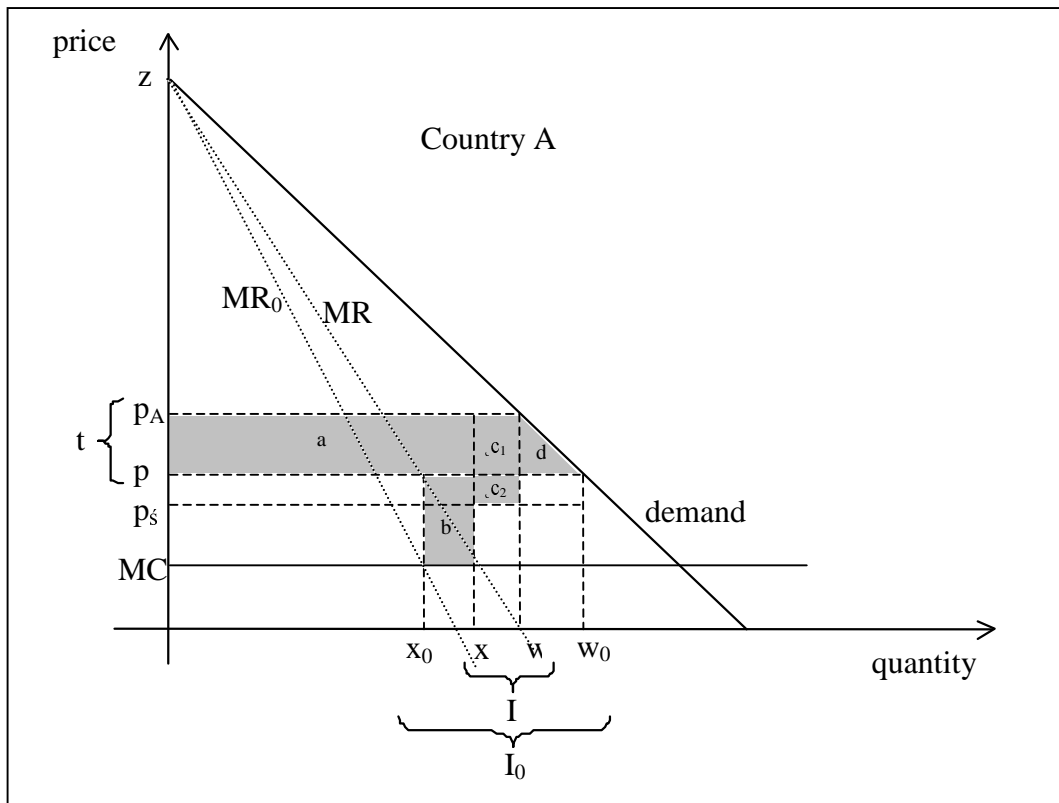
Figure 2. Gains and losses due to the import tariff in small country

Domestic consumers:	$-a, -c, -d$
Domestic producer:	$+a, +b,$
Budget income:	$+c$
<hr/>	
Net effect:	$+b, -d$

The country surplus finally depends on the difference between area b (gain) and d (loss). The given model is considered in partial equilibrium in small country. It means that the change in demand for the particular good in this country does not bring about the substantial change in total demand.

Nevertheless, the large country simulation is easy to work out. When import tariff in one country is imposed and it determine the world demand, the world price will change dramatically. All of the producers are eager to decide to decline the price in order to keep the market and get any revenue. It is better than loss in the market and bankruptcy. So that, price of the good declines, and the effect for the importers as well as for any other consumers is different than in the small country model. The importer, which is a large country, gains though terms-of-trade effect (c_2).

Figure 3. Import tariff effect; partial equilibrium, large country



The net effect of the tariff is not much different than before, but the terms-of-trade effect can cause additional gains for the importing country. This welfare gain is paid by the foreign producers.

The main difference in the large country model and the small country model, is the area of c_2 , which appears and is now paid by foreign firms.

Figure 4. Gains and losses due to the import tariff in large country

Domestic consumers:	$-a, -c_1, -d$
Domestic producer:	$+a, +b$
Government revenue:	$+c_1, +c_2$
<hr/>	
Net effect:	$+b, +c_2, -d$

Export support

Another way of intervention in trade is export support. There will be shown the impact of export support mechanism in international oligopoly. For further analysis r is used as a value of export subsidy or any other export support fund provided to the producer. This is the fund,

which is added to the each unit of the exported production, and it results in declining the cost of production and increasing revenue on foreign market.

When government provides the subsidy value r , former price of the good is rising to the value of p_B , because the number of goods on the domestic market is declining due to more goods are provided on foreign market.

$$p_B = p + r \quad (3)$$

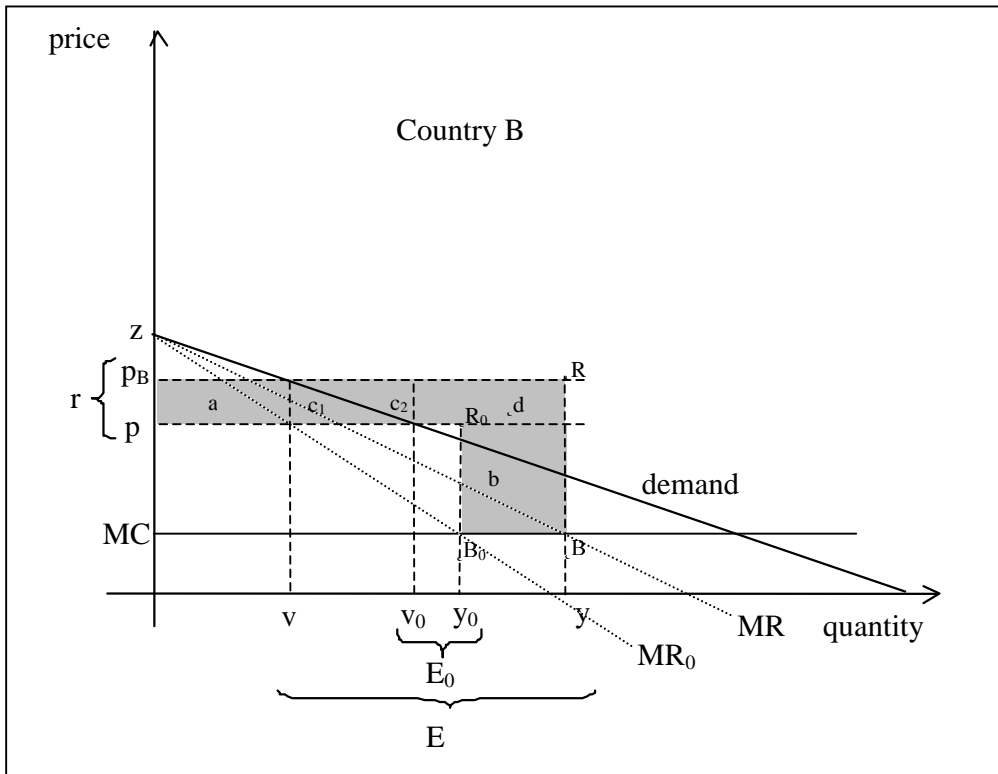
The profit formula in country B with regard to given price is as follows:

$$\Pi_B = p_B y - MCy = (p + r)y - MCy = py + y(r - MC) \quad (4)$$

where y is production and MC average and marginal cost.

The above equations of profits (2) and (4) clearly shows, that as import tariff (t) as well as export subsidy (r) affects marginal cost of production and finally creates additional profit. Obviously, that substantial assumption simplifies further analysis, but it is justified. It is easy to foreseen, that any financial support for the particular firm, for example direct export subsidy (used very rare), export credit guaranties, reimbursement of costs of transport, research and development supporting funds, is favourable to cost reduction.

Figure 5. Export subsidy effect; partial equilibrium



The domestic consumers after the price rising, lose their surplus by the value illustrated by area of a, c_1 on the figure 5. On the other hand, the domestic firm may produce more (from y_0 to y) and sell more on the foreign market (from E_0 to E). Its profit illustrated by the area $pMCB_0R_0$ rises to p_BMCBR . So that, producer's surplus rises by the value of area a, b, c_1, c_2, d . The cost of the support is covered by the government. The budgetary expenditures reach the value of y level of production multiplied by the subsidy r and this is illustrated by the are c_1, c_2, d . According to the summary of the surplus shifting analysis, the area b is not domestically transferred. It is shifted from foreign competitor because of its market loss.

The net effect of the subsidy arises from the summary of loses and gains of the consumers, producer and government, and is shown as a difference between surplus b and loss c_1 .

Figure 6. Gains and losses due to the export support

Domestic consumers:	$-a, -c_1$
Domestic producers:	$+a, +b, +c_1, +c_2, +d$
Government revenue:	$-c_1, -c_2, -d,$
Net effect:	$+b, -c_1,$

Welfare improvement

It is crucial to explain what it exactly means net effect for welfare improvement. For the welfare estimation I use the Cournot model of oligopoly, what means that firms' objective is to maximize profit and every firm on the market is an output setter and believes that its rival will not respond to its own decision. The model considers oligopolistic market and takes into account two firms. They operate in two countries: A - home country, B - foreign country, and produce homogeneous goods (for example steel or air aircraft producers). Due to the various demands in each country, they trade. Output (x) in country A does not cover the demand there (w). Country A needs to be an importer. The situation in country B is opposite – demand (v) is met by domestic producer (y) and additional stock has to be sold. Country B is an exporter.

The assumptions used in the model are following :

- (i) the number of firms is fixed – one in each country.
- (ii) marginal cost function is common and curve of this function is horizontal in order to assure symmetry. Firms are similar and horizontal marginal cost simplifies analysis. So that, marginal cost is common at a given value MC . (Heffernan, Sinclair, 1990)
- (iii) in order to define countries demand, consider the demands as a linear function, where p_A denotes price in country A after import tariff is imposed, and p_B denotes price in country B after export support is provided. Independent variable z represents the vertical intercept on the market demand curve, and b is the slope of the demand curve.

$$w = a \frac{z - p_A}{b} \qquad v = (1 - a) \frac{z - p_B}{b} \quad (5)$$

- (iv) in demand functions a expresses the difference between countries ($0 < a < 1$). In this model demand in country A is greater than in country B (model feature), so for all the analysis a should be greater than 0.5.
- (v) Markets are segmented so that consumers are not able to chose less expensive goods. There is no price arbitrage. Prices are differed by the appropriate instrument of the government intervention. So that, the counsumers in country A have to buy goods paying the price p_A , and consequently – in country B consumers have to pay the price p_B

All analysis are aimed to find welfare function in respect to t or r . If country welfare (W) is defined as the sum of consumers' surplus (CS), producer's profit (Π) and cost of government intervention (GR), it can be express in the following way:

$$W_A = CS_A + \Pi_A + GR_A = \left[\frac{1}{2} (z - p_A) w \right] + [p_A x - MCx] + [t(w - x)] = w \left(\frac{z - p_A}{2} + t \right) + x(p_A - MC - t) \quad (8)$$

(6)

Using the first order condition, we can set up the optimal level of t . At this value of import tariff national welfare is maximized.

$$t = \frac{(z-c)(2a^2+1) - r(a^2+3a-1)(a-2)}{(2-a)(a^2+6a+2)} \quad (7)$$

Similar analyses are provided for country B . Welfare function is as follows:

$$W_B = CS_B + \Pi_B + GR_B = \left[\frac{1}{2}(z-p_B)v \right] + [p_B y - MCy] + [r(v-y)] = v \left(\frac{z-p_B}{2} + r \right) + y(p_B - MC - r) \quad (8)$$

According to the first order condition, optimal r is set up:

$$r = \frac{(z-c)(2a^2-4a+3) + t(a+1)(a^2-5a+3)}{(a+1)(a^2-8a+9)} \quad (9)$$

When formula r (equation [9]) is substituted into the formula for t (equation [7]) and *vice versa*, we can illustrate the Cournot equilibrium in the international oligopoly where the governments take actions. Optimal level of import tariff in country A and export subsidy in country B are set up simultaneously. It is therefore shown that, t as well as r depends on a and $z-c$ (the difference between price at which demand vanishes and marginal cost of production)¹.
(10,11)

If only we substitute the function of both trade policy instruments (eq. [7], [9]) to the functions of welfare (eq. [6], [8]) we can estimate the function of welfare depending on the tariff or subsidy. There is a need of assumption for a parameter, which illustrates the difference between countries. The parameter a is defined on the value of 0.75, which determined country A

$$t = \frac{(z-c)(4a^4 - 6a^3 + 8a^2 - 10a - 1)}{(a+1)(a-2)(-8a^2 + 8a + 7)} \quad r = \frac{(z-c)(4a^4 - 10a^3 + 14a^2 - 4a - 5)}{(a+1)(a-2)(-8a^2 + 8a + 7)}$$

demand is two times country B demand. Two other assumptions are made, but as calculations shown, they have no significant impact on the welfare equation.

To simplify the analysis, the assumption is: $z-c=1$, $b=1$.

¹ For all further analysis and comparisons: $z-c=1$

(10)

$$W_A = f(t, r, a, z, c, b) = a \frac{2(z-c) - (t-r)(2-a)}{3b} \frac{2(z-c) + t(4+a) + r(2-a)}{6} + \frac{z-c + (t-r)(2-a)}{3b} \frac{z-c - t(1+a) - r(2-a)}{3}$$

and

(11)

$$W_B = f(t, r, a, z, c, b) = (1-a) \frac{2(z-c) + (t-r)(1+a)}{3b} \frac{2(z-c) + t(1+a) + r(5-a)}{6} + \frac{z-c - (t-r)(1+a)}{3b} \frac{z-c - t(1+a) - r(2-a)}{3}$$

We can evaluate the welfare formulas as a function of tariff (welfare of country A) and subsidy (welfare of country B).

(12)

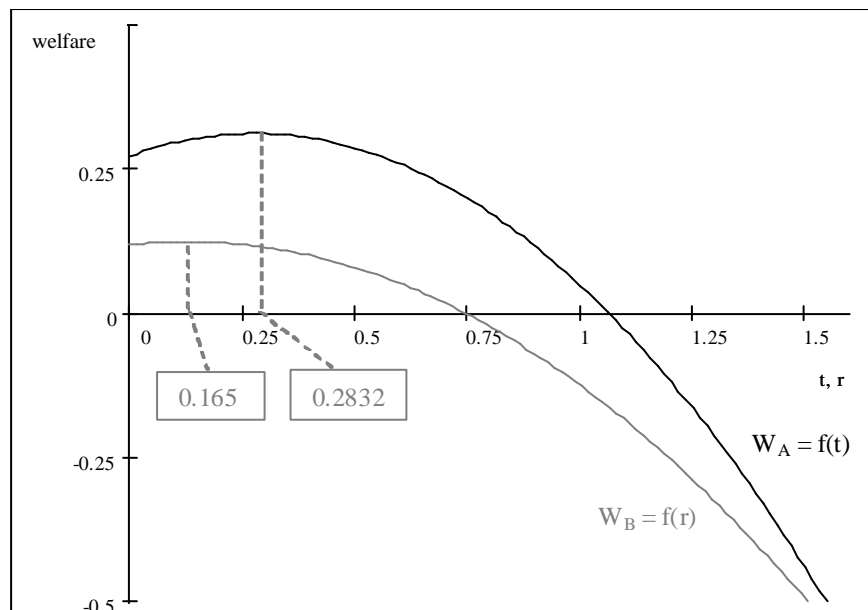
$$W_A = f(t) = -0.49045t^2 + 0.23977t + t(4.5426 \times 10^{-2} - 0.01325t) + 0.23872(0.18045 - 5.2632 \times 10^{-2}t)^2 + 0.26525$$

(13)

$$W_B = f(r) = (-6.5265 \times 10^{-2}r - 3.3628 \times 10^{-2})(1.3009r - 2.4212) + (1.3009r + 0.57876)(6.4307 \times 10^{-2} - 0.18879r)$$

And finally, the above formulas as a function of t and r are presented graphically on the figure 7.

Figure 7. Welfare as a function of tariff and subsidy



The national welfare is rising to the particular level of tariff or subsidy. It means that there is threshold value of trade policy instruments above which the welfare is not improving. Although, since there are two firms from two countries, and they compete as in Cournot model, what means they are highly interdependent, the government in each country has an incentive to intervene on the market using trade policy instruments. This sort of intervention is a way to help a national leader reaching greater share of the market and gaining the additional profits at the cost of its foreign competitors.

Conclusion

As long as there are national leaders on the international markets, there is an incentive for governments to intervene on the market in order to increase national welfare. Then, depending on the domestic demand, what determines the country is importer or exporter, the government imposes import tariff or export subsidy. These trade policy instruments are supposed to be on optimal level (according to the Cournot model and equilibrium point), and then the national welfare reaches the maximum level. The gains from the intervention on the imperfectly competitive market are completely different than on traditional theory of tariff and subsidy effects on perfectly competitive market.

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