Routledge
Taylor & Francis Group

Applied Economics Letters

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/rael20

Exports vs. FDI under counterfeiting: implications for the IPR policy of an importing country

Yang-Ming Chang & Manaf Sellak

To cite this article: Yang-Ming Chang & Manaf Sellak (04 Mar 2024): Exports vs. FDI under counterfeiting: implications for the IPR policy of an importing country, Applied Economics Letters, DOI: 10.1080/13504851.2024.2323695

To link to this article: https://doi.org/10.1080/13504851.2024.2323695

Published online: 04 Mar 2024.

APPLIED ECONOMICS LETTERS
https://doi.org/10.1080/13504851.2024.2323695

Routledge
Taylor & Francis Group

Exports vs. FDI under counterfeiting: implications for the IPR policy of an importing country

Yang-Ming Chang[a] and Manaf Sellak[b]

[a]Department of Economics, Kansas State University, Manhattan, KS, USA; [b]School of Business, Washburn University, Topeka, KS, USA

ABSTRACT

This paper analyzes how exports and foreign direct investment (FDI) differ in affecting the intellectual property rights (IPR) policy of an importing country faced with domestic counterfeiting problems. We identify the circumstances in which IPR protection and private protection are complementary. Our study also highlights the challenges of using IPR protection to fight counterfeiting while attracting FDI, which may reduce domestic welfare.

KEYWORDS

Exports; foreign direct investment; intellectual property rights; enforcement

JEL CLASSIFICATION

F12; L12; L13; L52

I. Introduction

In open markets with high levels of counterfeiting (or pirating),[1] there are several fundamental issues that consistently pose challenges for original product developers and anti-counterfeiting (or anti-piracy) governments.[2] Under what conditions will an importing country protect the intellectual property rights (IPR) of foreign product innovators in order to attract foreign direct investment (FDI) and maximize domestic welfare? Will R&D investments by original product developers deter counterfeiting, and how do they differ between exports and FDI? Are private protection (by a product developer) and public protection (by an importing country) complements or substitutes?[3]

In this paper, we present answers to the aforementioned questions. We examine the IPR policy and enforcement strategies set by the government of a country that imports an original product and confronts domestic counterfeiting issues. We show that it is Pareto-suboptimal to simply forbid counterfeiting goods without launching costly enforcement to punish offenders (Becker 1968). We identify the conditions under which public IPR protection and private protection and are *complementary*. We find that domestic welfare and consumer surplus under an import tariff policy in the context of counterfeiting can exceed those under tariff-jumping FDI when the quality of counterfeit goods is low. This exemplifies the difficulties an importing country faces in successfully combating domestic counterfeiting while attracting FDI.

Our study complements the recent work by Ikeda, Tanno, and Yasaki (2021) on socially ideal IPR policy for an importing country. There are some distinctions between the two analyses. Ikeda et al. (2021) analyse Cournot competition between a foreign innovator and a home imitator. We examine Bertrand competition between the competitors in a partially covered market with consumer heterogeneity in preferences

CONTACT Manaf Sellak sellak@Washburn.edu School of Business, Washburn University, Rm 310M Henderson Learning Center, 1700 SW College Ave, Topeka, KS 66621, USA

[1]Both counterfeit goods and commercial piracy entail the unapproved duplication or dissemination of the original developers' inventions. However, their differences lie in the kinds of items that are exchanged. Unauthorized reproduction, dissemination, or utilization of intellectual property, including software, music, films, and gaming, is commonly referred to as *digital piracy* (see, e.g. Chang and Walter 2015; Peitz and Waelbroeck 2006). This involves obtaining, disseminating, or selling digital content illegally. Contrarily, counterfeit goods are tangible items that are manufactured to look like a brand's name without permission. These can include products like leather goods, watches, and perfumes. Note that the two situations involve intellectual property rights infringement and have detrimental effects on the original developers. For a systematic review of issues related to counterfeiting and piracy and their implications for developing countries, see Fink, Maskus, and Qian (2016). We appreciate an anonymous referee for suggesting that we focus our analysis on counterfeit goods, which refer to infringements of trademarks, industrial designs, and patents.

[2]For studies on digital and software piracy effects on market outcomes, see, e.g. Slive and Bernhardt (1998), Shy and Thisse (1999), Belleflamme and Picard (2007), and Cremer and Pestieau (2009). For issues on the competition between a copyright owner and a commercial pirate, see Banerjee (2003, 2006). The studies mentioned above investigate issues of commercial piracy in closed economies. The study by Ikeda, Tanno, and Yasaki (2021) is an exception in analysing IPR policy in an open economy that imports an original product from a foreign monopoly.

[3]Lu and Poddar (2012) examine issues of accommodation or deterrence under commercial piracy and raise the interesting question of whether public protection (by the government) and private protection (by product innovators) are substitutes or complements.

for an original product and its counterfeit version with a lower quality. Second, Ikeda et al. (2021) show that an importing country's overall welfare under Cournot duopoly exceeds that under monopoly if the government chooses an optimal level of IPR protection. We find that whether or not domestic welfare under Bertrand duopoly is higher than that under FDI depends on the quality of counterfeit goods. Our analysis pinpoints the circumstances in which private protection and public IPR enforcement are complementary, implying cross-border cooperation is required to deter counterfeiting. Moreover, we investigate the different effects of exports and FDI on the IPR policy and enforcement strategies optimally chosen by an importing country under domestic counterfeiting.

In what follows, Section II presents a stylized model of Bertrand competition and analyzes differences in welfare implications between import tariffs and FDI. Section III concludes.

II. The analytical frameworks and equilibrium results

IPR and enforcement under an optimal tariff policy

We first consider a developer located in a foreign country who exports an original product to a country with a continuum of consumers. A home imitator has the technology to copy the original product. However, the counterfeit good has a lower quality of q, where $0 < q < 1$. To combat counterfeiting by raising its costs,[4] the foreign exporter of the original product undertakes R&Dinvestment, r, which is taken as a quadratic function :$c_o(r) = r^2/2$.

Domestic consumers with different valuations for a product (either the original one imported or the counterfeit good) are indexed uniformly over a unit line, $X \in [0, 1]$.[5] We consider a partially covered market where consumer heterogeneity in tastes is captured by the preference structures:

$$U(X) = \begin{cases} X - p_o \text{ if buys the foreign original product;} \\ qX - p_p \text{ if buys the domestic counterfeit good;} \\ 0 \text{ if not buying any of the products.} \end{cases} \quad (1)$$

where p_o is the price of the original product, and p_p is that of the counterfeit good. The marginal consumer, X^*, who is indifferent between buying the original product and the counterfeit good, implies that $X^* - p_o = qX^* - p_p$ or $X^* = \frac{p_o - p_p}{1-q}$. The marginal consumer, Y^*, who is indifferent between buying the counterfeit good and not buying any product, implies that $qY^* - p_p = 0$ or $Y^* = \frac{p_p}{q}$. Demand for the original product is:

$$D_o = \int_{X^*}^{1} dx = (1 - X^*) = 1 - \frac{p_o - p_p}{1 - q} \quad (2)$$

and demand for the counterfeit good is:

$$D_p = \int_{Y^*}^{X^*} dx = (X^* - Y^*) = \frac{p_o - p_p}{1 - q} - \frac{p_p}{q} = \frac{qp_o - p_p}{q(1 - q)}. \quad (3)$$

Under an optimal tariff policy, government revenues come from (i) tariff revenue tD_o by imposing a per-unit tariff $t(>0)$ on the foreign product, and (ii) fines on domestic counterfeiting cD_p through imposing a per-unit penalty cost $c(>0)$ net of enforcement cost, which is taken as a quadratic function $(\frac{1}{2}c^2)$.

We adopt a three-stage game. In stage one, the government implements IPR protection by imposing a fine on counterfeiting and setting a tariff rate on the foreign original product to maximize domestic welfare. In stage two, given the government policies, the foreign product developer undertakes an optimal R&D investment to increase the cost of counterfeiting. In stage three, the foreign developer and the domestic imitator engage in Bertrand competition. We solve the three-stage game backward.

In stage three, the foreign developer sets a price to maximize its profit function, $\pi_o = (p_o - t)D_o - (1/2)r^2$, and the domestic imitator sets a price to maximize its profit function, $\pi_p = (p_p - c - r)D_p$, where D_o is given in (2) and D_p is given in (3).[6] The FOCs imply that the Bertrand prices are:

[4]This is consistent with the notion of cost raising strategies as discussed in Salop and Scheffman (1987).

[5]A high value of X means high valuation for the product (or higher willingness to pay), while a low value of X means low valuation for the product (or lower willingness to pay).

[6]The FOCs for the two competitors are: $\frac{\partial \pi_o}{\partial p_o} = \frac{t - q - 2p_o + p_p + 1}{(1-q)} = 0$ and $\frac{\partial \pi_p}{\partial p_p} = \frac{c + x - 2p_p + qp_o}{q(1-q)} = 0$.

$$p_o = \frac{2t + (r + c) + 2(1 - q)}{4 - q} \text{ and}$$
$$p_p = \frac{2(c + r) + q + q(t - q)}{4 - q}. \quad (4)$$

Substituting the prices from (4) back into (2)-(3) yields:

$$D_o = 1 - \frac{p_o - p_p}{(1 - q)} = \frac{(c + r) + 2(1 - q) + t(q - 2)}{(4 - q)(1 - q)};$$
$$D_p = \frac{qp_o - p_p}{q(1 - q)} = \frac{q(1 - q) + tq + (c + r)(q - 2)}{q(1 - q)(4 - q)}. \quad (5)$$

In stage two, the foreign developer undertakes R&D investment to raise the cost of counterfeiting by solving the profit maximization problem:

$$\underset{\{r\}}{\text{Max}}\, \pi_o = p_o D_o - \frac{r^2}{2} = \left[\frac{2t + c + r + 2(1 - q)}{4 - q}\right] \left[\frac{(c + r) + 2(1 - q) + t(q - 2)}{(4 - q)(1 - q)}\right] - \frac{r^2}{2}.$$

The foreign firm's FOC implies that its optimal R&D investment is:

$$r = \frac{2c + 4(1 - q) - 2t(2 - q)}{14 - 24q + 9q^2 - q^3}. \quad (6)$$

The second-order condition(SOC)is:

$$\frac{\partial^2 \pi_o}{\partial r^2} = -\frac{(14 - 24q + 9q^2 - q^3)}{(1 - q)(4 - q)^2} < 0, \quad (7)$$

which holds when$q < 0.804\,177$. The optimal R&D investment is positive when the quality of the counterfeit good satisfies the following condition:

$$\tilde{r} > 0 \text{ when } q < 0.804177. \quad (8)$$

Substituting $\tilde{r}$ from (6) into the price, demand, and profit functions yields:

$$\begin{aligned}
p_o &= \frac{c(4 - 5q + q^2) + t(6 + 2q^2 - 10q) + (8 - 18q + 12q^2 - 2q^3)}{14 - 24q + 9q^2 - q^3},\\
p_p &= \frac{2c(4 - 5q + q^2) + t(-2 + 4q - 5q^2 + q^3) + (2 + 2q - 9q^2 + 6q^3 - q^4)}{14 - 24q + 9q^2 - q^3},\\
D_o &= \frac{(4 - q)[c + 2(1 - q) - t(2 - q)]}{14 - 24q + 9q^2 - q^3},\\
D_p &= \frac{c(-8 + 6q - q^2) + t(2 + 4q - q^2) + (-2 + 4q - 5q^2 + q^3)}{q(14 - 24q + 9q^2 - q^3)},\\
\pi_o &= \frac{[c + 2(1 - q) - t(2 - q)]^2}{14 - 24q + 9q^2 - q^3},\\
\pi_p &= \frac{(1 - q)[c(8 - 6q + q^2) + t(-2 - 4q + q^2) + (2 - 4q + 5q^2 - q^3)]^2}{q(14 - 24q + 9q^2 - q^3)^2}.
\end{aligned} \quad (9)$$

Additionally, we have:

$$X^* = \frac{c(q - 4) + t(8 - 6q + q^2) + (6 - 14q + 7q^2 - q^3)}{14 - 24q + 9q^2 - q^3},$$
$$Y^* = \frac{2(1 + 4c) + cq(-10 + 2q) + t(-2 + 4q - 5q^2 + q^3) + q(2 - 9q + 6q^2 - q^3)}{q(14 - 24q + 9q^2 - q^3)} \quad (10)$$

In stage one, the government imposes a fine on the domestic imitator as IPR protection and a tariff rate on the imported product by solving the welfare (W) maximization problem:

$$\underset{\{c,t\}}{\text{Max}}\, W = \int_{X^*}^{1}(X - p_o)dx + \int_{Y^*}^{X^*}(qX - p_p)dx + \pi_p + tD_o + (cD_p - \frac{1}{2}c^2),$$

The FOC implies that the optimal IPR protection and the tariff rate are[7]

$$\tilde{c} = \frac{2q(4-q)(1-q)(-1+4q-5q^2+q^3)}{4-20q-84q^2+393q^3-393q^4+159q^5-29q^6+2q^7}.$$
$$\tilde{t} = \frac{4-12q-38q^2+177q^3-186q^4+76q^5-14q^6+q^7}{4-20q-84q^2+393q^3-393q^4+159q^5-29q^6+2q^7}. \quad (11)$$

It follows from (11) that:

(*i*) *When* $q < 0.160795, \tilde{c} \bar{0} \wedge \tilde{t} > 0$;
(*ii*) *When* $0.160795 < q < 0.436196, \tilde{c} = 0$ *and* $\tilde{t} > 0$;
(*iii*) *When* $q < 0.436196, \tilde{c} \bar{0}$ *and* $\tilde{t} > 0$. (12)

The conditions in (8) and (12) indicate that: (*i*) When the quality of the counterfeit good is critically low ($q < 0.160795$) or moderate ($0.436196 < q < 0.804\,177$), the government imposes import tariff ($\tilde{t} > 0$) without offering IPRprotection to deter counterfeiting ($\tilde{c} = 0$), making government and private protection($\tilde{r} > 0$) *substitutes*. (*ii*) When the counterfeit good's quality is low($0.160795 < q < 0.436196$), the governments provides IPR protection ($\tilde{c} > 0$) while setting tariff rate to zero ($\tilde{t} = 0$), making government and private protections ($\tilde{r} > 0$) *complements*. (*iii*) When the counterfeit good's quality is sufficiently high ($q > 0.804\,177$), both the government and the foreign developer find deterring counterfeiting too costly.

Substituting $\tilde{c}$ and $\tilde{t}$ from(11) back into the foreign firm's profit function in (9) yields

$$\tilde{\pi}_o = \frac{(14-24q+9q^2-q^3)(2+5q-27q^2+19q^3-3q^4)^2}{(4-20q-84q^2+393q^3-393q^4+159q^5-29q^6+2q^7)^2}, \quad (13)$$

which implies that

$$\tilde{\pi}_o > 0 \text{ when } q < 0.80414. \quad (14)$$

Lemma 1: *For foreign exports under the optimal tariff policy, the equilibrium results are*:

$$\tilde{\pi}_p = \frac{4q(1-q)(4-q)^2(1+2q-q^2)^2(1-4q+5q^2-q^3)^2}{(4-20q-84q^2+393q^3-393q^4+159q^5-29q^6+2q^7)^2} > 0,$$
$$\tilde{S} = \frac{q(4-q)^2(4-20q+265q^3-710q^4+139q^5+1644q^6-2049q^7+982q^8-207q^9+16q^{10})}{2(4-20q-84q^2+393q^3-393q^4+159q^5-29q^6+2q^7)^2} > 0,$$
$$\tilde{W} = \frac{q^2(4-q)(9q+25q^2-23q^3+4q^4-7)}{2(4-20q-84q^2+393q^3-393q^4+159q^5-29q^6+2q^7)} > 0. \quad (15)$$

IPR and enforcement under tariff-jumping FDI[8]

We next consider the scenario of tariff-jumping FDI in that the foreign original product developer avoids paying the tariffs by undertaking direct investment in an importing country. The foreign developer locates its production in the host market while still undertaking costly investment to fight against counterfeiting. We wish to see how such

[7]Note that $W = \left[\frac{1}{2}X^2 - p_oX\right]_{X^*}^{1} + \left[\frac{1}{2}qX^2 - p_pX\right]_{Y^*}^{X^*} + \pi_p + tD_o + (cD_p - \frac{1}{2}c^2)$, where X^* and Y^* are given in (10).
[8]This section is due to an anonymous referee who suggests that we examine FDI and IPR protection against counterfeiting.

a tariff-jumping FDI affects IPRs policy and enforcement strategies of the importing country and the resulting effects on domestic welfare.

We adopt the same three-stage game as in Section 2.1.[9] Using backward induction, in stage three, we solve for the profit-maximizing price chosen by the foreign product developer and the domestic imitator. Utilizing the profit functions of the two competitors, D_o in (2) and D_p in (3), the FOCs imply the Bertrand prices:

$$p_o = \frac{c + r + 2(1-q)}{4-q} \text{and} \quad p_p = \frac{2(c+r) + q(1-q)}{4-q}. \tag{16}$$

Substituting the prices from (16) into (2) and (3) yields the quantities demanded of the products:

$$D_o = 1 - \frac{p_o - p_p}{(1-q)} = \frac{(c+r) + 2(1-q)}{(4-q)(1-q)} \text{and} \quad D_p = \frac{qp_o - p_p}{q(1-q)} = \frac{q(1-q) + (c+r)(q-2)}{q(1-q)(4-q)}. \tag{17}$$

In stage two, the original product developer chooses its R&D investment by solving the profit maximization problem:

$$\underset{\{r\}}{\text{Max}}\, \pi_o = p_o D_o - \frac{r^2}{2} = \left[\frac{c + r + 2(1-q)}{4-q}\right]\left[\frac{(c+r) + 2(1-q)}{(4-q)(1-q)}\right] - \frac{r^2}{2}.$$

The FOC implies that the foreign developer's optimal R&D investment is:

$$r = \frac{2c + 4(1-q)}{14 - 24q + 9q^2 - q^3}. \tag{18}$$

The SOC is:

$$\frac{\partial^2 \pi_o}{\partial r^2} = -\frac{(14 - 24q + 9q^2 - q^3)}{(1-q)(4-q)^2} < 0,$$

which implies that

$$r > 0 \text{ when } q < 0.804177. \tag{19}$$

Substituting r from (18) into the price, demand, and profit functions yields:

$$\begin{aligned}
&p_o = \frac{[c + 2(1-q)](1-q)(4-q)}{14 - 24q + 9q^2 - q^3},\ p_p = \frac{(1-q)[2c(4-q) + (2 + 4q - 5q^2 + q^3)]}{14 - 24q + 9q^2 - q^3},\\
&p_p = \frac{(1-q)[2c(4-q) + (2 + 4q - 5q^2 + q^3)]}{14 - 24q + 9q^2 - q^3},\ p_p = \frac{(1-q)[2c(4-q) + (2 + 4q - 5q^2 + q^3)]}{14 - 24q + 9q^2 - q^3},\\
&\pi_o = \frac{[c + 2(1-q)]^2}{14 - 24q + 9q^2 - q^3},\ \pi_p = \frac{(1-q)[c(8 - 6q + q^2) + (2 - 4q + 5q^2 - q^3)]^2}{q(14 - 24q + 9q^2 - q^3)^2}.
\end{aligned} \tag{20}$$

Additionally, we have

$$X^{**} = \frac{c(q-4) + (6 - 14q + 7q^2 - q^3)}{14 - 24q + 9q^2 - q^3},$$
$$Y^{**} = \frac{(1-q)[2c(4-q) + (2 + 4q - 5q^2 + q^3)]}{q(14 - 24q + 9q^2 - q^3)}. \tag{21}$$

In stage one, the government imposes a monetary fine on the domestic imitator as IPR protection by solving the welfare maximization problem:

$$\underset{\{c\}}{\text{Max}}\, W = \int_{X^{**}}^{1} (X - p_o^*)dx + \int_{Y^{**}}^{X^{**}} (qX - p_p^*)dx + \pi_p + (cD_p - \frac{1}{2}c^2).$$

The FOC implies that the optimal IPR protection is[10]

$$\hat{c} = \frac{20 - 100q + 200q^2 - 176q^3 + 73q^4 - 14q^5 + q^6}{32 + 108q - 616q^2 + 815q^3 - 459q^4 + 129q^5 - 18q^6 + q^7}. \tag{22}$$

[9]Note that in the case of tariff-jumping FDI, the tariff rate paid by the foreign firm located in the domestic importing is now set to be zero $t = 0$.That is, in stage one, the government chooses only an optimal level of IPR protection.

[10]Note that $W = \left[\frac{1}{2}X^2 - p_o X\right]_{X^{**}}^{1} + \left[\frac{1}{2}qX^2 - p_p X\right]_{Y^{**}}^{X^{**}} + \pi_p + (cD_p - \frac{1}{2}c^2)$, where X^{**} and Y^{**} are given in (21).

The SOC is:

$$\frac{\partial^2 W}{\partial c^2} = -\frac{(32 + 108q - 616q^2 + 815q^3 - 459q^4 + 129q^5 - 18q^6 + q^7)}{q(14 - 24q + 9q^2 - q^3)^2},$$

which implies that

$$\frac{\partial^2 W}{\partial c^2} \langle 0 \text{if and only if } (32 + 108q - 616q^2 + 815q^3 - 459q^4 + 129q^5 - 18q^6 + q^7) \rangle 0. \quad (23)$$

It follows from (22) and (23) that

$$\hat{c} > 0 \text{ when } q < 0.611474. \quad (24)$$

The inequality conditions in (19) and (24) indicate that: (*i*) When the counterfeit good's quality is low($q < 0.611474$), IPR enforcement and private protection are *complementary*. (*ii*) A moderate quality of the counterfeit good ($0.611474 < q < 0.804\,177$) makes the IPR enforcement costly, causing the public and private protections to become *substitutes*. (*iii*) Nevertheless, a sufficiently high quality ($q > 0.611474$) results in a costly counterfeiting deterrence by both the government and the foreign developer.[11]

Substituting $\hat{c}$from(23) into the profit function of the foreign developer in (21) yields:

$$\hat{\pi}_o = \frac{(14 - 24q + 9q^2 - q^3)(6 + 14q - 69q^2 + 65q^3 - 20q^4 + 2q^5)^2}{(32 + 108q - 616q^2 + 815q^3 - 459q^4 + 129q^5 - 18q^6 + q^7)^2},$$

which implies that

$$\hat{\pi}_o > 0 \text{ when } q < 0.804\,177.$$

Lemma 2. *Under tariff-jumping FDI, the equilibrium results are*:

$$\hat{\pi}_p = \frac{(1-q)(16 - 32q - 14q^2 + 133q^3 - 160q^4 + 72q^5 - 14q^6 + q^7)^2}{q(32 + 108q - 616q^2 + 815q^3 - 459q^4 + 129q^5 - 18q^6 + q^7)^2} > 0,$$

$$\hat{S} = \frac{[(256 - 1216q + 2912q^2 + 6884q^3 - 60\,716q^4 + 130\,816q^5 - 98\,143q^6 - 37\,649q^7 + 120\,848q^8 - 95\,683q^9 + 40\,658q^{10} - 10\,362q^{11} + 1590q^{12} - 136q^{13} + 5q^{14})]}{2q(32 + 108q - 616q^2 + 815q^3 - 459q^4 + 129q^5 - 18q^6 + q^7)^2} > 0,$$

$$\hat{W} = \frac{(4 - 4q + 24q^2 + q^3 - 190q^4 + 267q^5 - 131q^6 + 27q^7 - 2q^8)}{2q(32 + 108q - 616q^2 + 815q^3 - 459q^4 + 129q^5 - 18q^6 + q^7)} > 0.$$

Comparisons

We now compare the different outcomes between the tariff policy and tariff-jumping FDI. Comparing the results for $\tilde{c}$ in (11) and $\hat{c}$ in (23) yields:

$$\hat{c} - \tilde{c} = \frac{[(4 - 12q - 38q^2 + 177q^3 - 186q^4 + 76q^5 - 14q^6 + q^7)(20 - 76q + 122q^2 - 62q^3 + 13q^4 - q^5)]}{[(32 + 108q - 616q^2 + 815q^3 - 459q^4 + 129q^5 - 18q^6 + q^7)(4 - 20q - 84q^2 + 393q^3 - 393q^4 + 159q^5 - 29q^6 + 2q^7)]},$$

which implies that

(i) $\hat{c} > \tilde{c}$ when $q < 0.611474$

and (ii) $\hat{c} < \tilde{c}$ when $q > 0.611474$.

These results lead to the following proposition:

PROPOSITION 1. *In the presence of counterfeiting, when the quality of counterfeit goods is sufficiently low, the level of IPR protection is higher for tariff-jumping FDI than for foreign exports under a tariff policy. However, when the quality of counterfeit goods is sufficiently high, the level of IPR protection is relatively higher for foreign exports under the tariff policy.*

Proposition 1 suggests that when the quality of counterfeit goods is low, importing governments can encourage FDI by enhancing IPR protection, which can lead to an increase in original products and a decrease in counterfeit goods.

[11] An overview of the results reveals that an importing country's government will NOT provide public protection unless the product quality of the counterfeit good is low ($q < 0.611474$).This illustrates the challenges faced by an importing country to deter or eliminate counterfeiting.

$$\hat{S}-\tilde{S}=\frac{\begin{pmatrix}4-12q-38q^2+177q^3\\-186q^4+76q^5-14q^6+q^7\end{pmatrix}\begin{pmatrix}1024-12\,032q+128q^2+230\,288q^3-1166\,624q^4\\+3261\,288q^5+203\,696q^6-34\,781\,256q^7+\\119\,821\,586q^8-212\,287\,191q^9+232\,720\,516q^{10}\\-166\,914\,855q^{11}+78\,080\,966q^{12}-21\,474\,210q^{13}\\+1371\,351q^{14}+1531\,300q^{15}-739\,033q^{16}+182\,191q^{17}\\-28\,149q^{18}+2753q^{19}-157q^{20}+4q^{21}\end{pmatrix}}{\begin{matrix}[2q(32+108q-616q^2+815q^3-459q^4+129q^5-18q^6+q^7)^2\\(4-20q-84q^2+393q^3-393q^4+159q^5-29q^6+2q^7)^2]\end{matrix}}>0.$$

As for consumer surplus, we have from Lemmas 1 and 2 that

It follows that

$$\begin{matrix}(\mathrm{i})\hat{S}<\widetilde{S}\,\text{when}\,q<0.48\\ \text{and}\,(\mathrm{ii})\hat{S}>\widetilde{S}\,\text{when}\,q>0.48.\end{matrix}$$

We thus have:

PROPOSITION 2. *In the presence of counterfeiting, foreign exports result in a higher consumer surplus under a tariff policy when the quality of counterfeit goods is low. Otherwise, domestic consumer surplus is higher with tariff-jumping FDI.*

As for domestic welfare, we have from Lemmas 1 and 2 that

$$\hat{W}-\tilde{W}=\frac{(4-12q-38q^2+177q^3-186q^4+76q^5-14q^6+q^7)^2}{\begin{matrix}[2q(32+108q-616q^2+815q^3-459q^4+129q^5-18q^6+q^7)\\(4-20q-84q^2+393q^3-393q^4+159q^5-29q^6+2q^7)]\end{matrix}}.$$

If follows that

$(\mathrm{i})\,\hat{W}>\tilde{W}$ when $0.436196<q<0.611474$;

$(ii)\,\hat{W}<\tilde{W}$ when $q<0.436196$ or when $q>0.611474$.

We thus have:

PROPOSITION 3. *In the presence of counter feiting, domestic welfare is higher with tariff-jumping FDI than foreign exports under a tariff policy when the quality of counterfeit goods is moderate. Otherwise, domestic welfare is relatively higher under the tariff policy.*

Propositions 2 and 3 imply that domestic welfare and consumer surplus may be lower under FDI than under import tariffs. It highlights the challenges an importing government faces to combat counterfeiting while attracting FDI.

III. Concluding remarks

This paper examines the IPR policy and enforcement strategies chosen by a government to attract FDI while facing domestic counterfeiting issues.

We identify the conditions under which public enforcement and private protection are complementary. We show that, when the quality of counterfeit goods is low, the government adopts a stricter IPR protection to attract FDI. However, domestic welfare and consumer surplus are lower under tariff-jumping FDI than those under a tariff policy. The analysis thus demonstrates how challenging it is for an

importing country to successfully combat domestic counterfeiting while attracting FDI.[12]

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

Manaf Sellak http://orcid.org/0000-0002-2885-7052

Compliance with Ethical Standards

The authors declare no conflict of interest. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

Banerjee, D. S. 2003. "Software Piracy: A Strategic Analysis and Policy Instruments." *International Journal of Industrial Organization* 21 (1): 97–127. https://doi.org/10.1016/S0167-7187(01)00090-X.

Banerjee, D. S. 2006. "Lobbying and Commercial Software Piracy." *European Journal of Political Economy* 22 (1): 139–155. https://doi.org/10.1016/j.ejpoleco.2005.03.003.

Becker, G. S. 1968. "Crime and Punishment: An Economic Approach." *Journal of Political Economy* 76 (2): 169–217. https://doi.org/10.1086/259394.

Belleflamme, P., and P. M. Picard. 2007. "Piracy and Competition." *Journal of Economics and Management Strategy* 16 (2): 351–383. https://doi.org/10.1111/j.1530-9134.2007.00142.x.

Chang, Y.-M., and M. F. Raza. 2018. "Import Competition, Product Quality Reversal, and Welfare." *Economics Letters* 163:162–166. https://doi.org/10.1016/j.econlet.2017.12.021 .

Chang, Y.-M., and M. Sellak. 2022. "Endogenous IPR Protection, Commercial Piracy, and Welfare Implications for Anti-Piracy Laws." *Applied Economics Letters* 29 (8): 718–722. https://doi.org/10.1080/13504851.2021.1884832.

Chang, Y.-M., and J. Walter. 2015. "Digital Piracy: Price-Quality Competition Between Legal Firms and P2P Network Hosts." *Information Economics and Policy* 31:22–32. https://doi.org/10.1016/j.infoecopol.2015.04.002.

Cremer, H., and P. Pestieau. 2009. "Piracy Prevention and the Pricing of Information Goods." *Information Economics and Policy* 21 (1): 34–42. https://doi.org/10.1016/j.infoecopol.2008.09.003.

Fink, C., K. E. Maskus, and Y. Qian. 2016. "The Economic Effects of Counterfeiting and Piracy: A Review and Implications for Developing Countries." *The World bank research observer* 31 (1): 1–28.

Ikeda, T., T. Tanno, and Y. Yasaki. 2021. "Optimal Intellectual Property Rights Policy by an Importing Country." *Economics Letters* 209:110–113. https://doi.org/10.1016/j.econlet.2021.110113.

Peitz, M., and P. Waelbroeck. 2006. "Piracy of Digital Products: A Critical Review of the Theoretical Literature." *Information Economics and Policy* 18 (4): 449–476. https://doi.org/10.1016/j.infoecopol.2006.06.005.

Salop, S. C., and D. T. Scheffman. 1987. "Cost raising strategies." *The Journal of Industrial Economics* 36 (1): 19–34. https://doi.org/10.2307/2098594.

Shy, O., and J. Thisse. 1999. "A Strategic Approach to Software Protection." *Journal of Economics and Management Strategy* 8 (2): 163–190. https://doi.org/10.1111/j.1430-9134.1999.00163.x.

Slive, J., and D. Bernhardt. 1998. "Pirated for profit." *Canadian Journal of Economics* (4): 886–899. https://doi.org/10.2307/136498.

Wauthy, X. 1996. "Quality Choice in Models of Vertical Differentiation." *The Journal of Industrial Economics* 44 (3): 345–353. https://doi.org/10.2307/2950501.

[12]One possible extension is to examine a full cover market as that is frequently adopted in several studies in the vertical product differentiation literature (see, e.g. Wauthy (1996), Chang and Raza (2018), and Chang and Sellak (2022)). For such an extension, a full cover market means that each consumer buys either a foreign original product or its private version. It can be verified that the optimal public protection to combat counterfeiting may be zero.