Fickle trade policy, productivity gaps and increasing marginal costs

Kazuhiro Takauchi
Hajime Sugeta
Tomomichi Mizuno

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Kazuhiro Takauchi*† Hajime Sugeta‡ Tomomichi Mizuno§

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Abstract

Recent real-world production asymmetry and model tractability have brought increasing attention to firm heterogeneity in monopolistic competition. Nevertheless, how productivity gaps in oligopolies affect trade policy tends to be overlooked. This study considers how the productivity gap between efficient and less-efficient oligopoly firms affects export policies in a third-market model. Firms have linear quadratic costs. We show that the subsidy-tax-subsidy effect appears to the degree of the productivity gap. We also show that a widening productivity gap increases the exporter's welfare. Hence, there may be some rationale for creating a national champion.

Keywords: Export policy; Productivity gap; Linear quadratic cost; Subsidy–Tax–Subsidy

JEL classification: F12; F13

*Corresponding author: Kazuhiro Takauchi, Faculty of Business and Commerce, Kansai University, 3-3-35 Yamate-cho, Suita, Osaka 564-8680, Japan. E-mail: kazh.takauch@gmail.com; Tel.: +81-6-6368-1817; Fax: +81-6-6339-7704.

†Research Fellow, Graduate School of Economics, Kobe University, 2-1 Rokkodai-cho, Nada-ku, Kobe-City, Hyogo 657-8501, Japan.

‡Faculty of Economics, Kansai University, 3-3-35 Yamate-cho, Suita, Osaka 564-8680, Japan. E-mail: sugeta@kansai-u.ac.jp; Tel.: +81-6-6368-1817; Fax: +81-6-6339-7704.

§Graduate School of Economics, Kobe University, 2-1 Rokkodai-cho, Nada-ku, Kobe-City, Hyogo 657-8501, Japan. E-mail: mizuno@econ.kobe-u.ac.jp. Tel.: +81-78-803-7245; Fax: +81-78-803-7289.

1 Introduction

In this quarter-century, trade theory has increasingly focused on firm heterogeneity (Melitz and Redding, 2014). As indicated by Head and Spencer (2017), in the 2010s, research on "monopolistic competition with firm heterogeneity" rapidly increased because heterogeneous firms are incorporated relatively easily under monopolistic competition. On the one hand, regarding international oligopoly trade policy, it is well established that the policy effect on firms depends on whether firms strategically interact (Brander and Spencer, 1985; Eaton and Grossman, 1986). As monopolistic competition models reflect the real-world situation where firms with high and low productivity coexist within the same industry in the same country, considering productivity gaps among domestic firms in oligopoly competition is important. However, the effects of the degree of productivity gap among oligopoly firms on trade policy tend to be overlooked.[1] Moreover, the productivity gap is often assumed as differences in marginal costs, although the constant marginal cost tends to be considered.

This paper examines the effect of the productivity gap among firms on export policy when firms have a linear quadratic cost[2] in the third-market model. We show that the "subsidy–tax–subsidy", an alternative optimal export policy pattern, appears as the productivity gap continues.[3] This result can occur when we extend the model to the differentiated good case. We also show that by widening productivity gap, *reduces* exporting country's welfare.

Our study is closely related to Long and Soubeyran (1999). They showed that when firms

[1]Cost heterogeneity between a home and a foreign firm and optimal export policy are discussed in models of third-country export rivalries, e.g., de Meza (1986), Collie and de Meza (1986), Mai and Hwang (1988), Neary (1994), Bandyopadhyay (1997), and Collie and de Meza (2003). These studies found that countries with low-cost firms tend to provide higher export subsidies than countries with high-cost firms.

[2]When firms have constant marginal costs, the optimal export policy is always a subsidy

[3]In licensing models, Ghosh and Saha (2008) found that the "subsidy–tax–subsidy" can appear. Mizuno and Takauchi (2020) showed that the "tax–subsidy–tax" can appear in vertical production models.

have convex costs, the export policy becomes a tax even in the case of quantity competition. In contrast, by considering the productivity gap, the optimal export policy becomes both a tax and a subsidy of the productivity gap. Hence, our model substantially differs from Long and Soubeyran (1999) and provides new insights into trade policy.

2 Model

We consider a standard third-market model; however, each identical country i ($i = H, F$) has two firms and there is a productivity gap between the two firms. Each firm has a linear quadratic cost, whose coefficient we refer to as "productivity". To better understand and simplify the analysis, we fix the productivity of one firm as unity, called firm n. The other firm's productivity is $\gamma > 0$: called firm b. The γ denotes the productivity gap between firms n and b. The profits of firms in exporting country i are defined by

$$\pi_b^i \equiv (p_i - (c + s_i))q_b^i - \frac{\gamma}{2}(q_b^i)^2; \quad \pi_n^i \equiv (p_i - (c + s_i))q_n^i - \frac{1}{2}(q_n^i)^2,$$

where p_i is the price in the third market, q_b^i (q_n^i) is the value of exports of firm b (n) in exporting country i, $i \neq j$, $i, j = H, F$, $a, c > 0$, and $a - c > 0$. When $\gamma < 1$ (> 1), firm b is regarded as an efficient (inefficient) firm and, thus, a smaller (larger) γ implies that the productivity gap is increasing. Note that export policy s_i is a tax (subsidy) if $s_i > (<) \, 0$.

The inverse demand in the third market is $p_i = a - (q_b^i + q_n^i) - (q_b^j + q_n^j)$.

A two-stage game is examined. Each country i first decides the level of export policy s_i. Subsequently, firms decide their exports to the third market. The game is solved by backward induction.

3 Results

Let $\boldsymbol{s} = (s_i, s_j)$ for $i \neq j$, $i, j = H, F$. In Cournot competition, the second-stage exports of each firm in country i are $q_b^i(\boldsymbol{s})$ and $q_n^i(\boldsymbol{s})$. These yield the maximization problem below and the optimal export policy s_i^*:

$$\max_{s_i} \pi_b^i(\boldsymbol{s}) + \pi_n^i(\boldsymbol{s}) + [q_b^i(\boldsymbol{s}) + q_n^i(\boldsymbol{s})]s_i \;\Rightarrow\; s_i^* = \frac{(1-\gamma)(\gamma^2-2\gamma-7)(a-c)}{11\gamma^3+83\gamma^2+177\gamma+113}. \quad (1)$$

We establish Proposition 1 from (1).

Proposition 1. *Although large productivity gaps result in export subsidies, small productivity gaps lead to export taxes. Formally,* $s_i^* < 0$, *if* $\gamma < 1$ *or* $\gamma > 1+2\sqrt{2}$; $s_i^* > 0$, *if* $1 < \gamma < 1+2\sqrt{2}$.

Proof. Solving $(1-\gamma)(\gamma^2 - 2\gamma - 7) \geq 0$ in (1) with respect to γ, we obtain Proposition 1. □

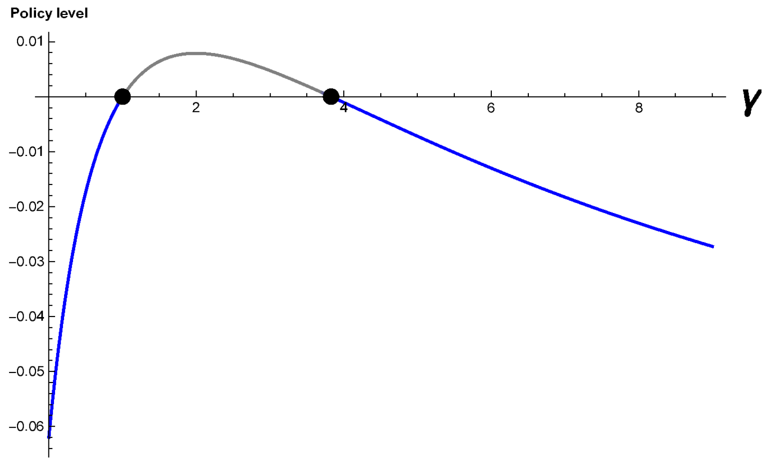

Figure 1: Optimal export policy: Blue is **Subsidy**; gray is **Tax**.

The intuition is as follows. When the productivity gap is small, there is no significant difference between firms in each exporter. If the exporting country provides a subsidy in an effort to promote exports, because a firm's marginal cost is rising, the production cost rapidly increases. This harms the exporter's welfare; thus, the exporter imposes a tax on their firms to increase their welfare through tax revenue. This result is similar to that of Long and Soubeyran (1999).

In contrast, when the productivity gap is large, efficient and less-efficient firms coexist in each exporting country i. If the exporter imposes a tax on its domestic firms, the less-efficient firm's export ability shrinks significantly. Because this diminishes domestic firms' market share and shifts rent from domestic to foreign firms, the exporting country provides an export subsidy (Brander and Spencer, 1985).

Our contribution is that the productivity gap within an industry possibly changes the optimal export policy several times. This implies that even if the slightest error is made in the productivity gap, because the optimal export policy sign can be the inverse, it may lead to a large welfare loss. Hence, export policy decisions require great care.

We next consider the exporting country's welfare. From (1), the welfare of exporting country i becomes as follows:

$$W_i^* = \frac{(\gamma+3)^2(3\gamma+5)(7\gamma^3+51\gamma^2+93\gamma+41)(a-c)^2}{2\left(11\gamma^3+83\gamma^2+177\gamma+113\right)^2}. \tag{2}$$

Using (2), we obtain

Proposition 2. *Suppose $\gamma < 1$. An improvement in an efficient firm's productivity decreases the welfare of exporters. Suppose $\gamma > 1$. A deterioration in a less-efficient firm's productivity increases the welfare of exporters.*

Proof. Differentiating (2) with respect to γ, we have

$$\frac{\partial W_i^*}{\partial \gamma} = \frac{8(\gamma+3)\left(2\gamma^6+7\gamma^5-21\gamma^4+174\gamma^3+1424\gamma^2+2811\gamma+1747\right)(a-c)^2}{\left(11\gamma^3+83\gamma^2+177\gamma+113\right)^3} > 0.$$

This implies Proposition 2. □

An increase in γ has two effects on the exporting country's welfare. The first effect is negative, leading to production inefficiency. The second effect is positive, shutting out less-efficient firms from the market (Lahiri and Ono, 1988). In our model, the negative effect is dominated by the positive effect; thus, an increase in γ always raises welfare.

Proposition 2 has an important implication. Even if domestic production becomes inefficient, shifting production from less-efficient to efficient firms may enhance welfare. This provides some rationale for an industrial policy that creates a national champion.

4 Discussion

In this section, we confirm the robustness of Proposition 1 in the case where we extend the model to differentiated goods.

Differentiated quantity competition. Here, we introduce $\beta \in [0,1]$, which is the variable of the degree of product differentiation between home and foreign goods. Hence, the inverse demand in the third market is $p_i = a - (q_b^i + q_n^i) - \beta(q_b^j + q_n^j)$. Note that if $\beta = 1\,(0)$, exporters goods are homogenous (independent).

The optimal export policy of country i is

$$s_i^{d*} = -\frac{(a-c)\left[\beta^2(\gamma+3)^3 - 4(\gamma+1)(3\gamma+5)\right]}{\beta(3\gamma+5)(\gamma+3)^2 - \beta^2(\gamma+3)^3 + (3\gamma+5)(3\gamma^2+18\gamma+19)}, \tag{3}$$

where the variable with "*d*" denotes the case of differentiated products.

We establish Proposition 3 from (3).

Proposition 3. *(i) The optimal trade policy is a subsidy, i.e., $s_i^{d*} < 0$, if $\frac{2\sqrt{(1+\gamma)(5+3\gamma)}}{\sqrt{(3+\gamma)^3}} \leq \beta \leq 1$.*
(ii) The optimal trade policy is a tax, i.e., $s_i^{d*} > 0$, if $\beta < \frac{2\sqrt{(1+\gamma)(5+3\gamma)}}{\sqrt{(3+\gamma)^3}}$.

Proof. From (3), solving $4(\gamma+1)(3\gamma+5) - \beta^2(\gamma+3)^3 \leq 0$, we have $\frac{2\sqrt{(1+\gamma)(5+3\gamma)}}{\sqrt{(3+\gamma)^3}} \leq \beta \leq 1$. □

Proposition 4. *Suppose $\beta > \frac{2}{3}\sqrt{\frac{5}{3}} \simeq 0.860663$. subsidy–tax–subsidy appears as γ goes up.*

Proof. From Proposition 3, $\left.\frac{2\sqrt{(1+\gamma)(5+3\gamma)}}{\sqrt{(3+\gamma)^3}}\right|_{\gamma=0} = \frac{2}{3}\sqrt{\frac{5}{3}}$. This implies Proposition 4. □

From the results of Propositions 3 and 4, our main result does not change when firms conduct differentiated Cournot competitions.

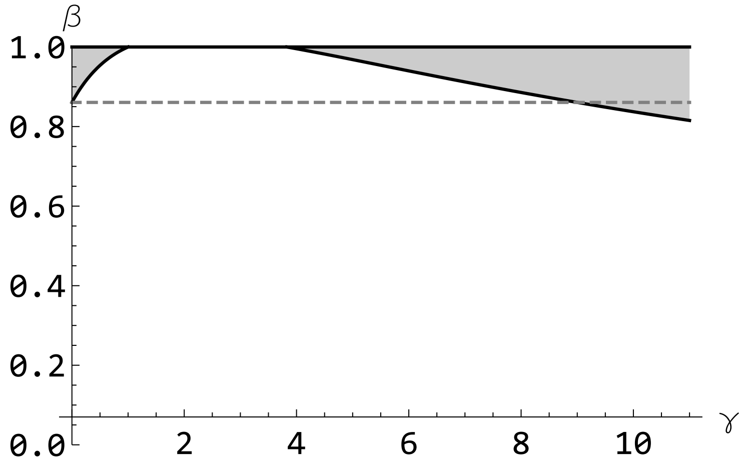

Figure 2: Shadow area is "subsidy" in (γ, β) space.

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