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A Reappraisal of Strategic Trade Policy

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Abstract We investigate the welfare effect of an export subsidy/tax in the "third market" trade model. The conventional wisdom is that an export subsidy increases home welfare in a Cournot setting (Brander and Spencer 1985) and an export tax increases home welfare in a Bertrand setting (Eaton and Grossman 1985). By allowing firms to compete in a Cournot-Bertrand duopoly model where one firm competes in output and the other competes in price, we are able to show that the conventional wisdom is incomplete. Optimal trade policy does not depend simply on whether firms compete in a Cournot or Bertrand type game. It only depends on whether the foreign firm competes in output or price.

Keywords Strategic trade policy · Cournot-Bertrand model

JEL Classifications C72 · D43 · F11 · F13

1 Introduction

Previous studies of the "third market" model in trade theory have investigated the effect of an export subsidy/tax on the welfare of a home country. The conventional wisdom is that an export subsidy increases home welfare in a Cournot setting (Brander and Spencer 1985) and an export tax increases home welfare in a Bertrand setting (Eaton and Grossman 1986). In a more sophisticated model, Maggi (1996) found that a subsidy is optimal when firms face a binding capacity constraint, which

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is likely to generate Cournot competition. Without this constraint, Bertrand competition emerges and an export tax becomes optimal.[1] Other studies show that the appropriate export policy depends on the number of competitors (Dixit 1984) and the extent to which there are barriers to entry (Etro 2011). These conflicting results demonstrate that optimal export policy depends on the details of market structure.

One limitation of previous analysis is that it focuses on the two traditional modes of competition, Cournot and Bertrand. To date, no one has considered a mixed Cournot-Bertrand model, in which one firm competes in output (*a la* Cournot) and the other competes in price (*a la* Bertrand). This is unfortunate because the Cournot-Bertrand model is becoming more popular and Cournot-Bertrand behavior is observed in the real world. In terms of modeling, the static Cournot-Bertrand model is discussed in Singh and Vives (1984), Klemperer and Meyer (1986), Martin (2002, 82), Tremblay and Tremblay (2011, 2012), and Tremblay et al. (2013a). Singh and Vives (1984), Klemperer and Meyer (1986), and Tremblay et al. (2013a) endogenize the choice of output and price, leading to the possibility of a Cournot, Bertrand, or Cournot-Bertrand outcome. In addition, Tremblay et al. (2013a) consider a dynamic version of the Cournot-Bertrand model. In the real world, Tremblay et al. (2013b) found that asymmetric set-up costs in the market for small cars led to a Nash equilibrium where some firms compete in output (e.g., Honda dealers) and others compete in price (e.g., Scion dealers). The work of Maggi (1996) suggests that Cournot-Bertrand behavior may occur in international trade as well. Firms in low-wage countries may be mass producers that face capacity constraints and compete in output, while competing firms in high-wage countries may produce custom made goods and compete in price.

In this note, we contribute to the literature on strategic trade policy by considering Cournot-Bertrand behavior. Our results establish that the conventional wisdom is incomplete. Optimal trade policy does not depend simply on whether firms compete in a Cournot or Bertrand type game. It only depends on whether the foreign firm competes in output or price. We formally demonstrate our result in the next section.

2 Strategic Trade Policy in Cournot, Bertrand, and Cournot-Bertrand Models

We consider the case where a home firm and a foreign firm export imperfect substitutes to a third country. These are the only competitors in the third country's market. The home government has the option of imposing an export subsidy or tax on the home firm. Policy instrument s represents a per-unit subsidy when $s>0$ and a per-unit tax when $s<0$. The question of interest is whether a subsidy or a tax can give its home producer a strategic advantage and increase the welfare of the home country.

We begin our discussion by considering a non-cooperative game with two stages. In the first stage, the home government chooses s; other countries are assumed to be policy inactive. In the second stage, the home and foreign firms compete by simultaneously choosing output (q) or price (p). We extend the general framework of Brander (1995), by considering all strategic possibilities. This produces four possible games, as described in Fig. 1. The northwest

[1] This reflects the Kreps and Scheinkman (1983) contribution that when price (capacity) can adjust more quickly than capacity (price), then the Cournot (Bertrand) outcome will be reached. Maggi's main contribution is to show that when capacity can serve as a commitment device, a subsidy on the home firm's capacity is optimal whether firms compete in a Cournot or a Bertrand setting.

		Foreign Firm: q	Foreign Firm: p
Home Firm	q	q_h, q_f Cournot	q_h, p_f Cournot-Bertrand
	p	p_h, q_f Bertrand-Cournot	p_h, p_f Bertrand

Fig. 1 State doupoly games and the choice of strategic variable: output (q) or price (p)

corner of the figure identifies the Cournot game, where both firms compete in output. The southeast corner identifies the Bertrand game, where both firms compete in price. The other corners identify games with a "strategic asymmetry." The northeast corner describes the Cournot-Bertrand game, where the home firm competes in output and the foreign firm competes in price. The southwest corner describes the Bertrand-Cournot Game, where the home firm competes in price and the foreign firm competes in output. Brander and others have considered only the first two models. To our knowledge, we are the first to consider the last two cases in an international trade setting.

In this framework, firms compete in actions a_h and a_f, where subscript h represents the home firm and f the foreign firm. If only the home firm receives a subsidy (or tax), firm profits are:

$$\begin{aligned} &\Pi_h(a_h, a_f, s) = \pi_h(a_h, a_f) + sq_h(a_h, a_f) \\ &\pi_f(a_h, a_f) \end{aligned} \tag{1}$$

where π_h is the home firm's operating profit and $s \cdot q_h$ is the amount of the home firm's subsidy. These functions are assumed to be well behaved, so that first- and second-order conditions of profit maximization are met and the Nash equilibrium in the second stage game is unique and stable. Firms need not face the same costs, but costs are assumed to be sufficiently low so that both firms participate. Following Amir and Grilo (1999) and Tremblay et al. (2013a), we also assume that these games have the "typical" geometry or structure. That is, $\partial\pi_i/\partial a_j$ is negative (positive) when a_j is output (price), where subscript i represents h or f and subscript j represents the other firm. In addition, outputs are strategic substitutes in the Cournot game (i.e., $\partial^2\pi_i/\partial q_i\partial q_j < 0$); prices are strategic complements in the Bertrand game (i.e., $\partial^2\pi_i/\partial p_i\partial p_j > 0$). With mixed Cournot and Bertrand behavior, firm i's actions are strategic complements when firm i competes in output and firm j competes in price (i.e., $\partial^2\pi_i/\partial q_i\partial p_j > 0$) and are strategic substitutes when firm i competes in price and firm j competes in output (i.e., $\partial^2\pi_i/\partial p_i\partial q_j < 0$).

The government's goal is to maximize home welfare (W). Because all output is exported and assuming that the subsidy is financed by non-distortionary taxes, W is just the home firm's total profit minus the subsidy.[2]

$$W(a_h,\ a_f) = \Pi_h(a_h,\ a_f,\ s) - sq_h(a_h,\ a_f) = \pi_h(a_h,\ a_f) \tag{2}$$

[2] W is indirectly a function of s, because a_i is a function of s. Collie (2002) allows for a tax distortion by adding parameter $\lambda \geq 1$ to the welfare function. In his specification, $W(a_h, a_f) = \pi_h(a_h, a_f, s_i) - \lambda sq_h(a_h, a_f)$. When $\lambda = 1$, there is no tax distortion. When $\lambda > 1$, there is an added deadweight loss due to tax distortions and the optimal s approaches zero as λ increases.

Backwards induction is used to solve for the sub-game perfect Nash equilibrium (SPNE). In the second stage, firms optimize after observing s. The Nash equilibrium is reached when the first-order conditions of profit maximization are met simultaneously (i.e., $\partial \Pi_h / \partial a_h = 0$ and $\partial \pi_f / \partial a_f = 0$). In the first stage, the government chooses the level of s that maximizes W, correctly anticipating each firm's best-reply or first-order conditions in the second stage. The value of s that maximizes home welfare is[3]:

$$s^* = \frac{\partial \pi_h}{\partial a_f} \frac{da_f}{da_h} \frac{\partial a_h}{\partial q_h}. \tag{3}$$

Analysis of the derivatives in equation (3) determines whether the government should impose a subsidy ($s^* > 0$) or a tax ($s^* < 0$) to maximize welfare. The implications are summarized in the following proposition.

Proposition 1 Assume the duopoly game described above. Whether the home firm competes in output or price:

A. An export subsidy is optimal if the foreign firm competes in output.
B. An export tax is optimal if the foreign firm competes in price.

Proof The sign of the first derivative in equation (3), $\partial \pi_h / \partial a_f$, depends on the choice of action. When the foreign firm competes in output, $\partial \pi_h / \partial a_f = \partial \pi_h / \partial q_f < 0$. When the foreign firm competes in price, $\partial \pi_h / \partial a_f = \partial \pi_h / \partial p_f > 0$.

The second derivative in equation (3), da_f / da_h, is the slope of the foreign firm's best-reply function. With the typical geometry, $da_f / da_h = dq_f / dq_h < 0$ in the Cournot model, and $da_f / da_h = dp_f / dp_h > 0$ in the Bertrand model. If firms choose a different mix of output and price, Tremblay et al. (2013a) show that the slopes of the best-replies differ by firm. If firm 1 competes in output and firm 2 competes in price, then firm 1 has a positively sloped best reply and firm 2 has a negatively sloped best reply. Thus, the sign of the best-reply function depends upon which firm is which. In the Cournot-Bertrand model where $a_h = q_h$ and $a_f = p_f$, $da_f / da_h = dp_f / dq_h < 0$; in the Bertrand-Cournot model where $a_h = p_h$ and $a_f = q_f$, $da_f / da_h = dq_f / dp_h > 0$.

The sign of last derivative in equation (3), $\partial a_h / \partial q_h$, depends on the home firm's choice of action. When the home firm competes in output, $\partial a_h / \partial q_h = \partial q_h / \partial q_h = 1 > 0$; when the home firm competes in price, $\partial a_h / \partial q_h = \partial p_h / \partial q_h < 0$ (given negatively sloped demand).

With Cournot competition: $\partial \pi_h / \partial a_f = \partial \pi_h / \partial q_f < 0$, $da_f / da_h = dq_f / dq_h < 0$, and $\partial a_h / \partial q_h = \partial q_h / \partial q_h = 1 > 0$. Therefore, $s^* > 0$.

With Bertrand competition: $\partial \pi_h / \partial a_f = \partial \pi_h / \partial p_f > 0$, $da_f / da_h = dp_f / dp_h > 0$, and $\partial a_h / \partial q_h = \partial p_h / \partial q_h < 0$. Therefore, $s^* < 0$.

[3] The details of this derivation are as follows. Given firm h's first-order condition ($\partial \Pi_h / \partial a_h = 0$) and given that welfare is a direct function of a_h and a_f, the total differential of W is: $dW = \frac{\partial \pi_h}{\partial a_h} da_h + \frac{\partial \pi_h}{\partial a_f} da_f = \left(\frac{\partial \Pi_h}{\partial a_h} - s \frac{\partial q_h}{\partial a_h} \right) da_h + \frac{\partial \pi_h}{\partial a_f} da_f = -s \frac{\partial q_h}{\partial a_h} da_h + \frac{\partial \pi_h}{\partial a_f} da_f$. Setting this to zero and solving for s gives the optimal subsidy: $s^* = \frac{\partial \pi_h}{\partial a_f} \frac{da_f}{da_h} \frac{\partial a_h}{\partial q_h}$.

Table 1 The mode of competition and the optimal subsidy/tax on exports

Game	Sign of:			Optimal Subsidy (s^*)
(Action Variable)	$\partial\pi_h/\partial a_f$	$\partial a_f/\partial a_h$	$\partial a_h/\partial q_h$	
Cournot ($a_h=q_h$; $a_f=q_f$)	(−)	(−)	(+)	$s^* > 0$ (subsidy)
Bertrand ($a_h=p_h$; $a_f=p_f$)	(+)	(+)	(−)	$s^* < 0$ (tax)
Cournot-Bertrand ($a_h=q_h$; $a_f=p_f$)	(+)	(−)	(+)	$s^* < 0$ (tax)
Bertrand-Cournot ($a_h=p_h$; $a_f=q_f$)	(−)	(+)	(−)	$s^* > 0$ (subsidy)

a_i is firm i's action: output (q_i) or price (p_i). Subscript h corresponds to the home firm and subscript f corresponds to the foreign firm. $\partial a_f/\partial a_h$ is the slope of the foreign firm's best reply function

With Cournot-Bertrand competition: $\partial\pi_h/\partial a_f = \partial\pi_h/\partial p_f > 0$, $da_f/da_h = dp_f/dq_h < 0$, and $\partial a_h/\partial q_h = \partial q_h/\partial q_h = 1 > 0$. Therefore, $s^* < 0$.

With Bertrand-Cournot competition: $\partial\pi_h/\partial a_f = \partial\pi_h/\partial q_f < 0$, $da_f/da_h = dq_f/dp_h > 0$, and $\partial a_h/\partial q_h = \partial p_h/\partial q_h < 0$. Therefore, $s^* > 0$. Q.E.D.

The main elements of the proof are summarized in Table 1. The first row is the Brander and Spencer (1985) result: an export subsidy is optimal in a Cournot game. The second row is the Eaton and Grossman (1986) result: an export tax is optimal in a Bertrand game. These are the conventional strategic-trade results, as found in Brander (1995, 1416) and Feenstra (2004, 291). The next two rows are new. In the Cournot-Bertrand game where the home firm competes in output and the foreign firm competes in price, an export tax is optimal. In the Bertrand-Cournot game where the home firm competes in price and the foreign firm competes in output, an export subsidy is optimal. Equation (3) reveals that these results depend on the slope of the foreign firm's best reply, not the slope of the home firm's best reply.[4] The proposition demonstrates that the strategic trade policy implications of Brander and Spencer (1985) and Eaton and Grossman (1986) are incomplete. Whether it is optimal to impose an export subsidy or tax depends on the strategic choice of the foreign firm and does not depend on the strategic choice of the home firm.

An intuitive way of thinking about these outcomes is to realize that the export policy serves as a commitment device that enables the home firm to reach a Stackelberg leader outcome. This is illustrated graphically in Eaton and Grossman 1986, (Figs. 1 and 2) for both the Cournot and Bertrand models.[5] In the Cournot case, a subsidy allows the home firm to commit to greater output. This aggressive behavior causes the foreign firm to cut output and the home firm to achieve greater profit. A similar argument applies to the Bertrand case, except in reverse. The

[4] Two an anonymous referees pointed out that this result can be derived from the analysis of Brander (1995) and Leahy and Neary (2010). Nevertheless, these previous studies consider only the Cournot and Bertrand models, not the mixed Cournot-Bertrand model.

[5] These results are also described in Feenstra (2004, 286–293).

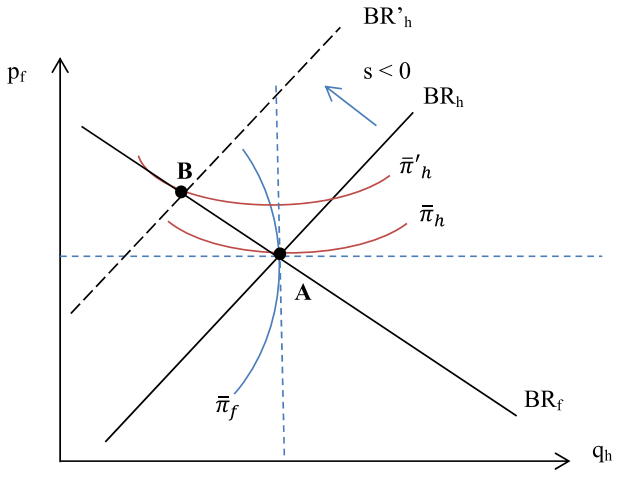

Fig. 2 Tax the home firm in a cournot-bertrand model

appropriate policy is a tax, because the tax softens price competition between the home and foreign firms. With an optimal subsidy/tax policy, the home firm behaves as a Stackelberg-type leader and generates the greatest operating profit (welfare), given the foreign firm's best-reply function.

An analogous argument applies when firms compete in different choice variables. Figure 2 illustrates this for the Cournot-Bertrand model, where the home firm competes in output and the foreign firm competes in price. The figure plots each firm's iso-profit functions ($\bar{\pi}_i$) and linear best-reply functions (BR_i). Notice that the home firm's best-reply function has a positive slope and the foreign firm's best reply has a negative slope. In this case, the optimal policy is a tax because this softens the price competition of the foreign firm. Without the tax, the Nash equilibrium occurs where the best-reply functions (BR_h and BR_f) intersect (point A). A tax

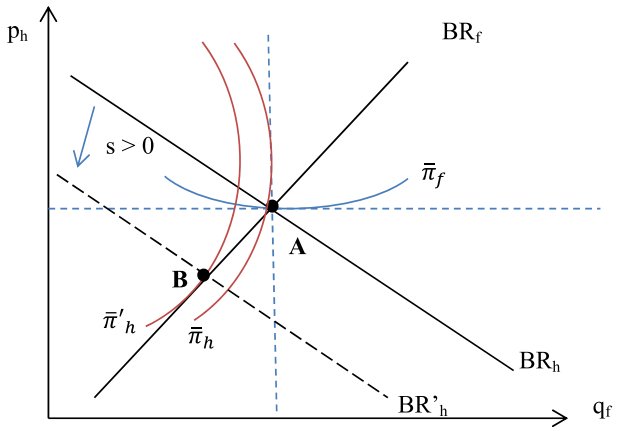

Fig. 3 Subsidy to the Home Firm in a Bertrand-Cournot Model

causes BR_h to shift left, and the optimal tax is reached at point B, which corresponds to the home firm's highest iso-profit, given BR_f.[6]

Figure 3 illustrates the Bertrand-Cournot model where the home firm competes in price and the foreign firm competes in output. In this case, the optimal policy is a subsidy because it causes the home firm to be more aggressive and induces the foreign firm to cut output. Without the subsidy, the Nash equilibrium occurs where the best-reply functions intersect (point A). A subsidy causes BR_h to shift down, and the optimal subsidy is reached at point B, which corresponds to the home firm's highest iso-profit, given BR_f.

3 Conclusion and Policy Implications

Our reappraisal demonstrates that the conventional wisdom regarding strategic trade policy is incomplete. The optimal policy does not depend simply on whether firms compete in a Cournot or Bertrand type game. Allowing firms to compete in Cournot, Bertrand, and Cournot-Bertrand settings reveals that the optimal subsidy/tax policy only depends on whether the foreign firm competes in output or price.

Of course, the World Trade Organization, with over 150 member countries, has been effective at reducing trade barriers such as these. Exemptions remain, however, especially for low-income, developing countries. At issue is how to shape world trade policy so that it promotes efficiency and helps the world's poor. Our work provides policymakers with a more complete picture regarding the potential merits of an export subsidy or tax. This is not to suggest that the implementation of an optimal trade policy is now an easy task. It may be difficult to tell whether foreign firms compete in output or price, and subsidy/tax wars with foreign governments must be avoided. Nevertheless, we demonstrate that to develop an optimal policy, government needs less information than conventional strategic trade theory suggests.

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References

Amir R, Grilo I (1999) Stackelberg versus cournot equilibrium. Games Econ Behav 26:1–21
Brander JA (1995) Strategic trade policy. In: Grossman G, Rogoff K (eds) Handbook of international economics, vol 3. North-Holland, Amsterdam, pp 1395–1455
Brander JA, Spencer BJ (1985) Export subsidies and international market share rivalry. J Int Econ 18:83–100
Collie DR (2002) Prohibiting State aid in an integrated market: cournot and Bertrand oligopolies with differentiated products. J Ind Compet Trade 2(3):215–231
Dixit, A (1984) International Trade Policies for Oligopolistic Industries. *Econ J*, Supplement, 1984, 1–16
Eaton J, Grossman GM (1986) Optimal trade and industrial policy under oligopoly. Q J Econ 101:383–406
Etro F (2011) Endogenous market structures and strategic trade policy. Int Econ Rev 52(1):63–84
Feenstra RC (2004) Advanced international trade: theory and evidence. Princeton University Press, Princeton
Klemperer P, Meyer M (1986) Price competition vs. Quantity competition: the role of uncertainty. Rand J Econ 17(40):618–638

[6] This outcome is consistent with a dynamic version of the Cournot-Bertrand model, which is discussed in Tremblay and Tremblay (2012) and Tremblay et al. (2013a).

Kreps D, Scheinkman J (1983) Quantity precommitment and Bertrand competition yield cournot outcomes. Bell J Econ 14(2):326–337

Leahy D, and JP Neary, "Oligopoly and Trade," Social Science Research Network, 2010, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1742697

Maggi G (1996) Strategic trade policies with endogenous mode of competition. Am Econ Rev 86(1):237–258

Martin S (2002) Advanced industrial organization. Blackwell Publishers, Malden

Singh N, Vives X (1984) Price and quantity competition in a differentiated duopoly. Rand J Econ 15(4):546–554

Tremblay CH, Tremblay VJ (2011) The cournot-bertrand model and the degree of product differentiation. Econ Lett 111(3):233–235

Tremblay VJ, Tremblay CH (2012) New perspectives on industrial organization: with contributions from behavioral economics and game theory. Springer, New York

Tremblay VJ, Tremblay CH, Isariyawongse K (2013a) Endogenous timing and strategic choice: the cournot-bertrand model. Bull Econ Res 65(4):332–342

Tremblay VJ, Tremblay CH, Isariyawongse K (2013b) Cournot and Bertrand competition when advertising rotates demand: the case of Honda and scion. Int J Econ Bus 20(1):125–141