Research Article

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Lobbying for Tariff Protection, International Technology Licensing and Consumer Surplus

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Abstract: It is well known that the protectionist view for tariff protection can be justified if the tariff induced international technology licensing benefits the consumers. We show that this view may not hold true if the domestic firm lobbies for tariff protection. If lobbying determines tariff following the "tariff-function formation" approach, lobbying reduces consumer surplus by reducing the incentive for licensing. However, if lobbying determines tariff following the "political contribution" approach, lobbying increases the incentive for licensing but creates an ambiguous effect on consumer surplus. Hence, whether the protectionist view for tariff protection can be justified under international technology licensing depends on the way the tariff rates are determined.

Keywords: consumer; lobbying; technology licensing; tariff

JEL Classification: D43; D72; F13; L13

1 Introduction

The text book view suggests that tariff protection makes the domestic consumers worse off by distorting the firms' choice of outputs. However, in an interesting paper,

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Kabiraj and Marjit (2003) argued that tariff protection may benefit the domestic consumers by attracting superior foreign technologies through international technology licensing.[1] Hence, they suggest that the protectionist view for tariff protection can be justified if the tariff induced international technology licensing benefits the consumers.[2] We show that this conclusion may not hold true if the tariff rate is influenced by lobbying by the domestic firm. Hence, whether the protectionist view for tariff protection can be justified under international technology licensing depends on the way the tariff rates are determined.

While the literature on international technology licensing under endogenous tariff protection provides important insights, it is restrictive due to its attention on welfare-maximising governments.[3] It is widely recognised that trade policies are often influenced by many special interest groups (Bhagwati 2000; Cai and Li 2014; Findlay and Wellisz 1982; Gawande, Krishna, and Olarreaga 2012; Grossman and Helpman 1994; Hillman 1989; Kayalica and Lahiri 2007; Long and Soubeyran 1996; Magee, Brock, and Young 1989; Mayer 1984; Mitra 1999; Weymouth 2012, to name a few) and domestic firms often lobby for tariff protection. Given this background, we examine how lobbying for tariff protection by the domestic firm affects international technology licensing and the corresponding consumer surplus.

To show the implications of lobbying by the domestic firm for tariff protection, we consider the non-committed tariff game of Kabiraj and Marjit (2003), where they

1 Arora, Fosfuri, and Gambardella (2001) mentioned that more than 15,000 technology licensing transactions occurred worldwide during 1985 and 1997 with an average worth of $25 billion per year. As per The Economist (2005), technology licensing worldwide was worth around $1000 billion and the US alone accounted for around $45 billion. See also Vishwasrao (2007), Ghosh and Saha (2008, 2015), Kim (2009) and Maskus and Saggi (2014) for information on international technology licensing.

2 See also Mukherjee (2002), Mukherjee and Pennings (2006) and Ghosh and Saha (2008, 2015) for papers showing tariff inducing technology licensing.

3 Dinda and Mukherjee (2011) consider a vertical technology transfer under international outsourcing in the presence of a welfare-maximising tax policy of the host country. Wang, Mukherjee, and Zeng (2020) show how technology licensing affects the privatisation policy.

There is a vast literature on technology licensing where governments are not active agents. As a representative sample, one may look at Kamien et al. (1992), Kamien et al. (1988, 1992), Gallini and Winter (1985), Katz and Shapiro (1985), Gallini and Wright (1990), Marjit (1990), Rockett (1990), Muto (1993), Saggi (1996, 1999), Yang and Maskus (2001), Faulí-Oller and Sandonís (2002, 2003), Glass and Saggi (2002), Sen (2005), Mukherjee (2001), Mukherjee and Balasubramanian (2001), Poddar and Sinha (2004), Arya and Mitendorf (2006), Sen and Tauman (2007), Mukherjee, Broll, and Mukherjee (2008), Stamatopoulos and Tauman (2009), Chang, Hwang, and Peng (2013), Mukherjee and Mukherjee (2013), Bagchi and Mukherjee (2014, 2020), Avagyan, Esteban-Bravo, and Vidal-Sanz (2014), Duchêne, Sen, and Serfes (2015), Sen and Stamatopoulos (2016), Sen and Bhattacharya (2017), Lu, Banerjee, and Poddar (2019) and Wu (2019).

consider the following situation.[4] There is a technologically superior[5] foreign firm and a technologically inferior domestic firm competing in the domestic country. At stage 1, the foreign firms decides whether to license its technology to the domestic firm against a fixed-fee.[6] At stage 2, the domestic government imposes a per-unit tariff on the foreign firm's output to maximise welfare of the domestic country. At stage 3, they compete in the product market like Cournot duopolists.

The motivation for considering the non-committed tariff game comes from the time inconsistency problem. As Staiger and Tabellini (1987) mentioned, governments with some degree of discretion in policy may find it difficult to commit. The time inconsistency problem is considered in many contexts, such as in trade and industrial policy (Kabiraj and Marjit 2003; Mukherjee and Pennings 2006; Neary and Leahy 2000), investment subsidies (Harstad 2020), environment policy (García, Leal, and Lee 2018; Iida and Mukherjee 2020), monetary policy (Barro and Gordon 1983; Berlemann 2005; Kydland and Prescott 1977; Minford 1995), euro crisis (Willett and Srisorn 2014), utility regulation (Lim and Yurukoglu 2018), bank closure (Acharya and Yorulmazer 2007) and consumer's preference (Sayman and Öncüler 2009). In our context, even if the domestic firm can lobby before the licensing contract, its opportunistic behaviour ex-post licensing to gain a higher market share may create the motivation for the non-committed policy. As the welfare maximising government in Kabiraj and Marjit (2003) has the incentive for changing the tariff rate ex-post licensing, the domestic firm in our analysis can change the lobbying effort ex-post licensing to raise the tariff rate for extracting a higher market share from the foreign firm.

Although we consider the non-committed tariff game like Kabiraj and Marjit (2003), we differ from them in the way the tariff rate is determined. Unlike their

4 They have shown that even if the domestic government could commit to a tariff rate, there is a time inconsistency problem as the government prefers to change the tariff rate ex-post licensing. Hence, the non-committed tariff game is more appropriate to consider due to the time inconsistency problem.

5 In this paper, the marginal cost of production specifies the technology of a firm and a lower marginal cost of production implies better technology.

6 There are several other papers, such as Katz and Shapiro (1985), Marjit (1990), Kabiraj and Marjit (1993), Mukherjee (2001) and Yang and Maskus (2009), to name a few, considered fixed-fee licensing contracts in closed and open economies. Even if patent protection prevents duplication of innovation, imitation or "inventing around" with a non-infringing innovation is possible under technology licensing. Inventing around the licensed technology by the licensee or lack of information needed for a royalty provision may be the reason for charging a fixed fee licensing contract (see, e.g., Katz and Shapiro 1985; Rockett 1990). The use of a fixed-fee only in the licensing contract is also empirically relevant. For example, 13 % of the firms surveyed by Rostoker (1984) used fixed-fee alone. Vishwasrao (2007) collected data on all foreign technology licensing agreements by the manufacturing firms in India during 1989–1993, and found that 968 contracts, which was 45 % of all licensing agreements, used fixed-fee only during 1991–1993.

paper, which considers welfare-maximising tariff rate, we consider that the tariff rate is influenced by lobbying by the domestic firm.[7] Lobbying by the domestic firm only can be justified by Kayalica and Lahiri (2007) and Bandyopadhyay, Lahiri, and Wall (2012), which suggest that in many countries, it is legal for political parties to accept political contributions from the nationals of that country, but it is illegal to accept foreign contributions, and it is illegal in some countries to bribe abroad.

We consider two separate political economy models of lobbying – first, the "tariff-function formation" approach of Findlay and Wellisz (1982) and Long and Soubeyran (1996), and second, the widely used "political contribution" approach of Grossman and Helpman (1994). The first approach does not give consideration to welfare. Hence, it considers tariff formation in a way that is significantly different from the welfare-maximising tariff protection considered by Kabiraj and Marjit (2003). Thus, this model helps us to show the importance of the process of tariff formation in the simplest way. The second approach cares both welfare and political contribution, thus showing the implications of lobbying when the government also cares about domestic welfare.

We derive the following results. Whether we consider the "tariff-function formation" approach or the "political contribution" approach, the tariff rate is higher under licensing compared to no licensing. However, these models have different effects on the incentive for licensing and consumer surplus. The incentive for licensing is lower under lobbying compared to no lobbying under the "tariff-function formation" approach, while it is higher under the "political contribution" approach. While lobbying (compared to no lobbying) reduces consumer surplus under the "tariff-function formation" approach, the effect is ambiguous under the "political economy" approach. Hence, lobbying and the way it affects tariff protection may play an important role in determining the incentive for licensing and the corresponding consumer surplus.

Our results are strikingly different from Kabiraj and Marjit (2003). They show that welfare-maximising tariff protection benefits the consumers in the importing country by inducing technology licensing, thus suggesting that if free trade cannot attract foreign technologies, restrictive trade policies help to attract foreign technologies and benefits the consumers. In contrast, we show that tariff protection through lobbying may reduce the incentive for technology licensing and consumer surplus. Even if tariff protection through lobbying increases technology licensing,

7 For the evidence of lobbying for protection in the developing countries, one may look at Saha (2019, 2020) for India, http://www.ft.lk/front-page/Protected-sectors-depend-on-lobbying--IMF/44-657777 for Sri Lanka and https://www.cnbc.com/2019/09/06/reuters-america-exclusive-china-sugar-industry-to-lobby-government-for-extension-of-hefty-tariffs-on-imports-sources.html for China.

it may still reduce consumer surplus. *Hence, if technology licensing does not occur under free trade, it is not necessary that tariff protection will induce international technology licensing and will improve consumer surplus.* Therefore, one needs to be more cautious about the way tariff is determined when considering the effect of tariff induced international technology licensing.

When tariff protection induces technology licensing in our paper, the mechanism is different from Kabiraj and Marjit (2003). Technology licensing in their analysis reduces the tariff rate and therefore, benefits the foreign licenser by reducing its tariff inclusive cost. In contrast, tariff protection in our paper increases the incentive for licensing when it is higher under licensing. Higher tariff protection under licensing helps to increase the competitiveness and the profit of the domestic firm and the foreign firm can use the licensing fee to extract this benefit from the domestic firm.

To the best of our knowledge, there is no empirical research analysing how lobbying for tariff protection affects product-market competition and international technology licensing. Our results provide testable hypothesis for future empirical research on international technology licensing in the presence of lobbying for tariff protection.

The remainder of the paper is organised as follows. Section 2 describes the model and considers licensing under free trade. Section 3 considers licensing under the tariff-formation function approach of lobbying. Section 4 considers licensing under the political contribution approach of lobbying. Section 5 concludes.

2 The Model and the Results

Assume that there are two firms, a foreign firm (firm F) and a domestic firm (firm D). The foreign firm exports to the domestic country from the foreign country and the firms compete in the domestic country like Cournot duopolists with homogeneous goods. Assume that the constant marginal costs of productions for the domestic and foreign firms are c_d and $c_f(c_d > c_f)$ respectively. For simplicity, consider $c_f = 0$ and $c_d = c$. Assume for simplicity that there is no transportation cost of exporting.

Assume that the inverse market demand function is

$$P = a - q, \tag{1}$$

where P is price and q is the total output. We assume that $c < \frac{a}{2} \equiv c^{\max}$ to ensure that both firms always produce positive outputs under no lobbying.

2.1 Licensing under Free Trade

Under free trade, implying that there is neither any lobbying nor any welfare-maximizing tariff policy, we consider the following game. At stage 1, the foreign firm decides whether to license the technology. If it decides to license the technology, like Kabiraj and Marjit (2003), it charges an up-front non-negative[8] fixed fee for the technology. At stage 2, the domestic firm decides whether to accept the licensing contract. The domestic firm accepts the licensing contract if it is not worse off compared to the situation with no licensing. At stage 3, the firms compete like Cournot duopolists and the profits are realised. We solve the game through backward induction.

If there is no licensing, firms D and F respectively maximise the following expressions to maximise their outputs:

$$\underset{q_d}{\text{Max}}(a-q-c)q_d \tag{2}$$

$$\underset{q_f}{\text{Max}}(a-q)q_f, \tag{3}$$

where $q = q_d + q_f$. We get the equilibrium outputs of firms D and F under no licensing as $q_{d,ft} = \frac{a-2c}{3}$ and $q_{f,ft} = \frac{a+c}{3}$. The corresponding equilibrium profits are $\pi_{d,ft,n} = \left(\frac{a-2c}{3}\right)^2$ and $\pi_{f,ft,n} = \left(\frac{a+c}{3}\right)^2$.

If there is licensing, we get the equilibrium values by considering $c = 0$ in the above-mentioned expressions. The equilibrium outputs and profits of firms D and F are respectively $q_{d,ft,l} = \frac{a}{3}$, $q_{f,ft,l} = \frac{a}{3}$, $\pi_{d,ft,l} = \left(\frac{a}{3}\right)^2 - K$ and $\pi_{f,ft,l} = \left(\frac{a}{3}\right)^2 + K$, where K is the fixed-fee paid by firm D to firm F for the licensed technology.

Licensing is profitable if it does not make any of these firms worse off but makes at least one of them better off compared to no licensing. Hence, licensing is profitable if $\pi_{d,ft,l} = \left(\frac{a}{3}\right)^2 - K > \pi_{d,ft,n} = \left(\frac{a-2c}{3}\right)^2$ or $\left(\frac{a}{3}\right)^2 - \left(\frac{a-2c}{3}\right)^2 > K$ and $\pi_{f,ft,l} = \left(\frac{a}{3}\right)^2 + K > \pi_{f,ft,n} = \left(\frac{a+c}{3}\right)^2$ or $K > \left(\frac{a+c}{3}\right)^2 - \left(\frac{a}{3}\right)^2$. Both the conditions are satisfied if $\left(\frac{a}{3}\right)^2 - \left(\frac{a-2c}{3}\right)^2 > K > \left(\frac{a+c}{3}\right)^2 - \left(\frac{a}{3}\right)^2$, which can happen if $\left(\frac{a}{3}\right)^2 - \left(\frac{a-2c}{3}\right)^2 > \left(\frac{a+c}{3}\right)^2 - \left(\frac{a}{3}\right)^2$ or $2\left(\frac{a}{3}\right)^2 > \left(\frac{a+c}{3}\right)^2 + \left(\frac{a-2c}{3}\right)^2$, i.e. if licensing increases the industry profit compared to no licensing. In this situation, the licenser can charge a price for its technology that makes neither firm worse off but makes at least one of them better off under licensing compared to no licensing.

8 It is usual in the literature to consider non-negative fixed-fee, since a negative fixed-fee helps the firms to collude, which can be prevented by the antitrust authorities.

We get that licensing is profitable if $\Omega_l = \pi_{d,ft,l} + \pi_{f,ft,l} > \pi_{d,ft,n} + \pi_{f,ft,n} = \Omega_n$ or $c < \frac{2a}{5} \equiv c'$, which is similar to the condition provided in Marjit (1990) and Kabiraj and Marjit (2003) under free trade.

The above discussion gives the following result immediately.

Proposition 1. *If there is no lobbying, technology licensing with a non-negative fixed-fee is profitable, meaning none of these firms is worse off and at least one of them is better off under licensing compared to no licensing, if* $c < \frac{2a}{5} \equiv c'$.

On the one hand, licensing increases production efficiency in the industry, but on the other hand, it increases product-market competition by making the licensee more competitive. If the cost difference between the firms is very high, it creates a near monopoly of the licenser under no licensing, and makes licensing unprofitable by reducing the industry profit. However, if the initial technologies of the firms are very similar, licensing increases production efficiency in the industry sufficiently to make it profitable.

3 Licensing under Lobbying: Tariff-Formation Function Approach

Now consider lobbying by the domestic firm for tariff protection. In this section, we consider the tariff-formation function approach, as in Findlay and Wellisz (1982) and Long and Soubeyran (1996), where a tariff level is determined as a stable function of the resources committed to the political process by the interest group. This approach follows Findlay and Wellisz (1982) and Long and Soubeyran (1996), and as mentioned above, it helps to show the implications of lobbying by ignoring welfare-maximising tariff, thus considering tariff formation in a way that is significantly different from Kabiraj and Marjit (2003). We will consider the political contribution approach of Grossman and Helpman (1994) in Section 4.

Assume that the foreign firm faces a tariff $t(e)$ per unit of its output where e is the domestic firm's lobbying expenditure with $t(0) = 0$, $t' > 0$, and $t'' \leq 0$. Hence, the domestic government supports free-trade in the absence of lobbying. However, lobbying is costly and the domestic firm has to incur a cost $R(e)$ for lobbying with $R(0) = 0$, $R' > 0$ and $R'' > 0$. This formulation is similar to Long and Soubeyran (1996).

The reason for a convex lobbying cost can be attributable to the loss of resources, such as labour force, for productive activities, as in Findlay and Wellisz (1982). Labour could be used for lobbying and other productive activities. If the domestic firm increases lobbying, it needs more labour for that activity, implying

that it has less labour for other productive activities. As the domestic firm uses more and more labour for lobbying, it has less and less labour for other productive activities, which reduces other activities at an increasing rate due to the diminishing marginal productivities of labour in other activities, thus increasing the cost of lobbying at an increasing rate. In other words, as the labour for lobbying increases, the opportunity cost of lobbying increases at an increasing rate.

The property of *t(e)* could be explained in the following way. As the domestic firm increases lobbying, it may not change the government official's incentive for imposing further tariff, implying that the rate of change of tariff following lobbying remains constant in this situation. Alternatively, the domestic firm may find it harder to convince the government official for increasing the tariff rate when it already increased the tariff rate following lobbying; in this situation, the rate of change of tariff following lobbying reduces.

It is worth mentioning that our result will hold with different assumptions for t'' and R'', as long as the second order condition for the domestic firm's profit maximising lobbying effort holds.

We consider the following game in this section. At stage 1, the foreign firm decides whether to license the technology. At stage 2, the domestic firm decides whether to accept the licensing contract. The domestic firm accepts the licensing contract if it is not worse off compared to the situation with no licensing. At stage 3, the domestic firm lobbies for tariff on the foreign firm's output. At stage 4, the firms compete like Cournot duopolists and the profits are realised. We solve the above game through backward induction.

We consider a situation where the domestic firm lobbies after the technology licensing decision. It is a reasonable sequence to consider since, after the licensing decision, the domestic firm has the incentive to increase its profit by making the foreign firm less competitive by lobbying for a tariff protection.[9]

First, consider the game under no licensing. Given the tariff rate created by the lobbying expenditure, firms D and F maximise the following expressions to determine the respective outputs in stage 4:

$$\underset{q_d}{\text{Max}}(a - q - c)q_d \tag{4}$$

$$\underset{q_f}{\text{Max}}(a - q - t(e))q_f. \tag{5}$$

9 The sequence of moves we are considering is similar to the non-committed government policies considered in several papers in different contexts, such as Staiger and Tabellini (1987), Al-Saadon and Das (1996), Mukherjee (2000), Neary and Leahy (2000), Mukherjee and Pennings (2006), Poyago-Theotoky (2007), Golombek et al. (2010) and Dijkstra, Mathew, and Mukherjee (2011).

We get the equilibrium outputs of firms D and F under no licensing as $q_{d,lo} = \frac{a-2c+t(e)}{3}$ and $q_{f,lo} = \frac{a-2t(e)+c}{3}$. We assume that both firms produce positive outputs under lobbying.[10] The corresponding equilibrium profits are $\pi_{d,lo} = \left(\frac{a-2c+t(e)}{3}\right)^2$ and $\pi_{f,lo} = \left(\frac{a-2t(e)+c}{3}\right)^2$.

At stage 3, the domestic firm chooses the lobbying expenditure to maximize the following expression:

$$\pi_{d,lo} = \left(\frac{a-2c+t(e)}{3}\right)^2 - R(e). \tag{6}$$

The equilibrium lobbying expenditure is given by

$$\frac{2(a-2c+t(e))}{9}t'(e) = R'(e). \tag{7}$$

Assume that the second order condition for maximization is satisfied, i.e. $\left[\frac{2}{9}t'^2 + \frac{2}{9}(a-2c+t)t'' - R''\right] = Z < 0$. Define the equilibrium lobbying expenditure under no licensing by e_n^*. Hence, the equilibrium tariff under no licensing is $t(e_n^*)$.

The equilibrium profits of the domestic and foreign firms under no licensing are respectively $\pi_{d,lo,n} = \frac{(a+t(e_n^*)-2c)^2}{9} - R(e_n^*)$ and $\pi_{f,lo,n} = \frac{(a-2t(e_n^*)+c)^2}{9}$, and the corresponding equilibrium industry profit is

$$\Omega_{lo,n} = \frac{(a+t(e_n^*)-2c)^2}{9} + \frac{(a-2t(e_n^*)+c)^2}{9} - R(e_n^*). \tag{8}$$

Next, consider the situation under licensing. If both firms produce positive outputs under licensing, the equilibrium outputs and profits under licensing can be found by setting $c = 0$ in the equilibrium values under no licensing. The equilibrium outputs of the domestic and foreign firms are $q_{d,lo,l} = \frac{a+t(e_l^*)}{3}$ and $q_{f,lo,l} = \frac{a-2t(e_l^*)}{3}$ respectively, where e_l^* shows the equilibrium lobbying expenditure under licensing and $t(e_l^*)$ is the corresponding equilibrium tariff rate. The corresponding

10 It is trivial to understand that if lobbying creates domestic monopoly, the foreign firm will license the technology, implying that lobbying in this situation will increase the incentive for licensing compared to no lobbying. Further, domestic monopoly with the foreign technology can reduce consumer surplus compared to the situation with free trade and no licensing, due to the monopoly distortion created under lobbying. Since the case of domestic monopoly does not add much to our analysis, we concentrate on the situation where both firms always produce positive outputs. This is also directly comparable to Kabiraj and Marjit (2003).

equilibrium profits are $\pi_{d,lo,l} = \frac{(a+t(e_l^*))^2}{9} - R(e_l^*) - K$ and $\pi_{f,lo,l} = \frac{(a-2t(e_l^*))^2}{9} + K$. The equilibrium industry profit under licensing is:

$$\Omega_{lo,l} = \frac{(a + t(e_l^*))^2}{9} + \frac{(a - 2t(e_l^*))^2}{9} - R(e_l^*). \tag{9}$$

Proposition 2. *If both firms produce positive outputs, the domestic firm's lobbying expenditure and the tariff rate are higher under licensing compared to no licensing.*

Proof. Differentiating (7) with respect to c gives $\frac{\partial e}{\partial c} = \frac{4t'}{9Z}$. Therefore, $\frac{\partial e}{\partial c} < 0$ as $t' > 0$ and $Z < 0$. Since licensing reduces c, and the lobbying expenditure and the tariff rate increase with a lower c, licensing increases the lobbying expenditure and the tariff rate compared to no lobbying. □

If the marginal cost of production of the domestic firm decreases, it gives the domestic firm a higher market share and, therefore, higher profit for any given lobbying expenditure, which, in turn, induces the domestic firm to increase the lobbying expenditure. Hence, licensing increases the equilibrium lobbying expenditure and the equilibrium tariff rate compared to no licensing by reducing the marginal cost of the domestic firm.

For a clear exposition with the closed form solutions, we take the lobbying function and the cost of lobbying as

$$t(e) = Be \text{ and } R(e) = Ae^2. \tag{10}$$

Hence, $B = 0$ will replicate the situation under no lobbying.

We assume $B > 0$ and $A > \frac{B^2}{3}$, which ensure that both firms produce positive outputs irrespective of licensing. We avoid corner solutions, since that will not add much to our main point. The parameter B represents the effectiveness of lobbying in creating the tariff rate. The parameter B will be high if the government official is lenient in setting the tariff rate following domestic firm's lobbying effort. However, the term B will be low if the government official is not very responsive to the domestic firm's lobbying effort.

Given the functions in (10), the equilibrium tariff rates and the lobbying expenditures under no licensing and licensing are respectively

$$t(e_n^*) = e_n^* = \frac{B^2(a - 2c)}{9A - B^2} \tag{11}$$

$$t(e_l^*) = Be_l^* = \frac{B^2 a}{9A - B^2}. \tag{12}$$

Therefore, the costs of lobbying under no licensing and licensing are respectively

$$R\left(e_n^*\right) = \frac{AB^2(a-2c)^2}{\left(9A-B^2\right)^2} \tag{13}$$

$$R\left(e_l^*\right) = \frac{AB^2a^2}{\left(9A-B^2\right)^2}. \tag{14}$$

The equilibrium outputs of firms D and F under no licensing are respectively $q_{d,lo,n} = \frac{3A(a-2c)}{9A-B^2} > 0$ and $q_{f,lo,n} = \frac{a(3A-B^2)+c(3A+B^2)}{9A-B^2} > 0$. The equilibrium industry profit under no licensing is $\Omega_{lo,n} = \frac{a^2\left(18A^2-7AB^2+B^4\right)-2a\left(9A^2-2AB^2+B^4\right)c+\left(45A^2+2AB^2+B^4\right)c^2}{\left(9A-B^2\right)^2}$.

The equilibrium outputs of firms D and F under licensing are respectively $q_{d,lo,l} = \frac{3Aa}{9A-B^2} > 0$ and $q_{f,lo,n} = \frac{a(3A-B^2)}{9A-B^2} > 0$. The equilibrium industry profit under licensing is $\Omega_{lo,l} = \frac{a^2\left(18A^2-7AB^2+B^4\right)}{\left(9A-B^2\right)^2}$.

Due to the reason mentioned in subsection 2.1, technology licensing is profitable if $\Omega_{lo,l} > \Omega_{lo,n}$,[11] or

$$c < \frac{2a\left(9A^2-2AB^2+B^4\right)}{45A^2+2AB^2+B^4} \equiv c'', \tag{15}$$

where $c'' < c'$,[12] implying that lobbying reduces the incentive for licensing when both firms produce positive outputs under no licensing and licensing, which gives the following result immediately.

Proposition 3. *Given the demand function, cost function, $t(e) = Be$, $R(e) = Ae^2$, and $A > \frac{B^2}{3} > 0$, if both firms produce positive outputs under no licensing and licensing, technology licensing with a non-negative fixed-fee occurs for $c < \frac{2a\left(9A^2-2AB^2+B^4\right)}{45A^2+2AB^2+B^4} \equiv c''$. Since $c'' < c'$, lobbying in this situation reduces the possibility of licensing compared to no lobbying.*

The reason for the above result is as follows. There are two opposing effects of lobbying on the incentive for licensing compared to free trade that occurs under no lobbying in this section. First, if the foreign firm faces the same tariff rate irrespective of the licensing decision, it increases the possibility of licensing by reducing the cost difference between the firms.[13] This is similar to Kabiraj and Marjit (2003). Second, higher lobbying effort and higher tariff rate under licensing compared to

11 Note that $\Omega_{lo,n}$ and $\Omega_{lo,l}$, mentioned in (8) and (9) respectively, include the cost of lobbying.

12 $c'' = c'$ at $A = \frac{B^2}{3}$ and at $B = 0$.

13 If the foreign firm faces the same tariff rate under licensing and no licensing, the benefit from licensing is given by $\left(\frac{a+t}{3}\right)^2 + \left(\frac{a-2t}{3}\right)^2 - \left(\frac{a-2c+t}{3}\right)^2 - \left(\frac{a-2t+c}{3}\right)^2$ and it increases with t.

no licensing tends to reduce the benefit from licensing. On the balance, the second effect dominates the first effect and lobbying reduces the incentive for licensing.

3.1 The Implications of Lobbying on the Consumers

It is easy to understand that if licensing occurs either irrespective of lobbying or only without lobbying, lobbying reduces consumer surplus compared to no lobbying since lobbying reduces the industry output by imposing a tariff.

The following proposition is immediate from the above discussion.

Proposition 4. *The consumers are worse off under lobbying compared to no lobbying, irrespective of the effects of lobbying on licensing.*

Although lobbying reduces consumer surplus compared to no lobbying, it can be shown that lobbying may increase domestic welfare compared to no lobbying. The tariff revenue earned by the domestic government plays an important role for it. As an example, consider the case where $a = A = B = 1$ and licensing occurs under both no lobbying and lobbying. Considering that the foreign firm can extract the entire gain from licensing, i.e. ensuring that the domestic firm's profit under licensing is equal to its profit under no licensing, we get the domestic welfare under no lobbying as $W^{NLO,L} = \frac{1}{9}(3 - 4(1-c)c)$ and that of under lobbying as $W^{LO,L} = \frac{45}{128} - \frac{1}{2}(1-c)c$. Since $c'' = \frac{2a\left(9A^2 - 2AB^2 + B^4\right)}{45A^2 + 2AB^2 + B^4} = \frac{1}{3}$ for these parameter values, we consider $c \in (0, \frac{1}{3})$. We find that $W^{LO,L} - W^{NLO,L} = \frac{45}{128} - \frac{1}{2}(1-c)c - \frac{1}{9}(3 - 4(1-c)c) = \frac{7}{384} - \frac{1}{18}(1-c)c > 0$ for $c \in (0, \frac{1}{3})$. If the domestic firm earns more under licensing compared to no licensing, the domestic welfare will increase further under licensing compared to no licensing.

It can be shown also that lobbying increases welfare compared to no lobbying even if licensing occurs only under no lobbying.

4 Licensing under Lobbying: Political Contribution Approach

We considered in Section 3 a situation where tariff determination through lobbying did not care about welfare. Although it helped to show that the implications of tariff on technology licensing and consumer surplus can differ significantly when tariff is not determined to maximise welfare, a more general framework may need to focus also on welfare when lobbying by the domestic firm influences the tariff rate. To do

this, we consider in this section the widely used political contribution approach of Grossman and Helpman (1994), where the government maximises the tariff rate by giving weights on both welfare and political contributions.

Following Grossman and Helpman (1994), we consider that the domestic government maximises

$$H = L + \alpha(\pi_{d,lo} + CS + T) \equiv L + \alpha W, \tag{16}$$

where $W = (\pi_{d,lo} + CS + T)$, L is the domestic firm's political contribution, $\pi_{d,lo}$ is the domestic firm's gross profit (i.e. profit including the political contribution), CS is domestic consumer surplus and T is the tariff revenue.[14] We assume $\alpha > 2$ to ensure that both firms produce positive outputs irrespective of licensing.[15]

Following Grossman and Helpman (1994), we consider feasible and coalition-proof truthful political contribution by the domestic firm, implying that the domestic firm's political contribution is non-negative and can't be more than its profit, and it satisfies the following two conditions:

$$\underset{t}{\text{Max}}\ (\pi_{d,lo} - L) + H, \tag{17}$$

$$L^* = \alpha\left(\widehat{W} - W^*\right), \tag{18}$$

where $(L^* + \alpha W^*)$ is the maximum value of $(L + \alpha W)$ with respect to t and $\alpha\widehat{W}$ is the maximum value of αW with respect to t (i.e. when the domestic firm does not lobby and the government determines the welfare-maximising tariff).

As suggested in Grossman and Helpman (1994), condition (17) suggests that, given the political contribution of the domestic firm, the government policy must maximise the joint welfare of the domestic firm and the government, because, if that is not the case, the domestic firm can adjust its contribution to induce the government to choose the jointly optimal tariff and can appropriate some of the surplus generated from the switch in government policy.

Condition (18) suggests that to induce the government to change the policy by accepting the domestic firm's contribution, in equilibrium, the domestic firm needs to give the government at least the same level of utility that the government could

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14 As explained in Grossman and Helpman (1994), one can consider the government's objective function as $G = \alpha_1 L + \alpha_2(\pi_{d,lo} - L + CS + T)$, where α_1 is the weight on the political contribution of the domestic firm and α_2 is the weight on the net domestic welfare. Maximizing G is equivalent to maximizing H in (16) with $\alpha = \frac{\alpha_2}{\alpha_1 - \alpha_2}$ if $\alpha_1 > \alpha_2$, which is assumed to hold, i.e., the politicians value one pound to their political account more than to the hands of the public.

15 With reference to the previous footnote, $\alpha > 2$ implies $\alpha_2 > \frac{2\alpha_1}{3}$, which can be consistent with $\alpha_1 > \alpha_2$ for $\alpha_1 > \alpha_2 > \frac{2\alpha_1}{3}$.

get if it did not accept the domestic firm's contribution and determined the tariff to maximise αW.

Maximising (16) we get $\frac{\partial H}{\partial t} = 0$ and maximising (17), we get $\frac{\partial \pi_{d,lo}}{\partial t} - \frac{\partial L}{\partial t} + \frac{\partial H}{\partial t} = 0$. These two conditions give $\frac{\partial \pi_{d,lo}}{\partial t} = \frac{\partial L}{\partial t}$. Hence, we determine the tariff and the contribution by maximising H subject to $\frac{\partial \pi_{d,lo}}{\partial t} = \frac{\partial L}{\partial t}$ and (18).

Consider the following game in this section. At stage 1, the foreign firm decides whether to license the technology. At stage 2, the domestic firm decides whether to accept the licensing contract. The domestic firm accepts the licensing contract if it is not worse off compared to the situation with no licensing. At stage 3, the domestic firm decides on the political contribution. At stage 4, the domestic government determines the tariff on the foreign firm's output. At stage 5, the firms compete like Cournot duopolists and the profits are realised. We solve the above game through backward induction.

First consider the case under no licensing. If there is no licensing, at stage 5, given the political contribution and the tariff rate, firms D and F maximise the following expressions to determine the respective outputs:

$$\underset{q_d}{\text{Max}}(a - q - c)q_d - L \tag{19}$$

$$\underset{q_f}{\text{Max}}(a - q - t)q_f. \tag{20}$$

We get the equilibrium outputs of firms D and F under no licensing as $q_{d,lo} = \frac{a-2c+t}{3}$ and $q_{f,lo} = \frac{a-2t+c}{3}$. The corresponding equilibrium profits are $\pi_{d,lo} = \left(\frac{a-2c+t}{3}\right)^2 - L$ and $\pi_{f,lo} = \left(\frac{a-2t+c}{3}\right)^2$.

At stage 4, the government determines the tariff rate by maximising the following expression:

$$\underset{t}{\text{Max}}\, H = \underset{t}{\text{Max}}\, L + \alpha\left(\left(\frac{a-2c+t}{3}\right)^2 + \frac{1}{2}\left(\frac{2a-c-t}{3}\right)^2 + \frac{t(a-2t+c)}{3}\right). \tag{21}$$

subject to $\frac{\partial \pi_{d,lo}}{\partial t} = \frac{\partial L}{\partial t}$.

The equilibrium tariff rate is

$$t^*_{lo,n} = \frac{a(2+3\alpha) - 4c}{9\alpha - 2}. \tag{22}$$

Given the equilibrium tariff rate, the equilibrium outputs and profits are respectively $q^*_{d,lo,n} = \frac{2\alpha(2a-3c)}{9\alpha-2}$, $q^*_{f,lo,n} = \frac{a(\alpha-2)+c(2+3\alpha)}{9\alpha-2}$, $\pi_{d,lo,n} = \left(\frac{2\alpha(2a-3c)}{9\alpha-2}\right)^2 - L^*_{lo,n}$ and $\pi_{f,lo,n} = \left(\frac{a(\alpha-2)+c(2+3\alpha)}{9\alpha-2}\right)^2$, where $L^*_{lo,n}$ is derived below.

We get

$$\alpha W^*_{lo,n} = \frac{\alpha\left[a^2(-4+7\alpha(9\alpha-4))+4ac(4+3(4-9\alpha)\alpha)+3c^2(3\alpha-2)(9\alpha+2)\right]}{2(9\alpha-2)^2}. \tag{23}$$

The equilibrium political contribution of the domestic firm is given by $L^* = \alpha(\widehat{W} - W^*)$, as shown in (18), where $\alpha\widehat{W}$ is the maximum value of αW with respect to t. Maximising αW with respect to t, we get the welfare-maximising tariff rate in the absence of the domestic firm's political contribution. We find that $\widehat{t} = \frac{a}{3}$ maximises αW,[16] where $\widehat{t} = \frac{a}{3} < t^*_{lo,n} = \frac{a(2+3\alpha)-4c}{9\alpha-2}$, and the value of αW at $\widehat{t} = \frac{a}{3}$ is

$$\alpha\widehat{W}_n = \frac{\alpha(7a^2-12ac+9c^2)}{18}. \tag{24}$$

Hence, we get

$$L^*_{lo,n} = \alpha\left(\widehat{W}_n - W^*_{lo,n}\right) = \frac{8\alpha(2a-3c)^2}{9(9\alpha-2)^2}. \tag{25}$$

The equilibrium industry profits under no licensing is

$$\Omega_{lo,n} = \frac{a^2(36+17\alpha(9\alpha-4))-6ac(12+\alpha(63\alpha-4))+9c^2(4+\alpha(4+45\alpha))}{9(9\alpha-2)^2}. \tag{26}$$

Now consider the case under licensing, which can be found by considering $c = 0$ in the above-mentioned values.

The equilibrium tariff rate and the domestic firm's political contribution under licensing are respectively

$$t^*_{lo,l} = \frac{a(2+3\alpha)}{9\alpha-2} \tag{27}$$

$$L^*_{lo,l} = \alpha\left(\widehat{W}_n - W^*_{lo,n}\right) = \frac{32a^2\alpha}{9(9\alpha-2)^2} \tag{28}$$

We get the following result immediately from (22), (25), (27) and (28).

Proposition 5. *If both firms produce positive outputs, the domestic firm's equilibrium political contribution and the equilibrium tariff rate are higher under licensing compared to no licensing.*

The intuition for Proposition 5 is similar to that of under Proposition 2.

The equilibrium outputs and profits under licensing are respectively $q^*_{d,lo,l} = \frac{4a\alpha}{9\alpha-2}$, $q^*_{f,lo,l} = \frac{a(\alpha-2)}{9\alpha-2}$, $\pi_{d,lo} = \left(\frac{4a\alpha}{9\alpha-2}\right)^2 - L^*_{lo,l}$ and $\pi_{f,lo} = \left(\frac{a(\alpha-2)}{9\alpha-2}\right)^2$.

16 Since this value is independent of licensing, we do not use any subscript for this value.

The equilibrium industry profits under licensing is

$$\Omega_{lo,l} = \frac{a^2(36 + 17\alpha(9\alpha - 4))}{9(9\alpha - 2)^2}. \tag{29}$$

Now we are in a position to consider when licensing is profitable. Due to the reason mentioned in subsection 2.1, licensing will be profitable if $\Omega_{lo,l} - \Omega_{lo,n} > 0$. We get from (26) and (29) that $\Omega_{lo,l} - \Omega_{lo,n} = \frac{c\left[2a(12+\alpha(63\alpha-4))-3c(4+\alpha(4+45\alpha))\right]}{9(9\alpha-2)^2} > 0$ for $c < \frac{24a-8a\alpha+126a\alpha^2}{12+12\alpha+135\alpha^2} \equiv c^*$, where $\frac{a}{2} < c^*$, implying that licensing is profitable for any $c \in (0, \frac{a}{2})$.

The following result is immediate from the above discussion.

Proposition 6. *If both firms produce positive outputs under no licensing and licensing, technology licensing with a non-negative fixed-fee occurs for* $c < \frac{24a-8a\alpha+126a\alpha^2}{12+12\alpha+135\alpha^2} \equiv c^*$. *Since* $\frac{a}{2} < c^*$, *licensing is profitable for any* $c \in (0, \frac{a}{2})$ *and lobbying in this situation increases the possibility of licensing compared to free trade.*

Proposition 6 is different from Proposition 3. Like the previous section, which considered tariff-function formation approach, the domestic firm's cost of lobbying (the political contribution in this situation) and the tariff rate increase also in this section, where we consider the political contribution model. However, lobbying in this section increases the incentive for licensing.

Like the previous section, lobbying creates two opposing effects also in this section compared to free trade.[17] First, like Kabiraj and Marjit (2003), if the foreign firm faces the same tariff rate irrespective of the licensing decision, it increases the possibility of licensing by reducing the cost difference between the firms. Second, higher lobbying effort and higher tariff rate under licensing compared to no licensing tends to reduce the benefit from licensing. We find in this section that the first effect dominates the second effect and lobbying increases the possibility of licensing compared to free trade.

There is a difference between lobbying under the tariff-function formation approach, considered in the previous section, and the political contribution model, considered in this section. Under the tariff-function formation approach, the domestic firm's lobbying effort is entirely responsible for the tariff rate. In contrast, under the political contribution model, the domestic government determines the tariff rate, which is influenced by the domestic firm's political contribution, which needs

17 Note that no lobbying in this section does not mean free trade. If there is no lobbying in this section, we get the welfare-maximising tariff rate of $\widehat{t} = \frac{a}{3}$ and it follows from Kabiraj and Marjit (2003) that licensing occurs for $c \in \left(0, \frac{a}{2}\right)$ in this situation.

to ensure that the domestic welfare is not lower due to lobbying (as suggested by (18)). Hence, with $\alpha > 2$, i.e. $\alpha_2 > \frac{2\alpha_1}{3}$ (as mentioned in footnote 15), the tariff-function formation approach is not just a special case of the political contribution model. The difference between these approaches generates different results, viz., the tariff-function formation approach reduces the incentive for licensing, while the political contribution model increases the incentive for licensing.

4.1 The Implications of Lobbying on the Consumers

Now we want to see the implications of lobbying on the consumer surplus. Since consumer surplus is $\frac{q^2}{2}$, it will be enough for us to compare total outputs under these situations. To show this, we consider three situations – free trade, tariff under lobbying and the welfare-maximising tariff. We have seen that licensing occurs under free trade if $c < c'$ and it occurs for tariff under lobbying if $c < c^{\max}$. It follows from Kabiraj and Marjit (2003) that licensing occurs under welfare-maximising tariff if $c < c^{\max}$.

It is immediate that if $c < c'$ and licensing occurs under all these three situations – free trade, tariff under lobbying and the welfare-maximising tariff – consumer surplus is maximum under free trade and minimum under lobbying, since there is no tariff under free trade and the tariff rate is maximum under lobbying.

Now compare the situation under "free trade and no licensing" to that of under "lobbying and licensing", which occurs if $c \in (c', c^{\max})$.[18] The equilibrium outputs are $q^*_{ft,n} = \frac{2a-c}{3}$ and $q^*_{lo,l} = \frac{a(5\alpha-2)}{9\alpha-2}$ under "free trade and no licensing" and "lobbying and licensing" respectively. We get that

$$q^*_{ft,n} - q^*_{lo,l} = \frac{a(2+3\alpha) - c(9\alpha-2)}{3(9\alpha-2)} \lessgtr 0 \text{ for } c \lessgtr \frac{a(2+3\alpha)}{9\alpha-2} \equiv c''', \tag{30}$$

where $c''' - c^{\max} = \frac{3a(\alpha-2)}{2(2-9\alpha)} < 0$ but $c''' - c' = \frac{a(14-3\alpha)}{5(9\alpha-2)} \gtrless$ for $\alpha \lessgtr \frac{14}{3}$.

Since we are considering a situation where $c \in (c', c^{\max})$, we get from the above discussion that $c''' \in (c', c^{\max})$ if $\alpha < \frac{14}{3}$ but $c''' < c'$ (i.e. below the relevant range of $c \in (c', c^{\max})$) if $\alpha > \frac{14}{3}$. Hence, we can say that if $\alpha < \frac{14}{3}$, $q^*_{ft,n} < (>) q^*_{lo,l}$ for $c \in (c''', c^{\max})$ $(c \in (c', c'''))$ but if $\alpha > \frac{14}{3}$, $q^*_{ft,n} < q^*_{lo,l}$ for $c \in (c', c^{\max})$.

The following result is immediate from the above discussion.

Proposition 7. *(a) If licensing occurs under lobbying but not under free trade, the consumers are better (worse) off under lobbying compared to free trade if either*

18 Since it follows from Kabiraj and Marjit (2003) that licensing always occurs under welfare-maximising tariff, "welfare-maximising tariff and no licensing" is not an option here.

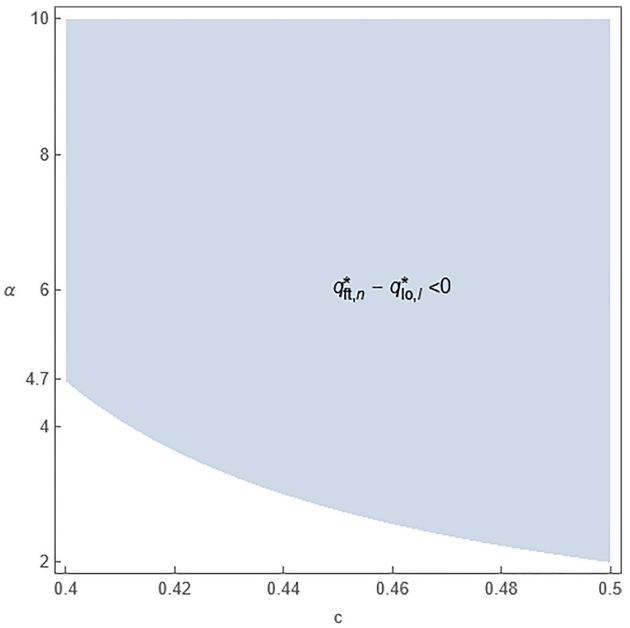

Figure 1: $q^*_{ft,n} - q^*_{lo,l}$ for $c \in (c', c^{\max})$ and $\alpha \in [2, 10]$ with $a = 1$

$\alpha < \frac{14}{3}$ and $c \in (c''', c^{\max})$ or $\alpha > \frac{14}{3}$ and $c \in (c', c^{\max})$ (if $\alpha < \frac{14}{3}$ and $c \in (c', c''')$). (b) When licensing occurs under free trade, lobbying and welfare-maximising tariff, the consumer surplus is maximum under free trade and it is minimum under lobbying.

Figure 1 shows Proposition 7(a).

We plot in Figure 1 $q^*_{ft,n} - q^*_{lo,l}$ for $c \in (c', c^{\max})$, $\alpha \in [2, 10]$ and $a = 1$.[19] The blue shaded (white) area shows that $q^*_{ft,n} - q^*_{lo,l} < (>)0$.

Proposition 7(a) contrasts both the result of Kabiraj and Marjit (2003) and Proposition 4 of the previous section. In contrast to Kabiraj and Marjit (2003), it shows that consumer surplus may reduce under tariff protection through lobbying compared to free trade when licensing occurs only under tariff protection. This happens if the government's weight on welfare is relatively low. On the other hand, in contrast to Proposition 4, Proposition 7(a) shows that consumer surplus may be higher under lobbying and licensing compared to free trade, if either the government's weight on welfare is sufficiently high or the cost difference between the firms is sufficiently large.

19 If $a = 1$, we have $c' = 0.4$ and $c^{\max} = 0.5$.

The reasons for the above-mentioned differences are as follows. First compare with Kabiraj and Marjit (2003). They showed that if the welfare-maximising tariff attracts licensing, it always increases consumer surplus compared to free trade with no licensing. This happens because the benefit from licensing dominates the distortion due to tariff. In our analysis, lobbying increases the tariff rate compared to the welfare-maximising tariff, thus increasing the distortion due to tariff. Further, the tariff rate under lobbying increases as α falls, i.e. as the government's relative weight on the political contribution increases. On the other hand, a relatively lower c tends to increase the consumer surplus under free trade with no licensing. Hence, if both α and c are relatively low, consumer surplus under free trade with no licensing is higher compared to consumer surplus under lobbying and licensing.

Now compare Proposition 7(a) and Proposition 4. In Section 3, lobbying imposes tariff and also reduces the possibility of licensing compared to the free trade. Both these adverse effects of lobbying reduce consumer surplus under lobbying compared to free trade. In contrast, lobbying in this section imposes tariff but increases the possibility of licensing. This benefit from licensing can outweigh the adverse effect of tariff, and consumer surplus may be higher under lobbying compared to free trade.

5 Conclusions

It is argued that tariff protection can benefit the consumers since it helps to attract superior foreign technologies through international technology licensing. Hence, the protectionist view for tariff protection can be justified if the tariff induced international technology licensing benefits the consumers. We show in this paper that this conclusion may not hold true if the tariff rate is influenced by lobbying by the domestic firm.

In contrast to the existing literature, we show that lobbying for a tariff protection may decrease or increase technology licensing compared to free trade, depending on the way lobbying affects the tariff rate. The effects of lobbying on consumer surplus also depend on the lobbying process. Hence, how tariffs are determined – by welfare-maximising governments or through lobbying by the domestic firms – and how lobbying affects the tariff rates are important for international technology licensing and the corresponding effects on the consumers.

To show that the results of Kabiraj and Marjit (2003) can be influenced significantly if the tariff rate is influenced by the lobbying effort of the domestic firm, we consider a market structure similar to theirs. An extension of our paper will be to consider the effects of multiple domestic firms. However, this is not a trivial

extension, as it will raise several new questions. The foreign firm needs to determine how many licenses to offer, in the manner studied by Sen and Tauman (2007) for licensing to multiple licensees. Since lobbying by multiple domestic firms can create a free rider problem for lobbying, there will be an issue of cooperative versus non-cooperative lobbying by the firms. These issues need a full-fledged analysis. We leave them for future research.

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