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Rent-seeking, R&D, and productivity

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Abstract

To investigate whether rent-seeking discourages productivity, we consider a third-market model, in which a domestic firm and a foreign firm engage in both Research and Development (R&D) and output competition. We show that the relationship between rent-seeking and productivity depends on two forces. On the one hand, rent-seeking increases the marginal benefit of R&D and encourages productivity. On the other hand, a lower production cost due to R&D enables the government to extract the rent from the firm to a greater extent and discourages the productivity. Which force is dominant depends on the level of corruption or, as an alternative interpretation, the weight the government attaches to political contributions. Unlike the monotonic relationship proposed by the literature, we find a non-monotonic relationship between rent-seeking and productivity.

KEYWORDS
corruption, export subsidy, interest groups, lobbying, R&D, rent seeking, trade policy

JEL CLASSIFICATION
D72; F13; L13

1 | INTRODUCTION

Firms are driven by profits. To earn profits, firms can devote resources to productive activities like Research and Development (R&D), or to unproductive ones, such as rent-seeking, or both (Baumol, 1990). Therefore, a question arises: when firms are able to influence policy-makers through lobbying or bribing, will such rent-seeking behavior increase or reduce the firms' productive activities? This paper aims to address this question. If rent-seeking deters productive activities, then it creates inefficiency in addition to distorting public policies. On the other hand, if rent-seeking stimulates productive activities, then it is not as inefficient as it seems.

There are two views regarding this issue. One view proposes that rent-seeking has harmful impacts on economic performance, including, e.g., Baumol (1990), Murphy, Shleifer, and Vishny (1991), Murphy, Shleifer, and Vishny (1993), Shleifer and Vishny (1993), Tanzi (1998),Hall and Jones (1999), and Brou and Ruta (2013). This view argues that when the reward to rent-seeking is higher than that to the productive activity, people will devote resources to rent-seeking and reduce the investment in the productive activity.

The other view asserts that rent-seeking is beneficial to economic performance, including, e.g., Grossmann and Steger (2008), and Júlio (2014).[1] This view contends that rent-seeking can enlarge the reward to R&D and stimulate productivity.

The two views do not receive full support from empirical studies.[2] The mixed empirical evidence suggests that this issue is not conclusive. We intend to reconcile the two views, and to obtain more comprehensive results.

As will be shown, whether rent-seeking encourages or discourages productivity depends on two forces that work in opposite directions. The harmful view focuses on the discouraging force, and the beneficial view concentrates on the other. As a result, the relationship between rent-seeking and productivity in the two views is monotonic.

In this paper, we present a non-monotonic relationship. When the government attaches a small weight to political contributions (or the level of corruption is low), the encouraging force is dominant, so rent-seeking stimulates productivity. When the government attaches a large weight to political contributions (or the level of corruption is high), the discouraging force prevails and rent-seeking deters productivity.

We demonstrate our point in an open economy, which captures the fact that trade policies are prominent targets of rent-seekers.[3] There is a domestic country and a foreign country, and each has an exporting firm. To present the results as clearly as possible, we assume that the two firms export to a third country.[4] The two firms engage in R&D activity, which enhances productivity.[5] In addition, each government sets the export subsidy to help its firm gain an advantage in the third market. The domestic government's decision regarding the export subsidy is subject to the influence of the domestic firm through lobbying or bribing, while the foreign government is free from the plague of special interests. This asymmetric setting enables us to clearly see how rent-seeking affects productivity.

The interactions among the economic agents are characterized by the following game. In the first stage, both firms simultaneously decide their investment in R&D. In the second stage, the two governments non-cooperatively set the export subsidies. In the last stage, the two exporting firms choose their output levels.

Within this setting, we find that rent-seeking enlarges the domestic firm's reward from R&D and thus stimulates the domestic firm's productivity. On the other hand, the higher productivity due to R&D strengthens the government's ability to extract the rents from the firm, which discourages the firm's investment in R&D.

We further find that when the weight the government attaches to the political contribution is small (or the level of corruption is low), the encouraging force outweighs the discouraging one, and thus rent-seeking is beneficial to productivity. When the weight is large (or the level of corruption is high), the discouraging force is dominant, and rent-seeking is harmful to productivity. The non-monotonic relationship between rent-seeking and productivity is consistent with the empirical evidence provided by Méndez and Sepúlveda (2006).

The contribution of this paper is to point out that the relationship between rent-seeking and productivity may not be monotonic. The two subjects are complements in countries with low corruption; and they are substitutes

[1]Leff (1964) asserts that bribes serve as "lubricants" in a sluggish economy and enhance its efficiency. However, Myrdal (1968) points out that corrupt officials may intentionally delay the application so as to receive more bribes. Lui (1985) contends that if this is the case, then the above efficiency-enhancing argument will be much less appealing. An in-depth discussion is, however, beyond the scope of the current paper.

[2]The evidence that supports the harmful view includes Mauro (1995), Campos, Lien, and Pradhan (1999), Hall and Jones (1999), and Lambsdorff (2003). The evidence that supports the beneficial view includes Taylor (1997), Alt et al. (1999), Egger and Winner (2005), Mathur et al. (2013), and Kerr, Lincoln, and Mishra (2014).

[3]See, e.g., Krueger (1974), and Hall and Jones (1999).

[4]This model belongs to the strategic trade theory, which investigates the optimal trade policy in imperfectly competitive markets. See Brander (1995) for a general survey.

[5]For the issue of R&D and strategic trade policy, see, e.g., Spencer and Brander (1983) and Bagwell and Staiger (1994).

in countries with high corruption. These results also suggest that in testing how rent-seeking affects economic performance, the degree of corruption or the weight the governments attach to political contributions is essential.

The remainder of this paper is organized as follows. In the next section we establish the model, and derive the equilibrium outputs of the firms. In Section 3, we determine the export subsidies of the two countries. The determination of the investment in R&D is presented in Section 4. We discuss the implications of the results in Section 5. Section 6 provides the concluding remarks.

2 | THE MODEL

We adopt a "third-market" model, in which one firm from a domestic country and the other from a foreign country compete in terms of output. This setting enables us to highlight the role played by the strategic trade policy in a pure form, and to demonstrate the results clearly.

Each country has two sectors, an export sector and a consumption-good sector. The consumption good serves as the numéraire good with price being unity. The export sector contains only one firm in each country, while the consumption-good sector is competitive.

There is only one factor of production, referred to as labor. Labor is internationally immobile, and is used in both sectors. The labor markets are competitive. The numéraire good sector has a constant returns-to-scale technology. Producing one unit of the numéraire good requires one unit of labor, and thus the wage rate is equal to one. In the domestic country, the exporting firm incurs F units of labor as a fixed cost for producing output. In addition, producing one unit of output needs c units of labor as a variable cost. The fixed cost and the marginal cost for the foreign firm are denoted by F^* and c^*, respectively.[6]

In what follows, we construct a game consisting of three stages. In the first stage, the two exporting firms simultaneously choose the level of R&D investment, which determines the marginal production cost. In the second stage, the two governments non-cooperatively set the export subsidies. In order to influence the making of the subsidy, the domestic firm provides its government with a political contribution schedule. The schedule shows the contribution contingent on the subsidy implemented by the government. We denote by $m(s)$ the contribution schedule provided by the domestic firm, where s is the amount of export subsidy. The domestic firm tailors this schedule to maximize its welfare. In the third stage, the two firms simultaneously choose output levels.

In order to obtain the subgame-perfect Nash equilibrium, we start to solve the game from the third stage. The objective function of the domestic firm in this stage is given by:

$$\pi = \Pi - F = xp(x+y) - cx + sx - F, \tag{1}$$

where x and y are the quantity produced by the domestic and foreign firms, respectively, and $p(x+y)$ is the demand for the exporting good. As indicated above, s is the export subsidy provided by the domestic government. The specification of the demand function implies that the products of the firms are homogeneous. The variable Π, which is equal to $(p-c+s)x$, stands for the domestic firm's operating profit.

Similarly, the objective function of the foreign firm is given by:

$$\pi^* = \Pi^* - F^* = yp(x+y) - c^*y + s^*y - F^*, \tag{2}$$

where Π^* is the foreign firm's operating profit, and s^* is the export subsidy set by the foreign government.

Each exporting firm seeks to maximize its profit by choosing the output level. In this stage, both s and s^* have been determined, and thus the firms treat them as parameters. The first-order conditions for profit maximization are:

[6]The lower bound of c and c^* can be equal to zero. Since we discuss the heterogeneous production costs, we let both c and c^* be greater than zero.

$$\frac{\partial \pi}{\partial x} = \frac{\partial \Pi}{\partial x} = xp' + p - c + s = 0, \tag{3}$$

$$\frac{\partial \pi^*}{\partial y} = \frac{\partial \Pi^*}{\partial y} = yp' + p - c^* + s^* = 0. \tag{4}$$

In order to obtain analytic solutions, we specify a linear demand function as $p = A - x - y$, where $A > 0$ is a shift parameter. With this specification, (3) and (4) become:

$$\frac{\partial \Pi}{\partial x} = A - 2x - y - c + s = 0, \tag{5}$$

$$\frac{\partial \Pi^*}{\partial y} = A - x - 2y - c^* + s^* = 0. \tag{6}$$

The second derivatives of $\partial\Pi/\partial x$ and $\partial\Pi^*/\partial y$ are equal to −2, which satisfies the second-order condition of profit maximization. The differentiation of $\partial\Pi/\partial x$ with respect to y is negative, as is the differentiation of $\partial\Pi^*/\partial y$ with respect to x. These reveal that the two firms' products are strategic substitutes; i.e., their best-response functions are downward-sloping. We also find that $(\partial^2\pi/\partial x^2)(\partial^2\pi^*/\partial y^2) - (\partial^2\pi/\partial x\partial y)(\partial^2\pi^*/\partial y\partial x) = 3 > 0$ which complies with the stability condition (Dixit, 1986).

The equilibrium of x and y can be obtained by solving (5) and (6) simultaneously, which gives:

$$\bar{x} = \frac{1}{3}(A - 2c + c^* + 2s - s^*), \tag{7}$$

$$\bar{y} = \frac{1}{3}(A + c - 2c^* - s + 2s^*). \tag{8}$$

Here we focus on the interior case, so that $\bar{x}$ and $\bar{y}$ are positive. From (7), when the governments do not subsidize export, the sufficient condition for $\bar{x}$ and $\bar{y}$ being positive is that $\max\{c, c^*\} < A$. We assume that this condition is satisfied throughout this paper.

Apparently, an increase in s enlarges $\bar{x}$ and reduces $\bar{y}$; a larger s^* has the opposite effects. Diagrammatically, an increase in s shifts out the best-response function of the domestic firm; since the subsidy reduces the domestic firm's effective cost, it leads the firm to produce a greater amount of output at any given export level of the foreign firm. With x and y being strategic substitutes, an expansion in x reduces the foreign firm's sales.

Moreover, a reduction in c has the same effect as an increase in s. A reduction in c shifts out the domestic firm's best-response function, resulting in a larger $\bar{x}$ and a smaller $\bar{y}$.

3 | EXPORT SUBSIDIES

3.1 | The determination of subsidies

In this section we move on to the second stage, in which the two governments simultaneously determine the export subsidy. The subsidy is financed by a lump sum tax on residents. We assume that the foreign government aims to maximize its national welfare, while the domestic government is subject to the influence of special interests.

We first look at the domestic government's policy-making. The determination of the export subsidy is subject to the influence of the domestic firm, which offers political contributions to the government in exchange for favorable policies.

Recall that the contribution schedule of the domestic firm is *m(s)*. We note that in the third stage, the political contributions are fixed costs, and thus m is a component of F. The domestic firm adjusts m to maximize the net profits, which can be rewritten as:

$$\pi = \Pi - m - \tilde{F}, \tag{9}$$

where $\tilde{F}$ is the fixed cost net of the political contributions.

The domestic government is assumed to maximize a weighted average of the national welfare and the political contributions received. Specifically, following Grossman and Helpman (1994), the objective function of the domestic government is given by:

$$G(s) = \theta m(s) + W(s), \tag{10}$$

where $\theta > 0$ is the weight the domestic government attaches to the political contributions; the larger θ is, the more the government cares about what the political contributions will be.[7] The parameter θ is exogenously determined. It depends on several factors, including, e.g., a country's political culture, or the quality of social infrastructure. As will be shown later, θ is essential in determining the relationship between lobbying and R&D.

The function $W(\cdot)$ represents the social welfare of the domestic country. By assuming that the labor endowment of the domestic country is L, and that the domestic firm is owned by the domestic residents, the social welfare is thus equal to the net income, which is $L + \pi - sx$. Since L is exogenously determined, we simply express the social welfare of the domestic country as:

$$W = \pi - sx. \tag{11}$$

The domestic government chooses s to maximize the objective function, (10).

An equilibrium of the domestic lobbying game consists of two parts: one is the domestic firm's political contribution function *m(s)*, and the other is the equilibrium domestic export subsidy, denoted by $\bar{s}$. According to Grossman and Helpman (1994), an equilibrium should satisfy the following two conditions:

(i) $\bar{s}$ maximizes the domestic government's objective function *G(s)*;
(ii) $\bar{s}$ maximizes $\pi(s) + G(s)$.

Condition (i) states that, given the contribution function, the domestic government sets the export subsidy to maximize its objective function. Condition (ii) stipulates that the equilibrium export subsidy must maximize the joint welfare of the domestic firm and the domestic government. If this condition is violated, then the domestic firm needs to reformulate the contribution schedule to induce the government to choose the jointly optimal policy.

The satisfaction of condition (ii) implies:

$$\frac{d\pi(\bar{s})}{ds} + \frac{dG(\bar{s})}{ds} = \left(\frac{d\Pi(\bar{s})}{ds} - \frac{dm(\bar{s})}{ds}\right) + \frac{dG(\bar{s})}{ds} = 0. \tag{12}$$

[7]The weights attached to political contributions can be measured, e.g., by the Corruption Perceptions Index published by Transparency International in empirical studies.

When deriving the middle part of (12), we apply the relationship that $\pi = \Pi - m - \tilde{F}$. In addition, the domestic government's maximization of G requires:

$$\frac{dG(\bar{s})}{ds} = \theta \frac{dm(\bar{s})}{ds} + \frac{dW(\bar{s})}{ds} = 0. \tag{13}$$

Then, inserting (13) into (12) gives rise to the following relationship:

$$\frac{dm(\bar{s})}{ds} = \frac{d\Pi(\bar{s})}{ds}. \tag{14}$$

Equation (14) indicates that the domestic firm sets its contribution schedule so that the marginal change in the contribution for a small change in s is the same as the effect of the change in s on the firm's operating profit.[8] Thus, (14) defines the contributions that the domestic firm needs to pay for "buying" the policy change. The differentiation of Π with respect to s is equal to:

$$\frac{d\Pi}{ds} = \frac{4}{9}(A - 2c + c^* + 2s - s^*) = \frac{4\bar{x}}{3} > 0. \tag{15}$$

Equation (15) reveals that, as long as the equilibrium x is positive, the domestic firm's operating profit increases with s. Thus, the combination of (14) and (15) shows that the domestic firm pays a larger amount of contributions in exchange for an increase in s.

With the help of (14), the condition for the maximization of G, (13), can be rewritten as:

$$\frac{dG(\bar{s})}{ds} = \theta \frac{d\Pi(\bar{s})}{ds} + \frac{dW(\bar{s})}{ds} = 0. \tag{16}$$

Equation (16) characterizes the equilibrium export subsidy of the domestic country. When setting the export subsidy, the government should balance the impacts between the social welfare and the firm's operating profit (or equivalently, the political contributions).

In order to solve $\bar{s}$, we need to know $\mathrm{d}W/\mathrm{d}s$. The differentiation of W with respect to s is equal to:

$$\frac{\mathrm{d}W}{\mathrm{d}s} = \frac{1}{9}(A - 2c + c^* - 4s - s^*). \tag{17}$$

When s and s^* are equal to zero, $\mathrm{d}W/\mathrm{d}s$ is positive, meaning that a benevolent government can enhance the social welfare by setting a positive export subsidy. This corresponds to the claim of strategic trade theory. Since $\mathrm{d}\Pi/\mathrm{d}s > 0$ as indicated by (15), the first-order condition for the government's optimization, (16), implies that $dW(\bar{s})/ds$ is less than zero. This means that s will be set sub-optimally high, because of the domestic firm's lobbying.

With (15) and (17), we rewrite the first-order condition for the domestic government's optimization as:

$$\frac{\mathrm{d}G}{\mathrm{d}s} = \frac{1}{9}[A - 2c + c^* - 4s - s^* + 4\theta(c^* - 2c + 2s - s^*)] = 0. \tag{18}$$

[8]The property has been known as the *local truthfulness*, because the increment in the contribution the firm pays is equal to the change in the operating profit due to an increase in s. See Grossman and Helpman (1994) for more details.

The second-order condition requires that $d^2G/ds^2 = 4(-1+2\theta)/9$ be negative, so that θ should be less than 1/2.

Equation (18) implies that the domestic government's best-response function is as follows:

$$s = \frac{(1+4\theta)(A-2c+c^*-s^*)}{4(1-2\theta)}. \tag{19}$$

Provided that $\theta < 1/2$, as required by the second-order condition, the denominator of (19) is positive. Equation (19) shows that s decreases with s^*, implying that the two countries' export subsidies are strategic substitutes.

We then turn to the foreign country's decision-making. Its goal is to maximize the national welfare, which is given by $W^* = \pi^* - s^*y$. The first-order condition for the foreign government's optimization is given as follows:

$$\frac{dW^*}{ds^*} = \frac{1}{9}[A-2c^*+c-4s^*-s] = 0. \tag{20}$$

The stability condition requires that $D \equiv d^2G/ds^2 \cdot d^2W^*/ds^{*2} - d^2G/dsds^* \cdot d^2W^*/ds^*ds$ be positive. Since D is equal to $(5-12\theta)/27$, and the stability condition requires that D be positive, θ should be less than 5/12. As we will see, the condition that $\theta < 5/12$ is essential in determining the comparative-statics properties.

From (20) we solve the foreign government's best-response function as follows:

$$s^* = \frac{1}{4}(A-2c^*+c-s). \tag{21}$$

Solving the two best-response functions gives rise to the equilibrium export subsidies:

$$\bar{s} = \frac{1+4\theta}{5-12\theta}[A-3c+2c^*], \tag{22}$$

$$\bar{s}^* = \frac{1}{5-12\theta}[A-3c^*+2c-4\theta(A-c^*)]. \tag{23}$$

Note that the interior solutions for the equilibrium of x and y ensure that both $\bar{s}$ and $\bar{s}^*$ are positive.[9] Equations(22) and (23) show that an increase in θ raises $\bar{s}$ and depresses $\bar{s}^*$. Since the amount of political contributions offered by the firm increases with s, the domestic government with a larger θ will set a higher $\bar{s}$ to receive a larger amount of contributions. Moreover, since $\bar{s}$ and $\bar{s}^*$ are strategic substitutes, a larger θ raises $\bar{s}$, which in turn reduces $\bar{s}^*$.

Inserting $\bar{s}$ and $\bar{s}^*$ into (7) and (8) gives the equilibrium x and y as follows:

$$\hat{x} = \frac{2(A-3c+2c^*)}{5-12\theta}, \tag{24}$$

$$\hat{y} = \frac{2[A-3c^*+2c-4\theta(A-c^*)]}{5-12\theta}. \tag{25}$$

Then in order to figure out the relationship between $\bar{x}$ and $\bar{y}$, we subtract $\hat{y}$ from $\hat{x}$, and obtain:

[9] Inserting (22) and (23) into (7) gives that the equilibrium x is equal to $(2/(5-12\theta))[A-3c+2c^*]$. An interior $\bar{x}$ requires that $A-3c+2c^*$ be greater than zero, which ensures a positive $\bar{s}$. The case of $\bar{s}$ can be obtained in a similar manner.

$$\hat{x}-\hat{y}=\frac{4\theta A-5c+(5-4\theta)c^*}{5-12\theta}. \tag{26}$$

When the domestic firm does not lobby, or θ is equal to zero, (26) becomes

$$\hat{x}-\hat{y}=2(c^*-c). \tag{27}$$

This indicates that when $\theta=0$, the country with a lower production cost will produce more.

3.2 | The relationship between *s* and *s**

Before moving to the next stage, (22) and (23) enable us to address the following question: will a country whose firms have relatively low productivity offer a higher or lower export subsidy? This question can be addressed by subtracting $\bar{s}^*$ from $\bar{s}$, which gives rise to:

$$\bar{s}-\bar{s}^*=\frac{5(c^*-c)+4\theta(2A-3c+c^*)}{5-12\theta}. \tag{28}$$

The conventional view, including, e.g., de Meza (1986), Neary (1994), Bandyopadhyay (1997), and Collie and de Meza(2003) suggests that a benevolent government will offer lower export subsidies to its firms, as long as its firms have relatively low productivity (or a relatively high production cost). Their point can be demonstrated by inserting $\theta=0$ (recall that in this situation, the government intends to maximize the national welfare) into (28), giving rise to the following relationship:

$$\bar{s}-\bar{s}^*=c^*-c. \tag{29}$$

Equation (29) indicates that if $c>c^*$, then $\bar{s}$ is less than $\bar{s}^*$; if $c<c^*$, then the opposite outcome occurs. The reason for this is that a firm with a lower cost can earn a higher marginal profit, and a benevolent government will have a stronger incentive to offer a higher export subsidy.

However, there exists empirical evidence that appears inconsistent with the above result. After deriving a result similar to (29), de Meza (1986) somewhat hesitates to interpret the result. He argues that "It seems to me that Japan ⋯ is very often the least efficient countries that tend to offer the greatest subsidies. If so, this is evidence against the strategic theory of export subsidies." [10](de Meza (1986), p. 348).

Such inconsistency can be modified by considering the influence of special interest groups. Let us return to (28). The denominator is positive as required by the stability condition. An interior solution for the equilibrium output implies that the term $(2A-3c+c^*)$ is greater than zero.[11]

Equation (28) shows that the difference between $\bar{s}$ and $\bar{s}^*$ depends on two forces: the cost difference (represented by the first term in the numerator), and lobbying (measured by the second term). The force of the cost difference has previously been described. Through this force, a higher marginal production cost brings about a lower

[10]Several empirical studies have shown that Japan has relatively low productivity compared to the US (see, e.g., Jorgenson, Kuroda, and Nishimizu (1987), Van Ark et al. (1993), and Jorgenson and Nomura (2007)).

[11]When θ is equal to zero, inserting (22) and (23) into (7) gives $\bar{x}=2(A-3c+2c^*)/(5-12\theta)$. An interior solution for $\bar{x}$ requires that $(A-3c+2c^*)$ be greater than zero. This condition can be rewritten as $2A-3c+c^*>A-c^*$. The term $A-c^*$ must be positive; otherwise $p-c^*$ would be negative. This proves that $2A-3c+c^*$ is positive.

export subsidy. The lobbying force leads the domestic government to set a higher s, because doing so enables it to receive a larger amount of political contributions.

When c is less than c^*, the two forces work in the same direction, and thus $\bar{s}$ is greater than $\bar{s}^*$. By contrast, when c is greater than c^*, the two forces work in opposite directions. The relationship between $\bar{s}$ and $\bar{s}^*$ depends on which force prevails. If the lobbying force is dominant (it is likely to occur when θ is large), then $\bar{s}$ is greater than $\bar{s}^*$, even when c is greater than c^*. This result may provide an explanation to the phenomenon that countries with relatively low productivity can offer high export subsidies.

4 | THE INVESTMENT IN R&D

Now we move on to the first stage, in which the firms decide the investment in R&D, which in turn determines the marginal production cost, c and c^*. Both firms have incentives to engage the R&D game, because a lower production cost helps them gain market leadership. Our aim is to address the issue of whether rent-seeking will lead the domestic firm to curtail or expand its investment in R&D.

4.1 | Foreign firm's decision

We first determine the foreign firm's R&D investment. In the first stage, its objective function is given as:

$$\pi^* = \Pi^* - \phi(c^*), \tag{30}$$

where $\phi(\cdot)$ denotes the R&D cost, with the properties $\phi' < 0$ and $\phi'' > 0$, indicating that the R&D cost is positive and increasing. The foreign firm seeks to maximize the profit by choosing c^*. Note that the expense in relation to R&D becomes the fixed cost, F^*, in stages 2 and 3.

The equilibrium production cost, denoted by $\bar{c}^*$, is characterized by the following first-order condition:

$$\frac{d\pi^*}{dc^*} = \frac{\partial \Pi^*}{\partial y}\frac{\partial \bar{y}}{\partial c^*} + \frac{\partial \Pi^*}{\partial x}\frac{\partial \bar{x}}{\partial c^*} + \frac{\partial \Pi^*}{\partial x}\frac{\partial \bar{x}}{\partial s^*}\frac{\partial \bar{s}^*}{\partial c^*} + \frac{\partial \Pi^*}{\partial c^*} - \phi'(c^*) = 0. \tag{31}$$

Equation (31) reveals that the equilibrium production cost (or equivalently the investment in R&D) of the foreign firm depends on several forces; the first four terms in the middle stand for the impacts of c^* on the foreign firm's operating profit, which we refer to as the foreign firm's marginal benefit of R&D (MBF), and the last term is the marginal cost of R&D. The equilibrium production cost should equate the MBF to the marginal cost of R&D.

Specifically, the MBF is equal to[12]:

$$\text{MBF} = \frac{2(52\theta - 23)[A - 3c^* + 2c - 4\theta(A - c^*)]}{3(5 - 12\theta)^2}. \tag{32}$$

Equation (32) is negative, as required by the stability condition and (25).

Combining the above results, we explicitly express (31) as: $\mathrm{d}\pi^*/\mathrm{d}c^* = \text{MBF} - \phi'(c^*) = 0$. This equation defines the equilibrium production cost of the foreign firm, $\bar{c}^*$.

[12]The derivation of (32) can be found in Appendix 1.

4.2 | Domestic firm's decision

We then turn to the domestic firm's decision. Its objective function is given by:

$$\pi = \Pi - \phi(c) - m. \tag{33}$$

To focus on the impact of lobbying, we let the two firms have the same R&D cost function. Unlike the foreign firm, in addition to the R&D cost, the domestic firm also needs to pay the political contribution, m.

The domestic firm must compensate the government for the loss of welfare associated with its failure to charge the export subsidy that maximizes the national welfare, which it would charge in the absence of lobbying. To determine the amount of political contributions, it is necessary to distinguish between the export subsidy with lobbying (s^l) and that without lobbying (s^n). The variable s^l is set according to (19). In the absence of lobbying, the domestic government chooses s by the following rule:

$$s^n = \frac{1}{4}(A - 2c + c^* - s^*). \tag{34}$$

Equation (34) is obtained by inserting $\theta = 0$ into (19).

Given an arbitrage level of s^*, the domestic firm's political contributions satisfy the following condition:

$$\theta m(s^l) + W(s^l; s^*) = W(s^n; s^*). \tag{35}$$

The left-hand side is the domestic government's payoff with lobbying, and the right-hand side is that without lobbying. From (35), we solve the equilibrium political contributions as follows:

$$m = \frac{1}{\theta}[W(s^n; s^*) - W(s^l; s^*)] = \frac{8\theta(A - 3c + 2c^*)^2}{(5 - 12\theta)^2}. \tag{36}$$

In deriving the above equation, we use (23). The political contribution is non-negative, and it is equal to zero when $\theta = 0$.

Equation (36) shows that the political contributions depend on c. The effect of c on the political contribution is equal to:

$$\frac{\partial m}{\partial c} = -\frac{48\theta(A - 3c + 2c^*)}{(5 - 12\theta)^2}. \tag{37}$$

The numerator is positive as long as $\bar{x}$ is an interior solution, so that (37) is negative. It implies that when c becomes lower, the domestic firm needs to pay a larger amount of political contributions. The reason for this is that, other things being equal, a decline in c increases the domestic firm's operating profit. Recall that the interest group's contribution schedule has the property of truthfulness, so when the domestic firm's profit becomes higher, it pays a larger amount of political contributions.

Alternatively, we can interpret this result as meaning that the higher profit due to a lower cost strengthens the government's ability to extract rents from the firm. Thus, we refer to $-\partial m/\partial c$ as the *rent-extracting* effect (REE). This effect describes the increments of rents that the domestic government extracts from the firm due to a decline in c. The REE discourages the domestic firm from engaging in

R&D. We also note that the REE increases with θ[13]; i.e., a larger θ enhances the government's ability to extract rents.

Next we turn to the domestic firm's decision regarding R&D. The impact of c on the domestic firm's profit is equal to:

$$\frac{d\pi}{dc} = \frac{\partial \Pi}{\partial x}\frac{\partial x}{\partial c} + \frac{\partial \Pi}{\partial y}\frac{\partial y}{\partial c} + \frac{\partial \Pi}{\partial y}\frac{\partial y}{\partial s}\frac{\partial \bar{s}}{\partial c} + \frac{\partial \Pi}{\partial c} - \frac{\partial m}{\partial c} - \phi'(c). \tag{38}$$

Like in Section 4.1, the first four terms describe the domestic firm's marginal benefit from R&D (MBD), and the last terms describe the marginal cost of R&D. The MBD is equal to[14]:

$$\text{MBD} = \frac{2(36\theta - 23)(A - 3c + 2c^*)}{3(5 - 12\theta)^2} < 0. \tag{39}$$

The value of MBD is negative as required by the stability condition. Inserting all the above results into (38) gives:

$$\frac{d\pi}{dc} = \text{MBD} + \text{REE} - \phi'(c). \tag{40}$$

Setting (40) equal to zero defines the domestic firm's equilibrium production cost, $\bar{c}$.

4.3 | The relationship between and

This subsection aims to determine the relationship between $\bar{c}$ and $\bar{c}^*$. To this end, we adopt the following strategy. Suppose that the two firms choose the same production cost initially. Without loss of generality, we let the initial production cost be equal to $\bar{c}^*$. If the resultant $d\pi(\bar{c}^*)/dc$ is equal to zero, then $\bar{c}$ is equal to $\bar{c}^*$; if it is greater than zero, then $\bar{c}$ is higher than $\bar{c}^*$; otherwise, the opposite occurs.

With $c = \bar{c}^*$, we can rewrite (40) as[15]:

$$\frac{d\pi(\bar{c}^*)}{dc} = \text{MBD} - \text{MBF} + \text{REE}. \tag{41}$$

The difference between MBD and MBF is given by:

$$\text{MBD} - \text{MBF} = \frac{8\theta(A - c)(52\theta - 27)}{3(5 - 12\theta)^2}. \tag{42}$$

When $\theta = 0$, MBD is equal to MBF. This implies that the difference between MBD and MBF arises from the domestic firm's lobbying. As long as $\theta = 0$, (42) is negative, meaning that MBD < MBF. Since both MBD and MBF are negative,

[13]This can be seen from the differentiation of the REE with respect to θ, which is given by: $\frac{dREE}{d\theta} = \frac{48(A-c)(5+12\theta)}{(5-12\theta)^3} > 0$.

[14]The derivation of (39) can be found in Appendix 2.

[15]The foreign firm's optimization in R&D investment implies that $\text{MBF} = \phi'(\bar{c}^*)$. Since $c = \bar{c}^*$ initially, $\phi'(c)$ is equal to $\phi'(\bar{c}^*)$. Thus, we can replace $\phi'(c)$ in (40) with MBF, and (41) follows.

the condition that MBD < MBF states that the magnitude of MBD is greater than that of MBF.[16] The reason for this is that, when the two firms have the same production cost initially, the domestic firm's lobbying leads the domestic government to set a relatively high export subsidy. The higher export subsidy brings about a larger $\hat{x}$ in the third market, which in turn results in a larger MBD (in absolute terms). This implies that the rent-seeking behavior increases the reward from R&D investment, and thus we refer to MBD-MBF as the *rent-seeking effect* (RSE).

On the other hand, the third term is the REE, which is positive. As indicated above, when the domestic firm invests more in R&D, the domestic government is able to extract more rents from it. Other things being the same, the larger the REE, the lower the investment in the domestic firm's R&D.

Since the two forces work against each other, the net effect depends on which one is dominant. The net effect is given as follows:

$$\frac{d\pi(\bar{c}^*)}{dc} = \text{RSE} + \text{REE} = \frac{8\theta(A-\bar{c}^*)(52\theta-9)}{3(5-12\theta)^2}. \tag{43}$$

The denominator of (43) is positive, while the sign of the numerator is undetermined. There exists a threshold value for θ, denoted by $\hat{\theta}$, such that $\hat{\theta} = 9/52$. When $0 < \theta < \hat{\theta}$, the resultant $d\pi(\bar{c}^*)/dc$ is less than zero, indicating that the RSE outweighs the REE. The dominant RSE leads to a relatively large R&D investment and a relatively low production cost in the domestic country. This also suggests that rent-seeking is complementary to the productive activity such as R&D, when the government attaches a small weight to the political contribution, or corruption is mild.

On the other hand, when $\theta > \hat{\theta}$, the REE will outweigh the RSE, and the resultant $d\pi(\bar{c}^*)/dc$ is positive. It means that the lobbying firm has a lower R&D investment and a higher production cost. This result suggests that rent-seeking is harmful to productivity, as long as the government attaches a large weight to the political contributions, or corruption is severe.

The following proposition summarizes the above findings:

Proposition 1

1. *When $0 < \theta < \hat{\theta}$, the lobbying firm has a relatively large R&D investment and relatively low production cost. This suggests that when θ is small, rent-seeking is complementary to productivity.*
2. *When $\theta > \hat{\theta}$, the lobbying firm has a relatively small R&D investment and relatively high production cost. This suggests that when θ is large, rent-seeking is harmful to productivity.*

These results indicate a non-monotonic relationship between rent-seeking and productivity. In less corrupt countries, rent-seeking encourages productivity, while in highly corrupt countries, rent-seeking discourages productivity. The results also suggest that in testing how rent-seeking affects economic performance, the level of corruption or the weight the governments attach to political contributions is important.

5 | DISCUSSIONS

As indicated in the Introduction, a number of papers have proposed that rent-seeking is harmful to economic performance, including those of Baumol (1990), Murphy et al. (1991), Murphy et al. (1993), Shleifer and Vishny (1993), Mauro (1995), Tanzi (1998), Campos, Lien, and Pradhan (1999), Lambsdorff (2003), Brou and Ruta (2013), and others. In these papers, rent-seeking discourages productive activities for various reasons. For example, some rent-seeking activities such as corruption need secrecy, which causes leaders of certain countries to maintain monopolies by preventing entry, and thus discouraging innovation (Shleifer & Vishny, 1993). Murphy et al.

[16] We leave the detail of the proof in Appendix 3.

(1991) show that when rent-seeking rewards talent more than entrepreneurship does, people will choose to become rent-seekers, which is harmful to growth. This strand of the literature focuses on the REE, and overlooks the enlarged rewards from lobbying, so it concludes that rent-seeking is detrimental to economic performance.

On the other hand, Grossmann and Steger (2008) and Júlio (2014) find that the entry barrier required by the incumbent firm through lobbying enlarges the reward from investing in R&D, so that lobbying and R&D investment are complementary. In their models, lobbying can enhance the marginal benefit of R&D. This is akin to the RSE in this paper. However, the government's ability to extract rents in their models is exogenously determined or ad hoc.[17] In their models, the RSE dominates the REE. This paper adopts a more delicate way to develop the REE. By reconciling the REE with the RSE, this paper provides more comprehensive results.

More importantly, the relationship between rent-seeking and productivity is monotonic in the two strands of the literature, while it is non-monotonic in this paper. The non-monotonic relationship is consistent with the empirical evidence provided by Méndez and Sepúlveda (2006). They find that corruption is beneficial to economic growth at low levels of corruption, and detrimental at high levels of corruption. Méndez and Sepúlveda (2006) attribute their finding to the costly activities in controlling corruption, causing the level of corruption that maximizes outputs to be positive.[18] We provide an alternative explanation.

6 | CONCLUDING REMARKS

This paper investigates whether rent-seeking encourages or discourages productivity. In a third-market model, we show that the relationship between rent-seeking and productivity depends on two forces. On the one hand, rent-seeking augments the marginal benefit of R&D, leading to a higher level of investment in R&D. On the other hand, the R&D activity enables the government to extract more rents from the firm, which weakens the firm's productivity.

Existing literature proposes a monotonic relationship between rent-seeking and productivity, while this paper shows evidence of a non-monotonic relationship. This result may explain the mixed empirical evidence, and it also suggests that the level of corruption is essential in testing the impacts of rent-seeking on economic performance.

Our model can be extended in several directions. For example, we can consider that the products are differentiated. Although the degree of substitution between the products alters the threshold value of θ, $\hat{\theta}$, the non-monotonic relationship is expected to remain. In addition, we can specify price competition rather than quantity competition between firms. These issues deserve more attention in future research.

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[17]Grossmann and Steger (2008) use a black-box approach to deal with lobbying, in which the government does not play a role. Their results depend on an exogenous parameter that describes the rent-seeking efficiency. Júlio (2014) employs a bargaining approach to conduct lobbying, while the distribution of the surplus between the firms and the policy-maker depends on an exogenous parameter.

[18]This idea comes from Acemoglu and Verdier (1998).

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APPENDIX

1. THE DERIVATION OF (32)

Let us examine the impacts of c^* on the profit of the foreign firm in detail. The first term on the right-hand side of (31) describes how a change in c^* affects $\bar{y}$, which in turn alters the foreign firm's operating profit. This term is equal to zero, as implied by the foreign firm's first-order condition of profit-maximization, (4).

The second and third terms state how a change in c^* affects $\bar{x}$, which in turn alters Π^*. A change in c^* affects $\bar{x}$ directly (given the level of s^*) and indirectly (through changing s^*). The second term describes the direct way. It indicates that, given the level of the export subsidies, a decline in c^* reduces $\bar{x}$ as indicated in (7). A smaller $\bar{x}$ enhances the foreign firm's operating profit, which can be seen from the fact that $\partial\Pi^*/\partial x = \hat{y}p' = -\hat{y}$, where $\hat{y}$ is given by (25).

Combining the result that $\partial\bar{x}/\partial c^* = 1/3$ with the fact that $\partial\Pi^*/\partial x = -\hat{y}$ gives the second term as $-\hat{y}/3 < 0$. This term indicates that a reduction in c^* increases the foreign firm's profit, leading the firm to invest more in R&D.

The third term states that a change in c^* affects $\bar{s}^*$, which in turn alters $\bar{x}$ and Π^*.

How c^* affects $\bar{s}^*$ can be obtained by differentiating $\bar{s}^*$ with respect to c^*, which gives

$$\frac{\partial\bar{s}^*}{\partial c^*} = \frac{4\theta - 3}{5 - 12\theta} < 0. \tag{44}$$

Recall that the stability condition requires θ be less than 5/12, so $\partial\bar{s}^*/\partial c^*$ is negative. This indicates that a lower c^* induces the foreign government to set a higher export subsidy. Since a lower c^* enlarges the marginal profit from selling y, the foreign government has a stronger incentive to raise the export subsidy. Together with (44) and the fact that $\partial\Pi^*/\partial x = -\hat{y}$ and $\partial\bar{x}/\partial s^* = -1/3$, the third term is equal to $(4\theta - 3)\hat{y}/[3(5 - 12\theta)] < 0$. Likewise, this force induces the foreign firm to incur more expenditure on R&D.

The fourth term depicts the impact of a change in c^* on Π^*, which is equal to $-\hat{y}$. Like the previous two forces, this one enlarges the foreign firm's investment in R&D. The combination of the second, third, and fourth terms is the marginal benefit of R&D.

2. THE DERIVATION OF (39)

The first term on the right-hand side of (38) is equal to zero, because x has been chosen to maximize the operating profit. The second term reflects how a change in c affects y, which in turn alters Π. This term contains two parts: $\partial y/\partial c$, which is equal to 1/3, and $\partial\Pi/\partial y$, which is equal to $-\hat{x}$. The equilibrium x in this stage is given by (24). Thus, the second term is negative, and it encourages the domestic firm to expand the investment in R&D.

The third term describes how a change in c affects $\bar{s}$, which in turn alters y and the domestic firm's profits. The impact of c on $\bar{s}$ is obtained by differentiating (22) with respect to c, which gives:

$$\frac{\partial \bar{s}}{\partial c} = -\frac{3(1+4\theta)}{5-12\theta}. \tag{45}$$

The denominator is positive, as required by the stability condition. As a result, (45) is negative, indicating that a lower c will induce the government to set a higher export subsidy. In addition, $\partial\Pi/\partial y = -\hat{x}$, as indicated before, and $\partial y/\partial s = -1/3$. Combining these results shows that the third term is negative, and it induces the firm to choose a lower c.

The fourth term measures the cost saving due to a lower c, which is equal to $-\hat{x}$. Thus, this force also encourages the domestic firm's R&D activity. Combining all of the above results gives rise to (39).

3. THE RELATIONSHIP BETWEEN THE MARGINAL BENEFIT FROM R&D OF THE TWO FIRMS

The second terms in (31) and (38) are equal to $-\hat{x}/3$ and $-\hat{y}/3$, respectively. When the two firms have the same marginal production cost, $\hat{x}-\hat{y} = [8(A-c^*)\theta]/(5-12\theta) > 0$, and thus $\hat{x}$ is greater than $\hat{y}$. This force in the domestic firm is greater than that in the foreign firm.

We then turn to the third terms in (31) and (38). Given $c = c^*$, subtracting the third term in (31) from that in (38) gives: $[8(A-c^*)\theta(4\theta-7)]/[3(5-12\theta)^2]$. The stability condition ensures that the numerator of the above term is negative. This means that the third term in (38) (in absolute terms) is greater than that in (31).

Next, the fourth term in (38) is $-\hat{x}$, and that of (31) is $-\hat{y}$. As indicated above, with $c = c^*$, $\hat{x} > \hat{y}$, so that the fourth term in relation to the domestic firm is greater than that for the foreign firm.

To sum up, the domestic firm is dominant in all of the three effects, and thus it has a larger marginal benefit from R&D.