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Trade in Secondhand Goods, Monitoring of Illegal Trade, and Import Quotas on Legal Trade

Keisaku Higashida
School of Economics, Kwansei Gakuin University

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SCHOOL OF ECONOMICS

KWANSEI GAKUIN UNIVERSITY

1-155 Uegahara Ichiban-cho
Nishinomiya 662-8501, Japan

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Abstract

This paper examines the monitoring of illegal trade, and restrictions on the legal trade, of secondhand goods. We assume that the home (foreign) country exports (imports) secondhand goods both legally and illegally. We demonstrate that when the trade restriction is nonbinding, and part of the legally imported goods serve not as secondhand but as materials, an increase in the probability of monitoring may increase expected foreign environmental damage. In contrast, when the trade restriction is binding, if part of the legal imports is resold for material use, a stricter trade restriction decreases expected foreign environmental damage. We also demonstrate that when governments noncooperatively select monitoring probabilities, the probability of foreign monitoring is necessarily higher than in the second-best situation. In this case, a commitment by the home government to its monitoring probability improves welfare in both countries, and this commitment arises in the extended game in which both governments choose the timing of the move in the first stage and the monitoring probabilities in the second stage. Moreover, when the foreign government chooses the level of the import quota on legal imports, it is possible that the foreign trade restriction is stricter than the second-best level. In such a case, any commitment by either government cannot simultaneously improve the welfare of both countries.

Keywords: hazardous wastes, monitoring, secondhand goods, trade restriction.
JEL Code: F13, F18, Q53.

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**School of Economics, Kwansei Gakuin University, 1-155, Ichiban-cho, Uegahara, Nishinomiya, Hyogo 662-8501, Japan. Email: *keisaku@kwansei.ac.jp*

1 Introduction

The transboundary movement of secondhand goods from developed to developing countries has increased substantially in the last few decades.[1] Importantly, imported secondhand goods frequently contain hazardous substances, and upon dismantling and recycling in importing/developing countries, often account for serious environmental pollution. Further, in developing countries, the recycling sector is informal and usually unskilled-labor intensive. Persons engaged in recycling in developing countries prefer pecuniary gains to environmental protection and generally have little understanding of the toxicity of hazardous substances. Therefore, they extract materials to acquire income without taking due care of the environment. Overall, although these countries gain some economic benefit from importation, their governments have realized that the loss from environmental degradation dominates any economic benefit, and so aspire to reduce the unskilled recycling of imported secondhand goods.

Theoretically, the best way to address this issue is to implement a form of Pigouvian tax in each importing country. However, we typically observe illegal recycling and dumping in many developing countries. Moreover, corruption is also sometimes serious in these same countries. Therefore, it is usually difficult for developing countries to implement environmental taxes effectively. In such cases, border measures, such as tariffs and import quotas, can be effective second-best policies.[2] In fact, having faced serious environmental damage caused by imported secondhand goods, several developing countries have restricted their trade, with some countries completely prohibiting the import of certain kinds of secondhand products, such as electric appliances.[3] International regulations, such as the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, also stipulate trade restrictions on hazardous waste. Many secondhand goods, such as used computers, contain toxic substances.[4] Therefore, the Basel Convention may also apply to the trade in secondhand goods. It is expected that even stricter regulation, known as the Basel Convention Export Ban Amendment (or Basel Ban Amendment), will

[1] See Kellenberg (2010), Ray (2008), Shinkuma and Huong (2009), and Wong et al. (2007), among others, for real-world situations concerning the trade in secondhand goods and waste.

[2] Copeland (1991) and Kinnaman and Yokoo (2011) referred to this same point and examined trade policies as second-best policies.

[3] See the website for the Asian Network for Prevention of Illegal Transboundary Movement of Hazardous Wastes for import controls on secondhand goods (http://www.env.go.jp/en/recycle/asian_net/Country_Information/Import_ctrl_on_2ndhand.html).

[4] When exported for material use or dumping, they are classified as E-waste (Electronic and Electrical Waste).

come into effect in the next few years.[5]

However, because of two important problems specific to the trade in secondhand goods, simple trade policies may not be able to reduce environmental pollution effectively. First, a large amount of the trade in secondhand goods is illegal, often disguised as recycled materials, which are not supposed to include hazardous substances. Although the exporting country should formally remove these hazardous substances prior to exportation, they are often exported with the secondhand goods. Thus, to consider this problem, we need to consider *monitoring* policies. In fact, the customs officers of exporting (importing) countries inspect exports (imports) of materials/wastes and scrap, and we often observe the ship-back of goods because the customs officers of importing countries discover illegally traded products. However, because of imperfect monitoring, monitoring systems do not work perfectly.[6] Second, some legally imported secondhand goods, supposedly for secondhand use, are also recycled for material use immediately after they are imported. A troublesome point is that it is almost impossible for the governments of importing countries to permit or prohibit the importation of secondhand goods according to their purpose, i.e., secondhand use or material use. Therefore, the governments have to restrict both types of legal trade simultaneously if they want reduce the importation of secondhand goods for material use.

In this paper, we examine monitoring policies on illegal trade and trade restrictions on legal trade in secondhand goods. In particular, we focus on the effect of those policies on environmental damage in importing countries. In other words, assuming that we should reduce environmental damage caused by imported secondhand goods in terms of the welfare of the importing countries and global welfare, we investigate effective policies. In addition, we examine the behavior of governments in choosing their monitoring probabilities and the level of trade restrictions. In particular, our main research questions are as follows: (a) should/do exporting/developed countries commit to stricter monitoring activities; and (b) should international rules restrict the trade in secondhand goods more severely?

There are three important features in our analysis. First, we consider an *import quota* on secondhand goods as a trade-restricting measure. The reason is as follows. In reality, importing countries usually prohibit older secondhand goods because they are difficult to be resold for secondhand use, and are therefore likely to be used as materials. Governments

[5]See the website of the Basel Convention (http://www.basel.int/).

[6]See Shinkuma and Managi (2011) for a comprehensive analysis of waste and recycling.

can then control the quantity of imports of secondhand goods by setting an age limit whereby secondhand goods older than this limit cannot be legally imported. In this paper, although we do not consider the age of secondhand goods explicitly, an import quota in our paper has the same effect as the trade restriction with an age limit in the real world. Because a simple tariff policy cannot distinguish between younger and older secondhand goods, quotas can be effective tools.[7]

Second, technology and environmental management may progress in the future. We also discount environmental damage in the future as we consider present values. Thus, we assume that one unit of recycling in an importing country at present generates greater environmental damage than one unit of recycling in the future. This implies that environmental damage generated by one unit of illegal import is greater than that generated by one unit of legal import for secondhand use because the former leads to recycling at present while the latter leads to recycling in the future. Similarly, the recycling of legal imports for material use generates greater environmental damage than does the recycling of legal imports for secondhand use. This situation justifies policy that strictly restricts secondhand goods for material use.

Third, developed countries benefit from the export of secondhand goods because they can alleviate any scarcity of landfill. On the other hand, when customs in an importing country detect illegal trade, exporters or the governments of exporting countries have to bear ship-back costs, which are sometimes very high. Moreover, detection sometimes leads to diplomatic issues, including the complete prohibition of trade in waste and scrap for a certain period. The home government may also lose reputation, particularly when it joins an international environmental agreement. Thus, we assume that exporting countries also have an incentive to monitor the illegal export of secondhand goods.

In terms of related work, Cassing and Kuhn (2003) investigated the effect of trade restrictions with waste trading. Copeland (1991) also examined trade restrictions in the presence of illegal dumping. However, neither study distinguished between legal and illegal trade, and therefore did not consider monitoring systems. Elsewhere, Clerides and Hadjiyiannis (2008) and Kinnaman and Yokoo (2011) focused on the effect of trade in durable goods, and demonstrated policies that achieve efficiency. However, they also did not consider monitoring issues. As for monitoring, Harford (1978, 1987), Macho-

[7]Selective tariffs, which depend on the ages of secondhand goods can distinguish between younger and older secondhand goods. Nevertheless, the theoretical effects of import quotas are the same as those of tariffs because we assume perfectly competitive markets.

Stadler and Pérez-Costirillo (2006), and Ino (2011) investigated enforcement policies when environmental policies are imperfectly enforceable. However, to our best knowledge, few studies have addressed strategic monitoring and trade restrictions in the context of the trade in secondhand goods.

We demonstrate that when the trade restriction is nonbinding and part of the legally imported goods serve not as secondhand but as materials, an increase in the probability of monitoring may increase expected foreign environmental damage. Alternatively, when the trade restriction is binding, if part of the legal imports (no legal import) is resold for material use, a stricter trade restriction decreases (increases) expected foreign environmental damage. We also demonstrate that when governments choose monitoring probabilities noncooperatively, the foreign monitoring probability is necessarily higher than that in the second-best situation. In such a case, the commitment to a monitoring probability by the home government improves welfare in both countries, and this commitment arises in an extended game in which both governments choose the timing of the move in the first stage and the monitoring probabilities in the second stage. In addition, we consider the situation in which the foreign government chooses not the monitoring probability, but rather the level of an import quota on legal imports. It is then possible that the foreign trade restriction is stricter than the second-best level. In such a case, any commitment by either government cannot simultaneously improve welfare in both countries.

The rest of the paper is organized as follows. Section 2 describes the model and legal/illegal trade. Section 3 defines environmental damage and examines the effects of the policy changes: namely, the monitoring probabilities and trade restrictions. Section 4 investigates the scenario in which both governments noncooperatively choose their monitoring probabilities. Section 5 examines the choice of the level of trade restriction by the government of an importing country. Section 6 extends the analysis to the case in which home country recycling activities in the home country exist. Section 7 provides some concluding remarks.

2 The Model

Consider a developed country, referred to as the *home* country, and a developing country, referred to as the *foreign* country. The home (foreign) country exports (imports) secondhand goods (X). For simplicity, we assume there is no demand for (supply of) secondhand goods in the home (foreign) country. Consumers in the home country use goods X for

one period, after which they are discarded. Conversely, consumers in the foreign country purchase secondhand goods and use them for one period, again discarding them after use.

2.1 Supply and Demand for Secondhand Goods

The supply of secondhand/discarded goods (X) in the home country is constant, denoted by X_s. Collectors in the home country collect discarded goods from consumers. No collector has market power. Collectors then have two alternatives: exporting the secondhand goods to the foreign country either *legally* or *illegally*.[8] These alternatives reflect the following situation. In developed countries, recycling is usually very costly, whereas in developing countries it is much less costly. This is partly because recycling is often conducted using unskilled labor, even though this type of recycling can cause serious environmental damage. Home collectors then have an incentive to export secondhand goods either legally or illegally. When exported illegally, secondhand goods are exported not for secondhand use, but rather for material use. In such cases, hazardous substances are not removed before exportation.[9] They are thus disguised as *recycled materials/waste and scrap*, which are formally supposed not to include hazardous substances. Foreign recyclers then extract materials from those goods. We also consider a scenario in which even legally imported goods may be recycled directly for material use, which also generates serious environmental pollution. Hereafter, we use *exporters* to represent home collectors.

When collectors export discarded goods legally, they have to repair the goods.[10] The marginal cost of repairing depends on the use of the secondhand good. The costs of repair for some goods are low, while those for other very badly broken goods may be high. Those costs may also depend on the skills of collectors. Thus, we define the marginal cost curve of legal export for the entire collecting industry as follows:

$$MC_l = MC_l(X_l), \quad MC_l' > 0,$$

where X_l denotes the quantity of legal exports. The shipping cost is included in MC_l.[11]

[8] A third alternative, selling the secondhand goods to home recyclers, is examined in Section 6. Because the results do not change qualitatively, for clarity, we exclude the alternative for home collectors to sell secondhand goods to home recyclers in the main analysis.

[9] In general, secondhand goods are dismantled so they can be disguised as waste or scrap. Therefore, it is difficult for importers to reassemble these goods for secondhand use.

[10] In reality, they have to do this because customs officers in the importing country often regard broken goods that cannot be used as secondhand. In such cases, importation is not permitted.

[11] We do not explicitly describe the transactions between consumers and collectors. Implicitly, we consider a situation in which the government sets a disposal fee on one unit of good X for consumers.

When collectors export discarded goods illegally, they are obliged to disguise these secondhand goods as materials. Thus, they have to pay a disguising cost, MC_d, which is constant. The shipping cost is also included in MC_d.

There are two types of demand for secondhand goods in the foreign country. First, consumers purchase and use these goods secondhand. Second, recyclers in the foreign country buy secondhand goods, and make profits by extracting the materials from these goods. The inverse demand curve of goods X for secondhand use in the foreign market is given by:

$$p^u = P^u(X_u), \quad P^{u'} < 0, \tag{1}$$

where X_u denotes the quantity of legal imports used secondhand. When a good X is recycled for material use, it provides revenue, p^m, which is exogenous.[12] When $p^u > p^m$ holds, an additional unit of imports of secondhand goods is sold to a consumer. Therefore, in equilibrium, $p^u \geq p^m$ holds. The equality holds when there are legal imports that are directly recycled for material use. Hereafter, let X_l and X_m denote the total quantity of legal imports and the quantity of legal imports which are directly recycled for material use. Note that $X_l = X_u + X_m$ holds.

2.2 Policies

We consider two kinds of policies. First, the foreign government may restrict the legal import of secondhand goods. International trade regulations may also restrict export of these goods. The purpose of this policy is to reduce the import for material use. In this paper, we consider an import quota on legal imports, denoted by $\bar{X}_l$. In the real world, importing countries of secondhand goods often ban the import of older secondhand goods. This is because their secondhand prices are lower than relatively newer secondhand goods, and therefore the older goods are more likely to be recycled following importation. Although we do not explicitly consider the age of the secondhand goods, the effects of import quotas in our theoretical analysis can be applied to the impact of a trade prohibition on older secondhand goods in the real world.[13]

Consumers then have an incentive to pay a collection fee to collectors if the collection fee is at most equal to the disposal fee.

[12]This assumption implies that the material market is competitive and demand is elastic. Moreover, we implicitly consider that the foreign recycling sector is an informal sector and that foreign recyclers receive a subsistence wage. Therefore, p^m more precisely denotes the price of the materials less the subsistence wage.

[13]The home government is also able to set an export restriction. However, importing countries and/or international environmental agreements usually attempt to set stricter restrictions. This is because

Second, both the home and foreign governments monitor illegal trade. Because illegal exports are disguised as recycled materials, governments inspect all material trade. However, customs officers may not be able to identify illegal trade with certainty. Alternatively, they may intentionally overlook any illegal trade. We let α_i $(i = h, f)$ denote the monitoring probability; more precisely, the product of the probability of monitoring and identifiability. The governments then choose the level of α_i.

It is costly for governments to monitor exports/imports. Moreover, when a government identifies goods arising from illegal trade, it must temporarily retain the goods, handing them back to the home collectors. In addition, the foreign government makes collectors ship these goods back to the home country. Hence, the expected operating cost of the monitoring system increases with the expected amount of identified illegal trade. The expected amount also depends on the strictness of the import quota. Thus, the expected operating cost of the monitoring system is:

$$E[C_{G,i}] = E[C_{G,i}(\alpha_i, \bar{X}_l)], \quad i = h, f. \tag{2}$$

Throughout the paper, the combinations of E and square brackets denote expected values. We set up the following assumption on the shape of this cost function.

Assumption 1

$$\frac{\partial E[C_{G,i}]}{\partial \alpha_i} > 0, \quad \frac{\partial^2 E[C_{G,i}]}{\partial \alpha_i^2} > 0, \quad \frac{\partial E[C_{G,i}]}{\partial \alpha_j} = 0,$$
$$\frac{\partial E[C_{G,i}]}{\partial \bar{X}_l} < 0, \quad \frac{\partial^2 E[C_{G,i}]}{\partial \bar{X}_l^2} > 0, \quad \frac{\partial^2 E[C_{G,i}]}{\partial \alpha_i \partial \bar{X}_l} < 0,$$

where $i, j = h, f,\ i \neq j$.

The first two inequalities in the first line are intuitive. The total quantity of traded materials, which are classified as waste and scrap according to trade classifications, is very large.[14] Therefore, the quantity of secondhand goods monitored does not affect the total monitoring cost. Thus, the probability of home (foreign) monitoring does not affect the foreign (home) monitoring cost: see the third equality in the first line. A laxer trade

importing countries suffer most from any environmental/health damage arising from pollution caused by the imported secondhand goods. In such a case, exporting countries respect the restrictions set by the importing countries. Thus, we focus on trade restrictions set by the importing countries and through international trade regulation.

[14] An example of a trade classification is the Harmonized Commodity Description and Coding System (HS) for tariff nomenclature.

restriction, which implies a larger $\bar{X}_l$, then leads to a lower monitoring cost because the expected amount of identified illegal trade decreases: see the three inequalities in the second line.

The fine set by each government is F_h and F_f, respectively.[15] In this model, we assume these fines are exogenous. The reason for this is that the level of the fine for the illegal export/import should accord with fines for other types of illegal activity. Thus, we exclude an infinitely large fine.[16]

2.3 Legal Trade, Illegal Trade, and Recycling in the Home Country

Assuming that the supply of discarded goods in the home country is sufficiently large such that illegal trade necessarily exists, we now consider the determination of the quantities of legal and illegal imports of the secondhand goods. We assume the following situation. There are many exporters (foreign brokers) in the home (foreign) country. We refer to a foreign broker as an importer. One importer and one exporter make a deal to trade each unit of secondhand goods. The two stakeholders divide the net expected profit from the deal. The ratio that the exporter (importer) gains is β $(1-\beta)$, where $0 < \beta < 1$.[17]

First, by taking into consideration monitoring by both the home and foreign countries, we redefine the cost of illegal export. This is because the exporter or the importer must pay the fine and ship-back cost associated with the discovery of illegal trade. Thus, the expected marginal cost of illegal export ($E[C_{il}]$) is greater than MC_d in the presence of monitoring:

$$E[C_{il}] = MC_d + \alpha_h F_h + \alpha_f(1-\alpha_h)(F_f + \lambda),$$

where λ denotes the ship-back cost.[18] We set up the following assumption.

Assumption 2 *$\partial E[C_{il}]/\partial \alpha_h > 0$, i.e., $F_h - \alpha_f(F_f + \lambda) > 0$.*

[15] Not only importing countries but also exporting countries usually set fines. For example, in Japan, the Waste Disposal and Public Cleaning Law stipulates fines for the illegal export of secondhand goods and waste. See the website for the Ministry of the Environment (http://www.env.go.jp/en/laws/recycle/index.html).

[16] The possibility of mistaken arrest also provides a basis for the argument that fines should not be infinitely large.

[17] We do not delve into the details concerning the problem of contracts between exporters and importers.

[18] As noted in the introduction and will be noted in Section 4, we assume the existence of an additional cost relating to detection, which is borne by the home government. Thus, the home government has an incentive to monitor illegal exports.

This assumption implies that an increase in the home identifying probability increases the expected cost of illegal export.

Some of secondhand goods that exporters attempt to export illegally are identified by customs officers of both countries and shipped them back to the home country. We assume that these shipped back goods are recycled in the home country. Let $\tilde{X}_{il}$ and X^*_{il} denote the quantity of discarded goods that home recyclers attempt to export illegally and the realized quantity of illegal exports, respectively. It then holds that:

$$E[X^*_{il}] = (1-\alpha_h)(1-\alpha_f)\tilde{X}_{il}. \tag{3}$$

Moreover, total expected import of discarded goods ($E[IM]$) is given by

$$E[IM^*] = X_l + E[X^*_{il}].$$

In addition, it holds that

$$X_s = X_l + \tilde{X}_{il} = X_l + X^*_{il} + X_r,$$

where X_r denotes the quantity of discarded goods that are recycled in the home country.

There are four possible cases. In the first case, an import quota is binding, and part of the legally imported secondhand goods is resold for material use (see Figure 1 (a)). In this case, $X_l = \bar{X}_l$ and $p^m - MC_l(\bar{X}_l) > (1-\alpha_h)(1-\alpha_f)p^m - E[C_{il}]$ hold. In the second case, an import quota is also binding. Contrary to the first case, no legally imported secondhand goods are resold for material use (see Figure 1 (b)). $X_l = \bar{X}_l$ and $P^u(\bar{X}_l) - MC_l(\bar{X}_l) > (1-\alpha_h)(1-\alpha_f)p^m - E[C_{il}]$ hold. In the third case, the trade restriction is nonbinding, and part of the legally imported secondhand goods is resold for material use (see Figure 1 (c)). "Nonbinding" implies either that there is no import quota, or that there is an international regulation, but it is too lax. The quantity of legal imports is determined such that

$$p^m - MC_l(X_l) = (1-\alpha_h)(1-\alpha_f)p^m - E[C_{il}] \tag{4}$$

holds. In the fourth case, the trade restriction is nonbinding. Contrary to the third case, no legally imported secondhand goods are resold for material use (see Figure 1 (d)). The quantity of legal imports is determined such that

$$P^u(X_l) - MC_l(X_l) = (1-\alpha_h)(1-\alpha_f)p^m - E[C_{il}] \tag{5}$$

holds.

3 Foreign Environmental Damage

The recycling of secondhand goods in the foreign country generates environmental pollution. When imported goods are for secondhand use, they will be recycled in the future. Technology and environmental management may progress in the future. As we consider present values, we discount the environmental damage generated in the future. Therefore, we assume that the environmental damage from the recycling of (a) illegal imports (X_{il}) and (b) legal imports for material use (X_m) is greater than that of legal imports for secondhand use (X_u): one unit of recycling in the foreign country at present generates μ_f^M units of environmental damage, while that in the future generates μ_f^S units of environmental damage, where $\mu_f^M > \mu_f^S$. Then, the foreign expected environmental damage is defined as

$$E[e_f] = \mu_f^M \cdot (E[X_{il}^*] + X_m) + \mu_f^S \cdot X_u. \tag{6}$$

Recycling activity in the home country is costly, but it does not generate environmental damage as we assume its proper management. However, the home country faces the problem of a scarcity of landfills. An increase in recycling activity in the home country thus leads to an increase in the residual disposed of into landfills. Thus, recycling in the home country generates an external cost. Assuming one unit of recycling in the home country generates μ_h units of external cost, the expected cost related to home recycling is defined as

$$E[e_h] = \mu_h \cdot (X_s - E[IM^*]).$$

3.1 Policy Effects

We now investigate whether monitoring or an import quota can decrease foreign environmental damage.

First, we examine the effect of an increase in the probability of monitoring. In terms of importers and exporters, α_h and α_f have similar effects. Thus, we focus on α_h. When an import quota is binding, a change in the monitoring probability does not affect the quantities of legal imports for both secondhand and material use, which also implies that $\tilde{X}_{il}$ does not change. Then, from (3), we obtain that

$$\frac{\partial E[X_{il}^*]}{\partial \alpha_h} = -(1 - \alpha_f)\tilde{X}_{il}.$$

The quantity of realized illegal imports decreases, because an increase in the monitoring probability increases the quantity of identified illegal trade.

When an import quota is nonbinding, the monitoring probability affects the quantity of legal imports. When part of the legal imports is recycled for material use (Figure 1 (c)), from (4) and Assumption 2, we obtain that

$$\frac{dX_m}{d\alpha_h} = \frac{(1-\alpha_f)p^m + \frac{\partial E[C_{il}]}{\partial \alpha_h}}{MC_l'(X_l)} > 0.$$

An increase in monitoring probability increases the expected cost of illegal trade. The costs of repair for some secondhand goods then become smaller than the expected cost of illegal trade. Thus, the quantity of legal trade for material use increases.

Because $\tilde{X}_{il} = X_s - X_l$ and because X_u does not change, it also holds that

$$\frac{d\tilde{X}_{il}}{d\alpha_h} = -\frac{dX_m}{d\alpha_h} < 0,$$

$$\frac{dE[X_{il}^*]}{d\alpha_h} = -(1-\alpha_f)\tilde{X}_{il} + (1-\alpha_h)(1-\alpha_f)\frac{d\tilde{X}_{il}}{d\alpha_h} < 0. \tag{7}$$

Whether the total expected quantity of imports for material use ($X_m + E[X_{il}^*]$) increases or decreases depends on the supply of secondhand goods, the value of the fines, the shape of the marginal repair cost curve, the level of α_h, and the ship-back cost. More precisely, two effects arise. First, the trade of secondhand goods for material use partly changes from illegal to legal trade. In this respect, the quantity of imports for material use increases because the foreign government cannot ship them back when legally imported. Second, an increase in monitoring probability increases the probability of identifying illegal trade. In this respect, the quantity of imports for recycling decreases. In total, the former effect may dominate the latter.

When no legal imports are recycled for material use (Figure 1 (d)), from (5), we obtain that

$$\frac{dX_u}{d\alpha_h} = \frac{dX_l}{d\alpha_h} = -\frac{(1-\alpha_f)p^m + \frac{\partial E[C_{il}]}{\partial \alpha_h}}{p^{u\prime}(X_l) - MC_l'(X_l)} > 0.$$

Note that (7) and $dX_u/d\alpha_h = -d\tilde{X}_{il}/d\alpha_h$ also hold in this case. Therefore, the amount of the increase in legal imports for secondhand use is smaller than the amount of the decrease in illegal imports. Because $\mu_f^S < \mu_f^M$, foreign environmental damage necessarily decreases.

Proposition 1

An increase in monitoring probability ($\alpha_i,\ i = h, f$) necessarily decreases expected foreign environmental damage (a) when an import quota is binding, or (b) when an import quota

is nonbinding and no legal imports are used for materials. On the other hand, when a trade restriction is nonbinding and part of the legal imports are for use as materials, an increase in the monitoring probability may increase the expected foreign environmental damage.

Next, we examine the effect of a stricter trade restriction: a decrease in $\bar{X}_l$. It is obvious that when an import quota is nonbinding, a stricter trade restriction does not affect the quantity of legal imports or the expected quantity of illegal imports. There is no effect on the quantity of goods for secondhand use and as materials.

On the other hand, when an import quota is binding, $\partial X_l/\partial \bar{X}_l > 0$ holds.

Lemma 1

Suppose that an import quota is binding. Then, given the monitoring probabilities of both countries, a stricter trade restriction necessarily decreases (increases) the quantity of legal (illegal) trade.

A stricter trade restriction implies a smaller $\bar{X}_l$. Lemma 1 implies that part of the imports for material use change from legal to illegal trade. When a part of legal imports is resold for material use, a stricter trade restriction leads to a decrease in imports for material use. The reason is that when discarded goods are imported legally for material use, customs officers cannot distinguish goods for material use from those for secondhand use. On the other hand, when discarded goods are imported illegally, foreign customs officers may be able to identify these goods and ship them back to the home country. Conversely, when no legal imports are for materials, a stricter trade restriction leads to an increase in the imports for material use. This is because part of the imports change from legal trade for secondhand use to illegal trade for material use. Consequently, the following result is established.

Proposition 2

When an import quota is binding, if part of the legal imports (no legal import) is resold for material use, a stricter trade restriction decreases (increases) expected foreign environmental damage.

We note three important policy implications. First, when an import quota is nonbinding, an increase in the monitoring probability may worsen foreign environmental damage because the quantity of imports for material use increases. Interestingly, the original purpose of monitoring is to decrease foreign environmental damage. However, it may give rise

to the opposite effect. In such a case, the foreign government does not have an incentive to increase the probability of monitoring. In other words, for the foreign government to have an incentive to monitor illegal imports to mitigate foreign environmental damage caused by the recycling of imported secondhand goods, there may be a need for a binding import quota.

Second, the smaller is α_i $(i = h, f)$, the larger the gains from illegal trade, and accordingly, the smaller the quantity of legal trade. This implies that a decrease in α_i increases the possibility that the trade restriction is nonbinding, given $\bar{X}_l$. Therefore, the trade restriction cannot be effective when monitoring systems do not function well. Thus, we can say that monitoring activities and trade restrictions are complements.

Third, in the literature when illegal activities cannot be punished with certainty, a trade restriction is justified to achieve the second-best outcome.[19] On the other hand, in the present case, because both legal and illegal imports generate environmental damage, a trade restriction may induce an increase in environmental damage. Therefore, a trade restriction is not always justified.

4 Noncooperative Choices of Monitoring Probabilities

We have obtained that a binding import quota can be important such that the foreign government has an incentive to monitor illegal trade when part of the legal imports is resold to foreign recyclers for material use. In this section, assuming that the level of trade restriction $(\bar{X}_l)$ is exogenous, we consider the situation in which the governments choose the monitoring probabilities $(\alpha_i \ (i = h, f))$ to maximize the welfare of their own countries. The exogeneity of the import quota suggests that it is part of the stipulations of an international environmental agreement. For clarity of the analysis and applicability to real-world situations, we focus on the case in which an import quota is binding, and part of the legally imported goods go directly into the recycling process of the foreign country for material use ($X_m > 0$, see Figure 1 (a)).

Home welfare is defined as the sum of the net profits of exporters and government revenue less the costs for the government arising from the identification of illegal trade

[19] For example, see Copeland (1991).

(T), the costs relating to home recycling, and the monitoring cost:

$$\begin{aligned} E[W_h] &= \beta \cdot \left(p^m \bar{X}_l - \int_0^{\bar{X}_l} MC_l(y)dy \right) + \beta \cdot \{(1-\alpha_h)(1-\alpha_f)p^m - E[C_{il}]\} \cdot \tilde{X}_{il} \\ &\quad + \alpha_h F_h \tilde{X}_l - \alpha_f (1-\alpha_h) T \tilde{X}_{il} - \mu_h \cdot (\alpha_h + \alpha_f - \alpha_h \alpha_f) \tilde{X}_{il} - E[C_{G,h}]. \end{aligned} \tag{8}$$

Note that $\tilde{X}_{il} = X_s - \bar{X}_l$. Moreover, T is the cost for the home government of the detection of illegal exports by the foreign government. Sometimes detection leads to diplomatic actions including the complete ban of waste and scrap for a certain period. The home government may also lose reputation, particularly when it is part of an international environmental agreement. Because this is a form of external cost, it is not considered by the exporter.

Foreign welfare is defined as the sum of consumer surplus from secondhand use (CS_u), the net profits of importers, and government revenue less the environmental damage and the monitoring cost:

$$\begin{aligned} E[W_f] &= CS_u + (1-\beta) \cdot \left(p^m \bar{X}_l - \int_0^{\bar{X}_l} MC_l(y)dy \right) \\ &\quad + (1-\beta) \cdot \{(1-\alpha_h)(1-\alpha_f)p^m - E[C_{il}]\} \cdot \tilde{X}_{il} + \alpha_f (1-\alpha_h) F_f \tilde{X}_{il} \\ &\quad - \mu_f^M \cdot \left\{ (1-\alpha_h)(1-\alpha_f)\tilde{X}_{il} + \bar{X}_l - X_u \right\} - \mu_f^S X_u - E[C_{G,f}]. \end{aligned} \tag{9}$$

4.1 Monitoring Game

Because the seriousness of the environmental damage arising from recycling goods X for material use differs from that when they are used secondhand, for the first-best situation to be achieved, the markets must be segmented according to their purpose for use. In other words, the price of goods for secondhand use should differ from that for recycling. However, in the situation we focus on for legally traded goods, it is difficult for customs officers to distinguish between secondhand goods for secondhand use and those for material use. We assume that in the foreign country these markets are integrated. Therefore, we consider that the second-best situation is the benchmark given the integration of these markets. Because the level of trade restriction is exogenous, the first-order conditions (FOCs) for the second-best situation are given by

$$\frac{\partial (E[W_h] + E[W_f])}{\partial \alpha_h} = 0, \quad \frac{\partial (E[W_h] + E[W_f])}{\partial \alpha_f} = 0.$$

We regard the combination of monitoring probabilities that satisfies the above FOCs as a cooperative equilibrium. We also assume that the second-order conditions (SOCs) hold.

By contrast, when each government selects its monitoring probability noncooperatively, from (8) and (9), the FOCs are

$$\begin{aligned}\frac{\partial E[W_h]}{\partial \alpha_h} &= -\beta \tilde{X}_{il} \cdot \{(1-\alpha_f)p^m + F_h - \alpha_f(F_f+\lambda)\} + (F_h + \alpha_f T)\tilde{X}_{il} \\ &\quad -\mu_h \cdot (1-\alpha_f)\tilde{X}_{il} - \frac{\partial E[C_{G,h}]}{\partial \alpha_h} = 0, \end{aligned} \tag{10}$$

$$\begin{aligned}\frac{\partial E[W_f]}{\partial \alpha_f} &= -(1-\beta)(1-\alpha_h)(p^m + F_f + \lambda)\tilde{X}_{il} \\ &\quad +(1-\alpha_h)(F_f + \mu_f)\tilde{X}_{il} - \frac{\partial E[C_{G,f}]}{\partial \alpha_f} = 0. \end{aligned} \tag{11}$$

For the home country, an increase in its own monitoring probability decreases the surplus from the export of secondhand goods, increases home recycling, and increases the monitoring cost. At the same time, it can avoid fines imposed by the foreign government and the costs related to detection/ship-back. For the foreign country, an increase in its own monitoring probability decreases the surplus from the import of secondhand goods and increases the monitoring cost. It also increases the revenue from fines and decreases environmental damage.

We let $\alpha_i^N (i = h, f)$ denote the equilibrium probabilities in the noncooperative Nash equilibrium.[20] We refer to this equilibrium as *the simultaneous move equilibrium*. In the following, we focus on the case in which the home government chooses a positive amount of monitoring probability. The home government can save the external cost related to the identification of illegal trade by foreign customs and gain government revenue by increasing the monitoring probability. Thus, it follows from (10) that the home government is likely to choose a positive monitoring probability (a) unless α_f and/or T are very small and (b) unless μ_h is large.

We obtain the following partial derivatives:

$$\begin{aligned}\frac{\partial E[W_h]}{\partial \alpha_f} &= -\beta \cdot (1-\alpha_h)(p^m + F_f + \lambda)\tilde{X}_{il} \\ &\quad -(1-\alpha_h)(T + \mu_h)\tilde{X}_{il} \\ &\quad < 0. \end{aligned} \tag{12}$$

[20] From Assumption 1, and Equations (10) and (11), we obtain

$$\frac{\partial^2 E[W_i]}{\partial \alpha_i^2} = -\frac{\partial^2 E[C_{G,i}]}{\partial \alpha_h^2} < 0, \quad i = h, f.$$

We will show in (14) and (15), $\partial^2 E[W_h]/\partial \alpha_h \partial \alpha_f > 0$ and $\partial^2 E[W_f]/\partial \alpha_h \partial \alpha_f < 0$ hold. Thus, the SOCs are satisfied.

$$\frac{\partial E[W_f]}{\partial \alpha_h} = -(1-\beta)\left\{(1-\alpha_f)p^m + F_h - \alpha_f(F_f+\lambda)\right\}\tilde{X}_{il} - \alpha_f F_f \tilde{X}_{il} + \mu_f \cdot (1-\alpha_f)\tilde{X}_{il}. \quad (13)$$

Thus, we obtain the following result.

Proposition 3

In the simultaneous move equilibrium, the foreign monitoring probability is necessarily higher than in the second-best situation. Conversely, whether the home monitoring probability is higher than that in the second-best situation is generally ambiguous. It is, however, likely that the home monitoring probability is lower (higher) than that in the second-best situation, if (a) foreign environmental damage is serious (not serious) and (b) the ratio of the net profits gained by importers are small (large).

An increase in the foreign monitoring probability decreases the realized imports for material use and increases the external cost related to ship-back and recycling in the home country. Both of these effects reduce home welfare. Because the foreign government does not take into consideration the loss of the home country, the foreign monitoring probability in the simultaneous move equilibrium is necessarily higher than in the second-best situation. An increase in the home monitoring probability also decreases the realized imports for material use. This decrease gives rise to three effects: first, the pecuniary benefit from illegal imports decreases; second, the foreign government revenue decreases; and third, foreign environmental damage falls. Thus, when the third effect dominates the sum of the first two effects, the home monitoring probability in the simultaneous move equilibrium is lower than that in the second-best situation.

4.2 Commitment

Given the level of trade restriction, can commitment by either government improve the welfare of both countries? First, we note the following second partial derivative.

$$\frac{\partial^2 E[W_h]}{\partial \alpha_h \partial \alpha_f} = \beta \cdot (p^m + F_f + \lambda)\tilde{X}_{il} + (T + \mu_h)\tilde{X}_{il} > 0. \quad (14)$$

From (11), we also obtain that

$$\frac{\partial^2 E[W_f]}{\partial \alpha_h \partial \alpha_f} = (1-\beta) \cdot (p^m + F_f + \lambda)\tilde{X}_{il} - (F_f + \mu_f)\tilde{X}_{il} < 0. \quad (15)$$

An increase in the foreign monitoring probability increases the possibility of ship-back. The home government can avoid this possibility of ship-back by increasing its own moni-

toring probability. Moreover, a marginal decrease in the surplus from the export of secondhand goods becomes smaller. Thus, the home government increases the monitoring probability in response to an increase in the foreign monitoring probability (see (14)).

By contrast, recalling that it is costly to monitor material trade, the foreign government can save the monitoring cost when the home government increases its monitoring probability. In this respect, the foreign government has an incentive to decrease its monitoring probability in response to an increase in the home monitoring probability. On the other hand, as the home monitoring probability becomes smaller, the marginal decrease in the surplus from the import of secondhand goods becomes smaller. In this respect, the foreign government has an incentive to increase its monitoring probability in response to an increase in the home monitoring probability. Equation (15) reveals that the former effect necessarily dominates the latter. Thus, the foreign government decreases its monitoring probability in response to an increase in the home monitoring probability. The situation in the case of $\partial E[W_f]/\partial \alpha_h > 0$ ($\partial E[W_f]/\partial \alpha_h < 0$) is shown in Figure 2 (a) (2 (b)). R_i $(i = h, f)$ and I_i $(i = h, f)$ denote the reaction function and social indifference curve, respectively.

Suppose that $\partial E[W_f]/\partial \alpha_h > 0$, and consider the situation in which the home government commits itself to a certain monitoring probability, i.e., the home (foreign) government is the leader (follower) in determining the monitoring probabilities. In this case, Point A in Figure 2 (a) depicts the equilibrium. It is clear that the welfare of both countries improves when compared with those in the noncooperative Nash equilibrium.

Let us define the extended game as follows. both governments choose the timings of moves in the first stage, and their own monitoring probabilities in the second stage. Thne, as proved by Hamilton and Slutsky (1990, Theorem V), the home government moves first and the foreign government moves second in the unique subgame perfect equilibrium in the extended game between both governments: that is, the governments choose the timing of the moves in the first stage and the monitoring probabilities in the second stage.

Proposition 4

Suppose that $\partial E[W_f]/\partial \alpha_h > 0$. A commitment of monitoring probability by the home government then improves the welfare of both countries compared with those in the simultaneous move equilibrium. Moreover, in the subgame perfect Nash equilibrium of the extended game, the home (foreign) government moves first (second), which implies that the home government chooses to make a commitment.

Proposition 4 provides an interesting policy implication. That is, a binding import quota not only gives the foreign government an incentive to monitor the illegal import of second-hand goods, but also generates a Pareto superior set of monitoring probabilities compared with those in the noncooperative Nash equilibrium through the choice of the timing of moves.

In the case of $\partial E[W_f]/\partial \alpha_h < 0$, the foreign government chooses to make a commitment in the subgame perfect Nash equilibrium of the extended game. In other words, the foreign (home) government becomes a leader (follower). Similar to the case of $\partial E[W_f]/\partial \alpha_h > 0$, a Pareto superior set of monitoring probabilities compared with those in the simultaneous move equilibrium arises, although the situation in which both monitoring probabilities in the simultaneous move equilibrium are higher than the second-best probabilities seems to be rather less realistic.

5 The Choice of Trade Restriction by the Importing Country

Let us now turn to the scenario where the foreign monitoring probability has an upper limit: $\alpha_f = \bar{\alpha}_f$. For example, slow decision-making processes in bureaucratic organizations may make it difficult for the foreign government to increase its monitoring probability in the short run because the policy change also requires changes in personnel. In this case, the foreign government may choose the level of trade restriction to maximize its own welfare, at least in the short run. On the other hand, and similar to the results in the previous section, the home government chooses its monitoring probability, and part of the legal imports are resold to foreign recyclers for material use.

In a noncooperative Nash equilibrium, the FOC for the home government is the same as (10), while the FOC for the foreign government is given by

$$\begin{aligned}\frac{\partial E[W_f]}{\partial \bar{X}_l} &= (1-\beta)(p^m - MC_l(\bar{X}_l)) - (1-\beta)\cdot\{(1-\alpha_h)(1-\alpha_f)p^m - E[C_{il}]\} \\ &\quad -\alpha_f(1-\alpha_h)F_f - \mu_f\cdot(\alpha_h+\alpha_f-\alpha_h\alpha_f) - \frac{\partial E[C_{G,f}]}{\partial \bar{X}_l} \\ &= 0.\end{aligned}$$

We assume that the SOCs and stability condition are satisfied.

For the level of trade restriction, we obtain that

$$\frac{\partial E[W_h]}{\partial \bar{X}_l} = \beta\cdot(p^m - MC_l(\bar{X}_l)) - \beta\cdot\{(1-\alpha_h)(1-\alpha_f)p^m - E[C_{il}]\}$$

$$-\alpha_h F_h + \alpha_f(1-\alpha_h)T + \mu_h(\alpha_h + \alpha_f - \alpha_h\alpha_f) - \frac{\partial E[C_{G,h}]}{\partial \bar{X}_l}. \qquad (16)$$

$p^m - MC_l(\bar{X}_l) > (1-\alpha_h)(1-\alpha_f)p^m - E[C_{il}]$ holds when an import quota is binding. Thus, from Assumption 1, the following result is obtained.

Proposition 5

In the simultaneous move equilibrium, the foreign trade restriction is stricter than in the second-best situation if the expected amount of punishment by the home government is smaller than the sum of the expected government cost with realized ship-back and expected home environmental damage. On the other hand, it is likely that the home monitoring probability is higher than that in the second-best situation if (a) the foreign environmental damage is serious, and (b) the ratio of the net profits gained by importers are small.

Similar to the previous section, focusing on the case of $\partial E[W_f]/\partial \alpha_h > 0$, we consider the commitment problem. Using (10) and Assumption 2, we obtain

$$\frac{\partial^2 E[W_h]}{\partial \bar{X}_l \partial \alpha_h} = \beta \cdot \{(1-\alpha_f)p^m + F_h - \alpha_f(F_f + \lambda)\} - F_h - \alpha_f T + \mu_h(1-\alpha_f) < 0. \qquad (17)$$

The intuition is the same as in the monitoring game: a stricter trade restriction increases the possibility of ship-back. The home government can avoid ship-back by increasing its own monitoring probability.[21] Moreover, from (13), we obtain

$$\frac{\partial^2 E[W_f]}{\partial \alpha_h \partial \bar{X}_l} = (1-\beta) \cdot \{(1-\alpha_f)p^m + F_h - \alpha_f(F_f + \lambda)\} + \alpha_f F_f - \mu_f \cdot (1-\alpha_f) < 0. \quad (18)$$

Contrary to the case of the monitoring game, the foreign government chooses a stricter trade restriction in response to a higher home monitoring probability. An increase in the home monitoring probability means that realized illegal imports decrease given the foreign monitoring probability. Therefore, the foreign government can decrease the import of secondhand goods for material use more effectively through stricter trade restrictions on legal imports. Note that strategic complements hold for both governments.[22]

The case in which $\partial E[W_h]/\partial \bar{X}_l > 0$ is shown in Figure 3 (a). In this case, a commitment by either government or an international agreement on a stricter trade restriction cannot simultaneously improve the welfare of both countries. This situation lies in sharp contrast

[21] We may recall that a smaller $\bar{X}_l$ implies a stricter trade restriction.

[22] Because a smaller $\bar{X}_l$ implies a stricter trade restriction, the inequalities of (17) and (18) implies strategic complements.

to the case in which the foreign government chooses its monitoring probability. To achieve a Pareto superior situation, the trade restriction on legal imports should be laxer and the home monitoring probability should be higher as compared with those in the simultaneous move equilibrium. Moreover, as proved by Hamilton and Slutsky (1990, Theorem V), both governments move simultaneously, even in the extended game. In this situation, a free hand should not be given to an importing country to set an import quota noncooperatively.

The case in which $\partial E[W_h]/\partial \bar{X}_l < 0$ is shown in Figure 3 (b). In this case, a commitment by either government can simultaneously improve the welfare of both countries. In addition, the extended game has multiple equilibria. In other words, it is important for the home (or foreign) government to commit to the second-best level of monitoring probability (or import quota).

6 Recycling in the Home Country

We have thus far considered that home collectors export discarded goods legally or illegally. However, they may have yet another alternative: namely, selling discarded goods to home recyclers. Even if we consider this scenario, we obtain similar results about the policy effects on foreign environmental damage. Similar to previous sections, we assume that the supply of discarded goods is sufficiently large such that illegal exports exist.

Let us define the marginal cost curve for recycling in the home country:

$$MC_r = MC_r(X_r), \quad MC_r' > 0.$$

Then, in addition to the conditions described in Subsection 2.3 for the possible four cases, such as (4) and (5), the following condition holds:

$$(1-\alpha_h)(1-\alpha_f)p^m - E[C_{il}] = p^m - MC_r(\tilde{X}_r),$$

where $\tilde{X}_r$ denotes the quantity of discarded goods that home collectors determine to sell them to home recyclers: $\tilde{X}_r = X_s - X_l - \tilde{X}_{il}$. This condition depends on neither whether the trade restriction is binding nor whether a part of any legal imports is resold to foreign recyclers. Because part of the illegal exports is shipped back to the home country, the expected quantity of total home recycling is:

$$E[X_r^*] = \tilde{X}_r + (\alpha_h + \alpha_f - \alpha_h\alpha_f)\tilde{X}_{il}.$$

The effect of a higher home monitoring probability on $\tilde{X}_r$ is given by

$$\frac{d\tilde{X}_r}{d\alpha_h} = \frac{(1-\alpha_f)p^m - \frac{\partial E[C_{il}]}{\partial \alpha_h}}{MC_r'} > 0.$$

This implies that when the home government increases its monitoring probability, not only the quantity of legal imports, but also the sales of discarded goods directly from home collectors to home recyclers increase. The increase in sales to home recyclers reduces foreign environmental damage. Thus, the possibility that a higher monitoring probability accounts for more serious foreign environmental damage is lower compared with the case without the alternative of selling discarded goods to home recyclers. However, even for the present case, Propositions 1 and 2 hold.

When both the home and foreign governments choose their own monitoring probabilities given the level of trade restriction, the slope of the reaction function of the home government is not necessarily positive. The reason is that an increase in the foreign monitoring probability increases the recycling cost in the home country. Because the marginal recycling cost also increases, an increase in the home monitoring probability becomes more costly. Then, the home government may decrease its monitoring probability in response to an increase in the foreign monitoring probability.

When the slope of the reaction function of the home government is negative, if $\partial E[W_f]/\partial \alpha_h > 0$, multiple equilibria exist in the extended game. This means that the following situation can arise: the home (foreign) government is a leader (follower) in the subgame perfect Nash equilibrium. This equilibrium achieves a Pareto superior set of monitoring probabilities compared with that in the simultaneous move equilibrium.

7 Conclusion

By assuming that the home (foreign) country exports (imports) secondhand goods, we examined monitoring policies on the illegal trade and restrictions on the legal trade in secondhand goods. We focused on the level of environmental damage in importing countries. We also investigated the behavior of both governments in choosing their own monitoring probabilities and the level of trade restrictions.

First, we demonstrated that when the trade restriction is nonbinding and part of any legally imported goods serve as materials, an increase in monitoring probability may increase expected foreign environmental damage. Moreover, when the trade restriction is

binding, if part of the legal imports (no legal import) is resold for material use, a stricter trade restriction decreases (increases) expected foreign environmental damage.

Second, we found that when governments choose their monitoring probabilities non-cooperatively, the foreign monitoring probability is necessarily higher than that in the second-best situation. In this case, a commitment to a monitoring probability by the home government improves welfare in both countries, and this commitment arises in the extended game in which both governments choose the timing of their move in the first stage and their monitoring probabilities in the second stage. The reason is that the home government increases its monitoring probability in response to an increase in the foreign monitoring probability.

Third, we consider the situation in which the foreign government chooses not the monitoring probability, but rather the level of an import quota on legal imports. It is possible that the foreign trade restriction is stricter than the second-best level. In such a case, any commitment by either government cannot simultaneously improve welfare in both countries.

Finally, the responses for our initial research questions are as follows. First, exporting countries should commit to stricter monitoring probabilities if the present situation appears to correspond to the simultaneous move equilibrium. In the presence of a binding trade restriction, a Pareto superior situation will then arise. Second, when importing countries choose the level of trade restriction, it is possible that they are too strict. In such a case, free hands should not be given to importing countries to set import quotas. International trade organizations should set the level of any trade restriction.

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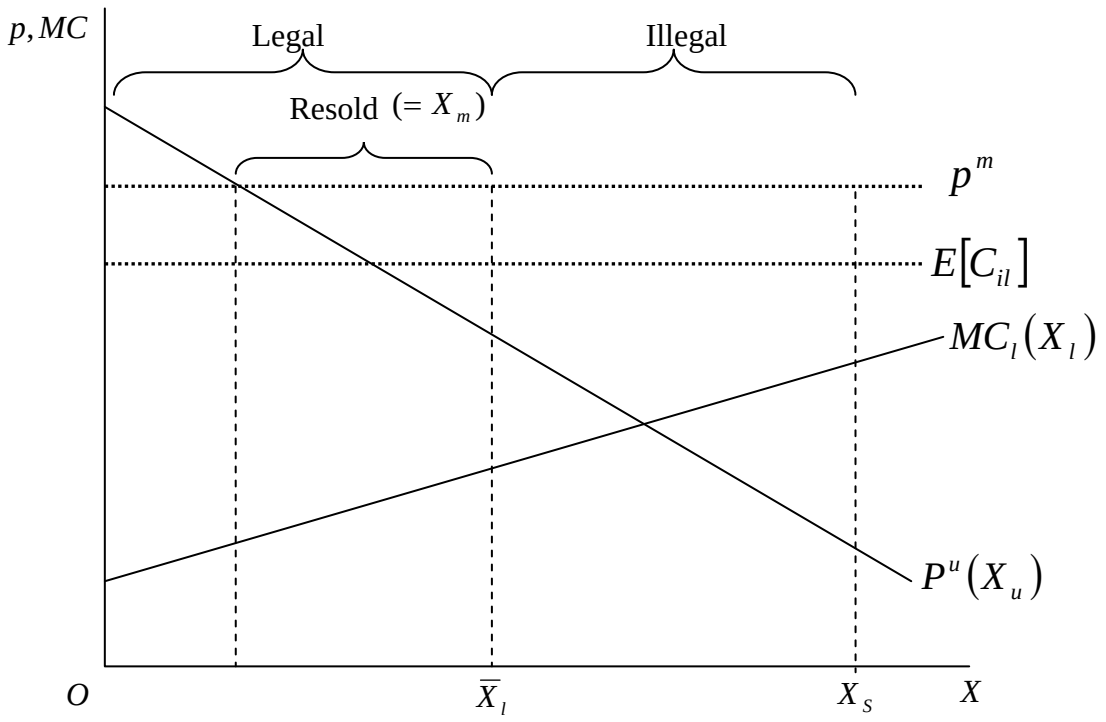

Figure 1 (a): The case of binding trade restriction when a part of legal imports are resold to foreign recyclers for material use.

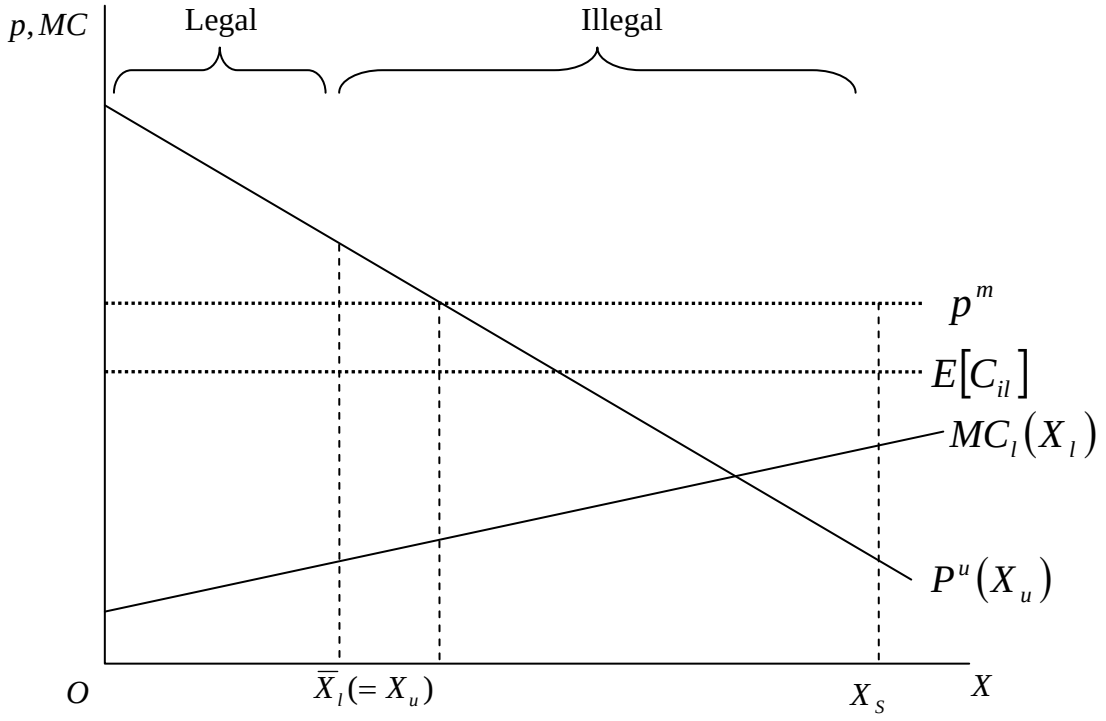

Figure 1 (b): The case of binding trade restriction when no legally traded imports are resold to foreign recyclers.

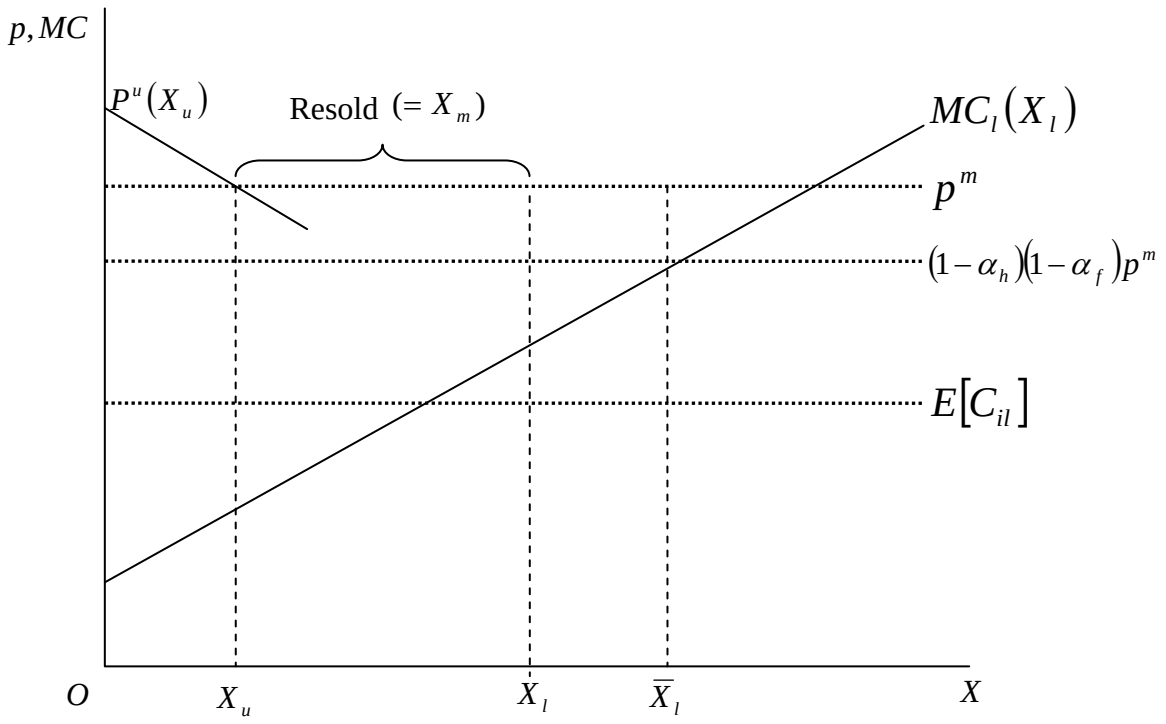

Figure 1 (c): The case of non-binding trade restriction when a part of legal imports are resold to foreign recyclers for material use.

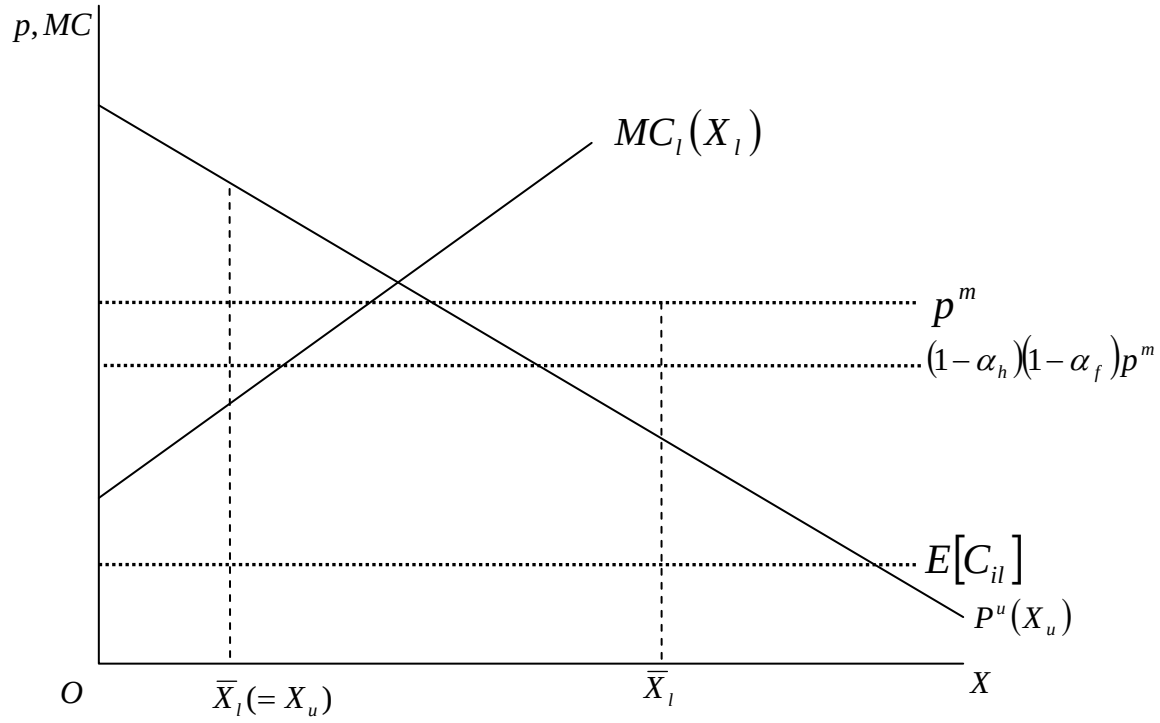

Figure 1 (d): The case of non-binding trade restriction when no legally traded imports are resold to foreign recyclers.

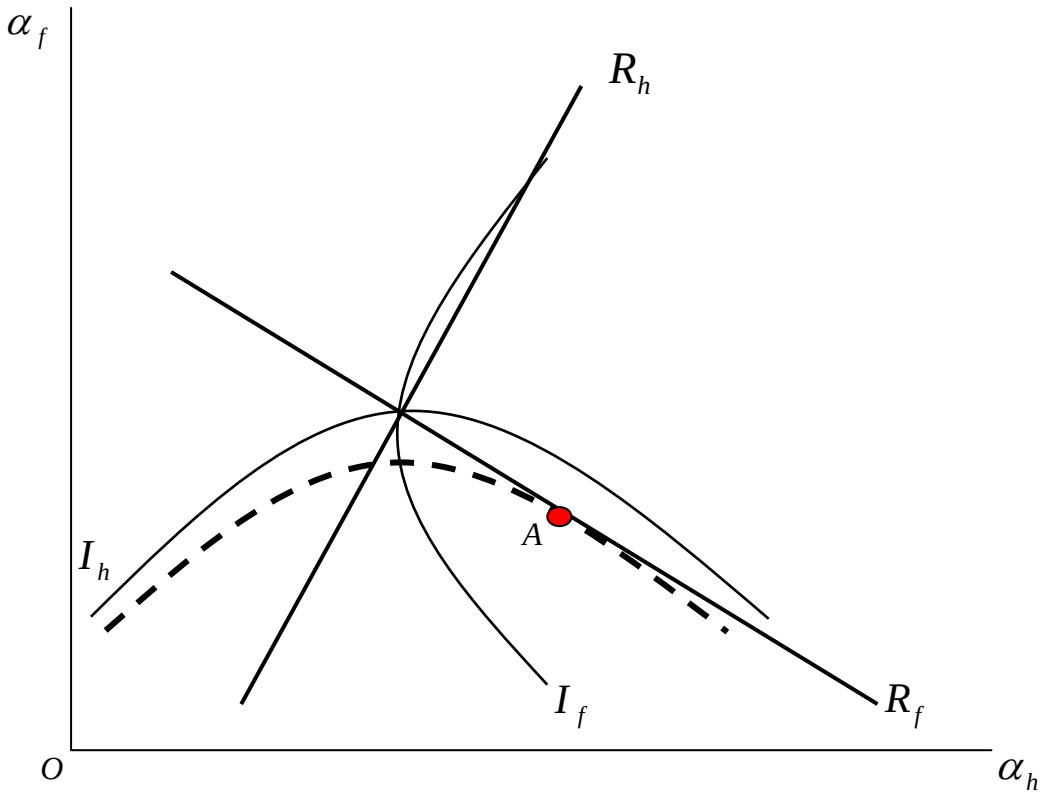

Figure 2(a) : Equilibrium in the monitoring game when $\partial E\lfloor W_f \rfloor / \partial \alpha_h > 0$

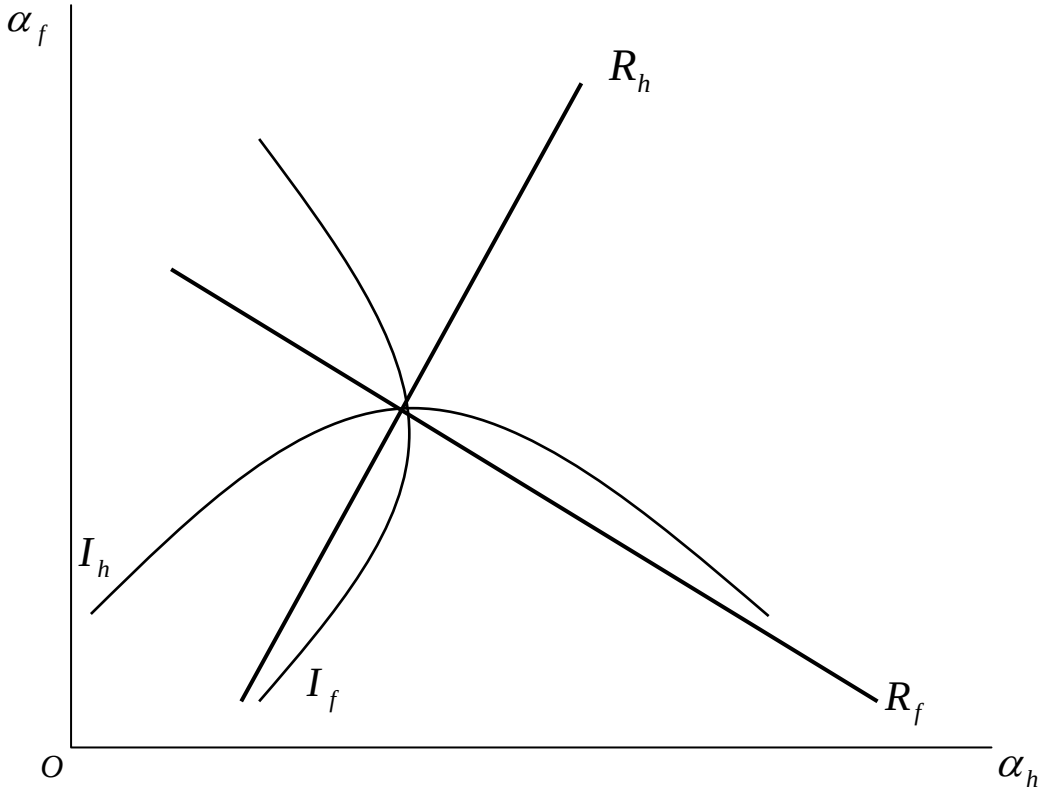

Figure 2(a) : Equilibrium in the monitoring game when $\partial E\lfloor W_f \rfloor / \partial \alpha_h < 0$

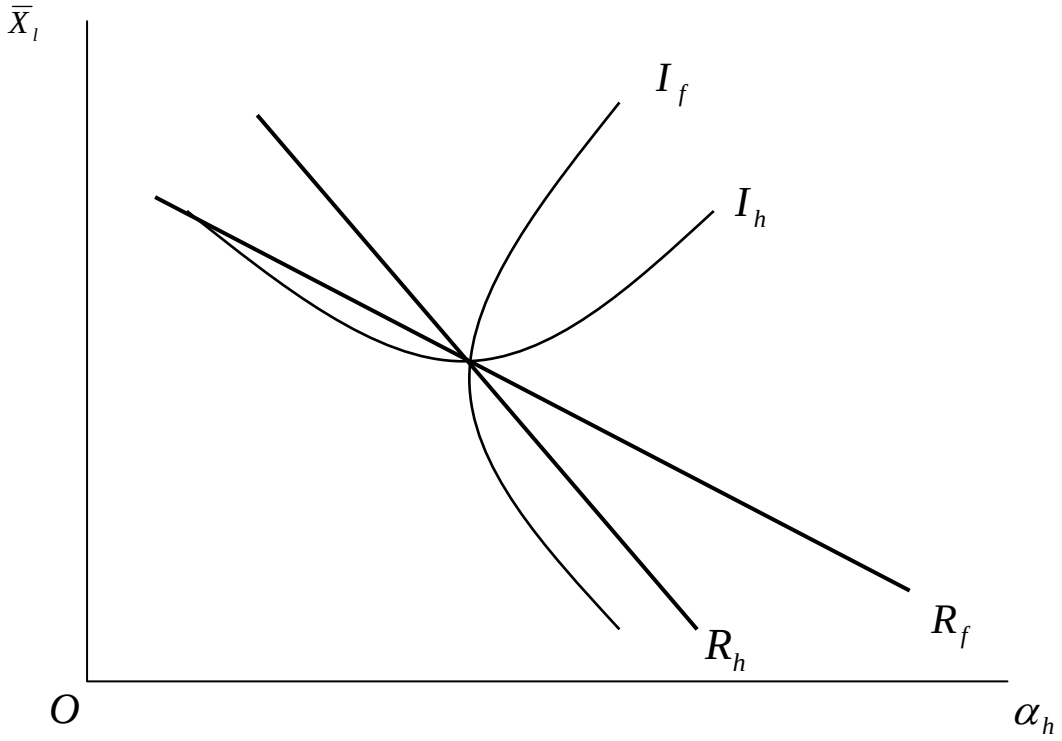

Figure 3 (a): The choice of trade restriction by the foreign government when

$$\partial E[W_h]/\partial \overline{X}_l > 0$$

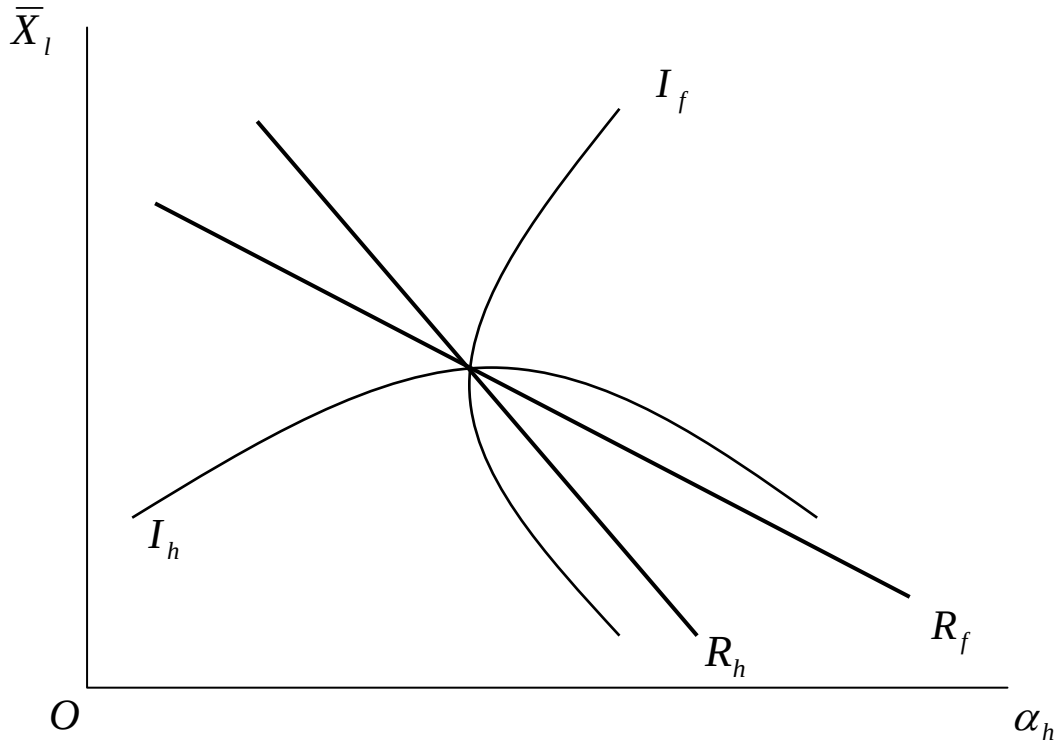

Figure 3 (b): The choice of trade restriction by the foreign government when

$$\partial E[W_h]/\partial \overline{X}_l < 0$$