

TRADE AND INDUSTRIAL POLICY UNDER OLIGOPOLY: COMMENT

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INTRODUCTION

Recently in this *Journal* Eaton and Grossman [1986] built a model characterized by a home firm that sells abroad with one foreign competitor. They determined what the home government tax policy should be, under different assumptions about oligopoly behavior and the other country's tax schedule.

A problem occurs when they write that the reaction function of the foreign firm is independent of the tax rate on the home firm. While this statement is true for the Cournot and Bertrand cases that they analyze, in the consistent conjectures case the foreign firm's reaction function must take into consideration the slope of the reaction function of the home firm which is dependent upon the tax rate. As we show, this invalidates their Proposition 3, which states that the optimal home tax in the consistent conjectures case is zero. In this comment we show by example that the optimal tax is not necessarily zero.

THE MODEL

The analysis that follows uses their notation. The home economy's variables are denoted by lowercase letters and those of the foreign economy by uppercase letters. The home firm faces a revenue function $r(x, X)$, where x and X denote the outputs of the home firm and the firm abroad, respectively. There are cost curves $c(x)$, and $C(X)$ and a tax t levied by the home government on sales of the home firm. After conjecturing the slope of the foreign firm's reaction function $\partial X/\partial x = \gamma$, the home firm chooses output x that maximizes its profits π . The analogous conjecture for the foreign firm is Γ , and its profits are Π . We shall look at the case of a home sales tax on the home firm only. This is what Eaton and Grossman examined. These are our demand, cost, and profit functions:

$$(1) \quad P = 12 - 3(x + X)$$

$$(2) \quad c = 2X^2; \quad C = 2X^2$$

$$(3) \quad \pi = (1 - t)(12 - 3(x + X))x - 2x^2$$

$$(4) \quad \Pi = (12 - 3(x + X))X - 2X^2.$$

When each firm profit maximizes, they pick their output to satisfy

$$(5) \quad \frac{\partial \pi}{\partial x} = (1-t)[12 - 3(x+X) - 3x(\gamma+1)] - 4x, \\ = (1-t)(12 - 3X - 6x - 3x\gamma) - 4x = 0,$$

and

$$(6) \quad \frac{\partial \Pi}{\partial X} = 12 - 3x - 6X - 3X\Gamma - 4X = 0.$$

Differentiating (5) with respect to X will give us the actual slope of the home reaction curve $g \equiv dx/dX$, which must be equal to the slope conjectured by the foreign firm:¹

$$(7) \quad -3(1-t)(1+2\Gamma+\gamma\Gamma) - 4\Gamma = 0.$$

Similarly

$$(8) \quad -3(1+2\gamma+\gamma\Gamma) - 4\gamma = 0 = -3 - 10\gamma - 3\gamma\Gamma.$$

Dividing (7) by $-(1-t)$, and adding it to (8) yields

$$(9) \quad 10\gamma = \Gamma(10-6t)/(1-t).$$

Therefore, $\Gamma = A\gamma$, where A is defined as $10(1-t)/(10-6t)$. Using this and substituting it into (8) yields

$$(10) \quad 3 + 10\gamma + 3A\gamma^2 = 0.$$

Solving for γ , using the quadratic equation yields

$$(11) \quad \gamma = \{-10 \pm \sqrt{100 - 36A}\}/6A.$$

Combining (9) and (11) yields

$$(12) \quad \Gamma = -\frac{5}{3} \pm \{\sqrt{100 - 36A}\}/6.$$

Profit maximization for the home firm implies that $\partial^2\pi/\partial x^2 < 0$. Thus, differentiating (5) with respect to x , while recognizing that $dX/dx = \gamma$ yields $\partial^2\pi/\partial x^2 = (1-t)(-6)(1+\gamma) - 4 < 0$ which, as we show in an unpublished appendix, implies that the positive roots in (11) and (12) are the only economically relevant ones.²

1. Bresnahan [1981, p. 945] showed for the straight line demand and marginal cost curves, $\partial\Gamma/\partial x = \partial\Gamma/\partial X = \partial\gamma/\partial x = \partial\gamma/\partial X = 0$.

2. Equations (11) and (12) using only the positive roots are consistent with Bresnahan [1981]. On p. 937 he states (translated into our notation) that with a straight line demand curve and a straight line marginal cost curve, $\Gamma = \gamma = -1 + c_2[1 - (1 - 4d/c_2)]/2d$, where d is the slope of the demand curve and c_2 is the slope of the marginal cost curve. In our model, his $c_2 = 4$, and $d = -3$. This implies that $\Gamma = \gamma = -\frac{1}{3}$. If $t = 0$, then $A = 1$ so $\Gamma = -\frac{5}{3} + \frac{4}{3} = -\frac{1}{3}$ and $\gamma = -\frac{5}{3} + \frac{4}{3} = -\frac{1}{3}$. Therefore, the free trade result is exactly what Bresnahan says it should be.

Now let us solve for x and X . From (5) we get

$$(13) \quad X = 4 - x(10 - 6t)/3(1 - t) - x\gamma.$$

From (8) we get $-10X - 3X\Gamma = X(-10\gamma - 3\gamma\Gamma)/\gamma = 3X/\gamma$, which combined with (6), yields

$$(14) \quad X = (x - 4)\gamma.$$

Setting (13) equal to (14) means that

$$(15) \quad 4 + 4\gamma = x[2\gamma + (10 - 6t)/3(1 - t)]$$

so

$$(16) \quad x = 12(1 + \gamma)(1 - t)/[10 - 6t + 6\gamma(1 - t)].$$

When $t = 0$, (11) tells us that $\gamma = -1/3$, and from (16) and (14) we get $x = X = 1$, and there are positive profits as one would expect.

Domestic welfare is defined as the sum of the domestic firm's profit and the tax revenue. Therefore, domestic welfare is defined as

$$(17) \quad w = (1 - t)(12 - 3(X + x))x - 2x^2 + t(12 - 3(X + x))x \\ = (12 - 3(X + x))x - 2x^2.$$

Substituting (14) into (17), and (16) into the result, then substituting the positive root of (11) into the result of that, we obtain an expression for w as a function of the tax rate. Simulations show that w is single peaked and reaches a maximum at $t = 0.07215$ or about a 7 percent tax rate, rising from $w = 4$ at $t = 0$ to $w = 4.0056$ at $t = 0.07215$. This means that *laissez-faire* is not optimal under consistent conjectures.

Our work also means that Eaton and Grossman's material on the foreign policy response (Section II) is correct for all cases except the consistent conjectures case. Turnovsky [1986] evaluates a case similar to their section "Foreign Policy Response" under consistent conjectures and concludes that free trade is not optimal.

Our results also partially invalidate their Proposition 4 (in their Section III) in which they say that with m foreign firms and n home firms the optimal policy is to tax when $n > 1$ and *laissez-faire* when $n = 1$ [Eaton and Grossman, 1986, p. 397].

CONCLUSIONS

Eaton and Grossman's conjecture about the form of the consistent conjectures' reaction function is inconsistent with consistent conjectures rendering their conclusions to part of their analysis

invalid. With a duopoly the optimal tax policy is not always to have laissez-faire. Otherwise, they did a fine job of analyzing an important and mathematically messy problem.

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