

Chapter – 4: Standards and “True” Negative Externality

4.1 Introduction:

In Chapter 3, we dealt with standards which are not related to actual negative externality (“no externality”/ “imposed externality”) Protection is the only one goal of such kind of standards. But it is not always the case. **Standard imposed by foreign country can be related to “true” negative consumption or production externality.** The examples of standards that reduce consumption externalities can be that aerosols and refrigeration equipment should not contain Cfc's in order to protect ozone layer, standards on biodegradable detergents and rules relating to recycling of containers. Standards which reduce production externalities can be related to “emission standard” or “labour standard”. **Even though these standards are imposed to combat negative externality, they can also be “protectionist” (i.e. above the “optimum” limit) by nature.** In Canada, for example, the cyromazine MRL permissible in potato and potato products, and trimethylsulfonium salt MRL in lentil were both found to be more stringent than international standard. In European Union members, it was glyphosate MRLs in eggs and egg products, and milk and milk products. Another example is Minimum Residue Limits (MRLs) for pesticides in cereals, fruit and vegetables, and products of animal origin. In United States’ case it is MRLs in beets and in spinach, corn, beans, sugar cane, soybeans, sorghum, potatoes, hops, wheat and coffee. In the case of Japan, it was the cadmium presence in brown rice and polished rice as well as the cyazofamid MRL for various agricultural products that were found to be more stringent than international standards. These are just some of the more conspicuous examples of the violation of the “spirit” of the SPS Agreement, and imposing the standard above the “optimum” standard. Overall, the study by CWS, 2010 shows mostly there was a movement

towards higher thresholds that were more stringent than internationally accepted norms; and an increase in the product coverage was observed. It should also be noted that the prevalence of national standards based on risk assessments point to the increased use of provisional maximum residue limits (P-MRLs). Higher P-MRLs are proposed when residue trials and toxicological data show an unacceptable risk to consumers. However, any additional residue and toxicology data from WTO Members concerning MRLs to be changed will be judged by local experts of the importing country. This is a lengthy and time-consuming process and can possibly destroy the production capacities in the developing countries. This will also give developed countries additional flexibility to use their discretion. All these effectively block market access by developing countries' exports (Swann, 2010; Disdier, Fontagne and Mimouni, 2007; and Fontagne, Mimouni and Pasteels, 2005).

The purpose of this chapter is to deal with **“true” externality** related to either consumption or production of the commodity. It shows even in the presence of externality, the importing country can use “protectionist” standard i.e. the standard above the optimum level (like following more stringent norms than internationally accepted). Moreover contrary to the earlier chapter in this situation there can be some welfare maximizing standard for exporting country also i.e. “positive standard” can place the country in Pareto superior regime. When the standard targets “true” consumption externality, the exporting country may also improve in welfare by adopting the standard; provided it follows that standard in the local market also. In that case the **exporting country may have some positive “welfare maximizing standard”**, but not surprisingly the importing country will not necessarily follow that standard. Lastly if the standard targets **“true” production externality** there is higher chances for the exporting country to improve upon by

adopting “positive standard” but the importing country may or may not be interested to impose and follow “positive standard” and may prefer to follow “null standard”.

Negative externality related to production or consumption distorts the welfare function of the countries when they are engaged in free trade and in such situations “regulated trade” can be better than “free trade”. Trade regulation can take various forms like tariff, quota, VER, specification of externality linked “standard” etc. The externality can be related to production or consumption. Consumption or the production related externalities have different consequences on volume of trade as well as welfare for both exporting and importing country. One major limitation of the present literature is sometimes it fails to discriminate between the nature of externality created by consumption or production of “dirty” goods. Tian (2003) demonstrates that an increase in the minimum required ‘environmental friendliness’ of imported goods is not necessarily protectionist in effect, as it may hurt domestic firms and increase imports. Acharyya (2001) rightly points out that to use production externality argument, that holds the centre stage in the large body of literature on trade and environment to justify imposition of environmental standard by North where the dirty good is imported and consumed, we need a much broader perspective. As he argues, if exports of dirty goods by India increase production and hence environmental degradation there, one might wonder why the importing country say U.S would like to impose environmental standards. Two possible answers can be i) concern for global environment and ii) transboundary pollution. So in the absence of non-physical relations and transnational damages (either due to nature of emission or due to the fact that exporting and importing countries in question are geographically far apart) “concern against dirty goods are hard to justify in terms of production externality”.

4.2 Defining externality:-

In this section we consider the existence of a true externality, for which reason, the functional relation between standard and welfare depends on the externality $E(\tau, q)$. We

consider an externality of the type, $E(\tau, q) = (l(\tau) - d)q; d > l(\tau) > 0; l' > 0; l'' < 0$ (4.2.1)⁵⁰

In other words we assume that either consumption or production produces a negative externality, which rises linearly with quantity. The magnitude of externality declines when the standard of the product is raised, but at a marginally diminishing rate. We assume externality (and its reduction) is not observable by individual (so does not affect demand) but has effect on welfare. Further we can assume we are doing the valuation of externality in monetary terms (the cost on health or any other resource) so that the cost and benefit of a marginal increase in standard becomes comparable.

We can further assume, $c_f < l < c_h; c'_f < l' < c'_h$ (4.2.2)

4.2.1 Consumption Externality:-

First we are dealing with the case of “consumption externality” i.e. the consumption of the product is generating some negative effect. The amounts of externality for importing and exporting country are respectively:

$$E_H(\tau, q) = (l(\tau) - d)q \text{ and } E_F(\tau, q) = (l(\tau) - d)(q_h + q_f)$$

4.2.1.1 Consumption Externality and Tariff:-

“Standard” imposed by importing country (when compared to “equivalent tariff”) leads to loss in consumer surplus and producer surplus for exporting country from its local market (as discussed in the last chapter). But there will be the benefit of reduction in negative externality by, $c_h(l(\tau) - d) / 2b$ (4.2.3)

⁵⁰ Fischer & Serra (2000)

This is the benefit of reduction in consumption of the good which creates negative externality. This benefit will outweigh the loss of consumer and producer surplus only when the initial negative externality is extremely high. But that is very unlikely as in that case probably the country itself could have adopted that minimum standard (as it is improving welfare) instead of requiring null standard.⁵¹ If the latter happens the exporting country will prefer to be discriminated by “NTB” like “minimum standard” than tariff. Otherwise it will continue to prefer “tariff” than “NTB”.

“Standard” will lead to an excess loss in consumer surplus and producer surplus for importing country by the same amount mentioned under “no externality” plus a fall in negative externality (due to the difference in consumption under tariff and “Standard”⁵²) by the amount,

$$(l(\tau) - d)c_f / 2b' \tag{4.2.4}$$

This benefit of fall in externality can overshadow the loss in consumer and producer surplus only when the initial negative externality is very high. If the latter happens the importing country will prefer NTB like minimum standard as a tool of protection even if it is free to impose tariff.

Proposition 4.1:-If the initial negative externality is sufficiently high, NTB like “minimum standard” will be the first best tool of protection.

4.2.1.2 Consumption externality and Welfare:

In this section we consider the functional relation between standard and welfare depending on the consumption externality.

⁵¹ we have assumed exporting country’s requirement is null standard but compelled to follow the standard stipulated by importing country due to high set up cost at two different standards

⁵²Appendix 3.2(Chapter3)

With negative externality social welfare of exporting country can be an increasing function of τ if the initial negative externality is very high.⁵³ For importing country the social welfare under duopoly is:

$$W^F_{CE}(\tau) = (2a - c_f - c_h)^2 / 18b' + (a - 2c_f + c_h)^2 / 9b' + \left[\frac{(2a - c_f - c_h)}{3b'} \right] (l(\tau) - d) \quad (4.2.5)$$

The above can be an increasing function of standard under a less stringent condition than no externality.⁵⁴ In the later the marginal benefit of increase in standard is c_h' and cost is c_f' . With consumption externality as the marginal benefit ($c_h' + l'$) of rise in standard is higher the condition is less stringent.

Similar to no externality situation the foreign firm will lobby for a prohibitive standard at which the domestic firm will quit exporting. The government (with increasing W^F_d) in that case can maintain $\tau^*_{CE} = \tau_{CEe}$,⁵⁵ where τ^*_{CE} is the optimum standard with negative externality and τ_{CEe} is the prohibitive standard with externality. If W^F_d is initially falling (and minimized at τ^{min}_{CE} and $\tau^{min}_{CE} > \tau_{CEe}$ then government of importing country will set $\tau^*_{CE} = 0$. Therefore,

$$\tau^*_{CE} = \tau_{CEe} \text{ if } \tau_{CEe} > \tau^{min}_{CE} \text{ and } W^F_d(\tau_{CEe}) > W^F_d(\tau = 0) \quad (4.2.5a)$$

$$= 0, \text{ Otherwise} \quad (4.2.5b)$$

If l' is sufficiently high and/or the initial negative externality is very large, then LSP will set the standard $\tau^*_{CE} \geq \tau_{CEe}$.⁵⁶ (4.2.6)

⁵³ See Appendix 4.1

⁵⁴ See Appendix 4.2

⁵⁵ If the government does not want to go for prohibitive standard then it will maintain the standard $0 < \tau^*_{CE} \leq \tau_{CEe}$

⁵⁶ see Appendix 4.2

The welfare of the exporting country (after the imposition of standard) will include consumer surplus from home, producer surplus from home as well as foreign and the externality associated with consumption.

$$W_{CE}^H(\tau) = 3(a - c_h)^2 / 8b + (a - 2c_h + c_f)^2 / 9b' + (l(\tau) - d)(a - c_h) / 2b \quad (4.2.7)$$

The relation between b and b' should not be same like “imposed” externality and to make the matter simpler we can assume $b = b'$.

The striking point is that contrary to “imposed externality”⁵⁷ situation, $W^H(\tau)$ can be initially increasing in τ , can reach a maximum and then decrease, provided the initial negative externality is very large. This possibility arises as we have taken the assumption that the exporting country is following the same standard for local market also, so with the imposition of τ it is getting the benefit of reduction in domestic consumption externality. Consequently the breakeven standard for exporting country will be higher than the earlier (“imposed” externality)⁵⁸ case;

$$\text{i.e. } \tau_{CEe} > \tau_e \quad (4.2.8)$$

Assuming the domestic firm exports or quits (appendix1) at the break even the foreign govt will set the standard at: $-\tau_{CE}^* \leq \tau_{CEe}$ (4.2.9)

For importing country the social welfare under duopoly($W_d^F(\tau)$) can be an increasing function of standard under a less stringent condition than “imposed” externality situation. As the social welfare of exporting country $W^H(\tau)$ can be initially increasing in τ , can reach a maximum and then decrease, (provided the initial negative externality is very large), there is a possibility that exporting country can improve upon with the imposition of “standard” (up to a certain τ) but the importing country is following the null standard if condition 4.2.5 is not fulfilled.

⁵⁷ Chapter3

⁵⁸ Ibid

Lemma 4.1: $\frac{\partial W_{CE}^H(\tau)}{\partial \tau} > 0$ is neither necessary nor sufficient for $\frac{\partial W_{CE}^F(\tau)}{\partial \tau} > 0$

Proof:-Differentiating 4.2.4 and 4.2.7 w.r.t τ

$$\begin{aligned} \frac{\partial W_{CE}^F(\tau)}{\partial \tau} &= (2a - c_h - c_f)(-c_h' - c_f') / 9b' + 2(a - 2c_f + c_h)(-2c_f' + c_h') / 9b' + \\ &\left[\frac{(2a - c_h - c_f)}{3b'} \right] l'(\tau) + (l(\tau) - d)(-c_h' - c_f') / 3b' \end{aligned} \quad (4.2.10)$$

$$\begin{aligned} \frac{\partial W_{CE}^H(\tau)}{\partial \tau} &= 3(a - c_h)(-c_h') / 4b' + 2(a - 2c_h + c_f)(-2c_h' + c_f') / 9b' + (l'(\tau))(a - c_h) / \\ &2b' + (l(\tau) - d)(-c_h') / 2b' \end{aligned} \quad (4.2.11)$$

When there is “real” negative externality, the increase in τ will have two effects on welfare. The direct effect, which will lead to fall in negative externality as a result of increase in l through $l'(\tau)$ and the indirect effect which will lead to change in the existing negative externality through increase in compliance cost as the change in compliance cost leads to change in production and/or consumption.

The fall in consumption due to increase in cost of compliance for importing country is $(c_h + c_f) / 3b'$ whereas for exporting country it is $c_h / 2b'$ which is greater than the former term due to our assumption regarding the compliance cost. The fall in the negative externality with increase in τ , through increase in compliance cost (as it leads to fall in consumption) is captured in the last term of 4.2.10 and 4.2.11. Due to assumption of the model last term of 4.2.11 exceeds that of 4.2.10. So if the initial negative externality is very large there is a possibility that 4.2.10 is decreasing in τ but 4.2.11 is increasing in τ .

If the initial negative externality is not that large it is likely that $\frac{\partial W_{CE}^H(\tau)}{\partial \tau} < 0$ but $\frac{\partial W_{CE}^F(\tau)}{\partial \tau} > 0$ (like “imposed” externality situation).

The final task is to find out whether this standard is “protectionist” or not. Recall the definition of protectionist strategy mentioned in no-externality (Fischer & Serra 2000). We can redefine the welfare of Foreign (F) when both firms are in F (local duopoly)

$$W^D_{cE} = \frac{(2a - c_f - c_h)^2}{18b'} + \frac{(a - 2c_f + c_h)^2}{9b'} + (a - 2c_h + c_f)^2 / 9b' + (l(\tau) - d)(2a - c_f - c_h) / 3b' \quad (4.2.12)$$

Social welfare of F when of firm is in D and another in F (global duopoly),

$$W^d_{cE} = \frac{(2a - c_f - c_h)^2}{18b'} + \frac{(a - 2c_f + c_h)^2}{9b'} + (l(\tau) - d)(2a - c_f - c_h) / 3b' \quad (4.2.13)$$

$$\frac{\partial (W^D_{cE} - W^d_{cE})}{\partial \tau} = 2(a - 2c_h + c_f) \frac{(-2c_h' + c_f')}{9b'} \quad (4.2.14)$$

This term is negative. This means the marginal benefit of rise in minimum standard is greater under duopoly with imports than under a local duopoly. So the minimum standard used in the former case is always high and protectionist by definition. So when there is a true negative externality the LSP of foreign country will always use a standard higher than if both the firms are *domestic*.

Lemma 4.1 and the above results apparently seems contradictory as the former is claiming the exporting country’s welfare can be increasing in τ even though that of importing country can be

decreasing (with sufficiently large initial negative externality) but 4.2.14 shows the standard used by importer will be “Protectionist” (i.e. marginal benefit for increase in standard is higher for importing country under present situation than under local duopoly). Actually there is no contradiction because situation described in lemma 4.1 happens when fall in negative consumption externality (with increase in τ) in exporting country’s local market has been taken care of. But the way we have defined “protectionist Standard” exporting country’s local consumption is not coming in consideration. Otherwise if we use definition of “protectionist” standard in terms of world welfare Engle (1996) then there will be no contradiction.

The world welfare under consumption externality,

$$W^w_{c_E} = \frac{(2a - c_f - c_h)^2}{18b'} + \frac{(a - 2c_f + c_h)^2}{9b'} + \frac{(a - 2c_h + c_f)^2}{9b'} + \left\{ \frac{3(a - c_h)^2}{8b'} \right\} + (l(\tau) - d)(3a - c_f - c_h)/3b' \quad (4.2.15)$$

$$\frac{\partial(W^w_{c_E} - W^d_{c_E})}{\partial\tau} = 2(a - 2c_h + c_f) \frac{(-2c_h' + c_f')}{9b'} + \left\{ \frac{3(a - c_h)(-c_h')}{4b'} \right\} + (l(\tau) - d) \left(\frac{-c_h'}{2b'} \right) + l'(\tau) \left(\frac{a - c_h}{2b'} \right) \quad (4.2.16)$$

If initial negative externality and/or $l'(\tau)$ is sufficiently high then the above term can be positive implying that the marginal benefit of rise in minimum standard can be greater if we take into account the world welfare (welfare of both the countries) than that of importing (i.e. standard imposing country). So the minimum standard is not “Protectionist”.

Proposition 4.2:- *The standard followed by importing (standard imposing) country will be necessarily “protectionist” by the comparison between welfare consequences of Local (both the firms in importing country) and global (one firm in importing country and another in exporting country) duopoly⁵⁹ but not necessarily by the comparison between local (importing) and global (importing and exporting country) welfare⁶⁰*

Proof:- Follows from (4.2.14) &(4.2.16) ■

We can give a game theoretic presentation where the Home country has two available strategies (Export, No Export) and the Foreign country has two available strategies (Free Trade i.e. null standard , protected Trade i.e. positive standard)

Table 4.1:- Game Theoretic Presentation (Consumption Externality)

		Trade (Export)	Autarky (no export)
Importing Country	$\tau=0$ (free Trade)	$a^2/3b' + (l(\tau) - d)2a/3b'$, $35a^2/72b', (l(\tau) - d)a/2b'$	$3a^2/8b' + (l(\tau) - d)a/2b'$, $3a^2/8b' + (l(\tau) - d)a/2b'$
	$\tau=\tau_{CEe(NTB)}$	$(2a - c_f - c_h)^2/18b' + (a - 2c_f + c_h)^2/9$ $+ (l(\tau) - d)(2a - c_f - c_h)/3b'$, $(a - 2c_h + c_f)^2/9b' + 3(a - c_h)^2/8b'$ $+ \tau(l(\tau) - d)(a - c_h)/2b'$	$3(a - c_f)^2/8b' + (l(\tau) - d)(a - c_f)/2b'$ $3a^2/8b' + (l(\tau) - d)(a/2b')$

⁵⁹ Fischer & Serra(2000)

⁶⁰Engle (1996)

Assuming $G(\tau) > 0$ and (4.2.5a) is fulfilled ($\tau = \tau_{cEe}$, export) will be the Nash equilibrium. As $G(\tau) > 0$, “Export” is also the “Dominant” strategy for Exporting country. If 4.2.5a is fulfilled then $\tau = \tau_{cEe}$ ⁶¹ can be a dominant strategy for the importing country (depending on the size of initial negative externality).

In case of “imposed” negative externality $\tau > 0$ is never a “dominant” strategy for the importing country because if the exporting country does not export then positive standard will lead to unnecessary loss in consumer and producer surplus for the importing country, where as in this situation of “true” negative externality (consumption) positive standard can be a “dominant” strategy for the importing country, provided the initial negative externality is very high.

4.2.1.3 Finding out optimum τ :-

The welfare function of foreign country under duopoly with consumption externality,

$$W_{CE}^d = (2a - \bar{c}_f \tau^2 - \bar{c}_h \tau^2)^2 / 18b' + (a - 2\bar{c}_f \tau^2 + \bar{c}_h \tau^2)^2 / 9b' + (\bar{b}\tau^2 - d)(2a - \bar{c}_f \tau^2 - \bar{c}_h \tau^2) / 3b' \text{ if } \tau^2 < \frac{d}{\bar{b}} \quad (4.2.17)$$

$$W_{CE}^d = (2a - \bar{c}_f \tau^2 - \bar{c}_h \tau^2)^2 / 18b' + (a - 2\bar{c}_f \tau^2 + \bar{c}_h \tau^2)^2 / 9b' \text{ if } \tau^2 \geq d/\bar{b} \quad (4.2.18)$$

If W^d initially falls (which is less likely as W^d will be a decreasing function of τ under a more stringent condition than no externality case) it will be minimized at:⁶²

⁶¹ Or, $\tau > \tau_{cEe}$ will be the dominant strategy for importing country.

⁶² Calculated by “equation solver” software (Annex 4.1) & taking only positive value

$$\begin{aligned} \hat{\tau}_{CE} &= \\ &= \sqrt{[-d(\bar{c}_h + 2\bar{b}) + 2a(\bar{c}_f - \bar{b})]/[\bar{c}_h^2 + 2\bar{c}_h\bar{c}_f - 2\bar{b}\bar{c}_f - 2\bar{b}\bar{c}_h + 3\bar{c}_f^2]} \end{aligned} \quad (4.2.19)$$

Lemma 4.2:-Higher the magnitude of \bar{b} lower will be $\hat{\tau}_{CE}$.

Proof:-Given (4.2.19);

$$\frac{d\hat{\tau}_{CE}}{d\bar{b}} < 0 \quad (4.2.20)$$

Condition 4.2.20 indicates that with increase in τ , if the negative externality falls at a higher rate then, W^d will be minimized for a lower value of τ .

Lemma 4.3: Higher the magnitude of d lower will be $\hat{\tau}_{CE}$

$$\text{Proof: -Given 4.2.15; } \frac{\partial \hat{\tau}_{CE}}{\partial d} < 0 \quad (4.2.21)$$

Condition 4.2.17 indicates that if the initial negative externality is very large then, W^d will be minimized for a lower value of τ .

Next task is to find out what is the highest minimum standard τ_{CEe} at which the exporting firm will quit to export. The net gain from Trade for the exporting country (after the imposition of standard) is as follows,

$$G_{CE}(\tau) = (a - 2\bar{c}_h\tau^2 + \bar{c}_f\tau^2)^2/9b' - \bar{c}_h\tau^2(\bar{b}\tau^2 - d)/2b' - 3[2a\bar{c}_h\tau^2 - (\bar{c}_h\tau)^2]/8b' \text{ if } \tau^2 < d/\bar{b} \quad (4.2.22)$$

$$G_{CE}(\tau) = (a - 2\bar{c}_h\tau^2 + \bar{c}_f\tau^2)^2/9b' - 3[2a\bar{c}_h\tau^2 - (\bar{c}_h\tau)^2]/8b' \text{ if } \tau^2 \geq d/\bar{b} \quad (4.2.23)$$

This expression shows the net gain of exporting country from trade without any negative externality plus the gain from reduction in negative externality due to the standard which the domestic firm has been compelled to follow for its local market also.

$G_{CE}(\tau)$ is decreasing (unless the initial negative externality (d) is very large) and once it reaches to 0 the Domestic firm will reach to break even between exporting or not. However, if the initial negative externality is very large, $G_{CE}(\tau)$ will be first increasing, will reach a maximum and then decreasing and finally reaches to zero. If the later happens, $G_{CE}(\tau)$ is maximized at, (see appendix 4.1)

$$\begin{aligned} & \tau_e(G_{max})_{consumption} \\ & = \sqrt{(-8ab'^2\bar{c}_f - 18d\bar{c}_h + 43ab'^2\bar{c}_h)/(8b'^2\bar{c}_f^2 - 32b'^2\bar{c}_h\bar{c}_f + 59b'^2\bar{c}_h^2 - 36\bar{b}\bar{c}_h)} \quad (4.2.24)^{63} \end{aligned}$$

Lemma 4.4:--Higher the initial negative externality higher will be $\tau_e(\max)$

Proof:⁶⁴ Given (4.2.24), $\frac{d\tau_e(G_{max})_{consumption}}{d(d)} > 0$ (4.2.25)

Condition 4.2.21 indicates that if d is high gain from trade for exporting country will be maximized for a higher value of τ .

⁶³ Calculated by “equation solver” software (Annex 4.2) & taking only positive value. Assuming $G(\tau)$ is inverted U shaped due to higher amount of initial negative externality

⁶⁴ see Appendix 4.3

4.2.2 Production Externality:-

Suppose, there exists a “true production externality” i.e. the production of the good is creating some negative effect which is not included in private cost of production. The social welfare function of exporting country:

$$W_{PE}^H(\tau) = 3(a - c_h)^2/8b' + (a - 2c_h + c_f)^2/9b' + (l(\tau) - d)(5a - 7c_h + 2c_f)/6b' \quad (4.2.26)$$

The social welfare functions of importing country under duopoly:

$$\begin{aligned} W_{PE}^F(\tau) &= (2a - c_f - c_h)^2/9b' + (a - 2c_f + c_h)^2/9b' \\ &\quad + (l(\tau) - d)(a - 2c_f + c_h) \\ &\quad /3b' \end{aligned} \quad (4.2.27)$$

The net gain from trade for exporting country,

$$\begin{aligned} G_{PE}(\tau) &= (a - 2c_h + c_f)^2/9b' + c_h(l(\tau) - d)/2b' - 3(2ac_h - c_h^2)/8b' \\ &\quad + (l(\tau) - d)(a - 2c_h + c_f)/3b' \end{aligned} \quad (4.2.28)$$

The last term shows the additional negative externality created by the production for export market. Compared to consumption externality situation, there is a higher possibility that net gain will be first increasing in τ , reach a maximum and then decreasing.

Again our task is to find out whether this standard is protectionist or not. Recall the definitions of protectionist strategy mentioned in “no-externality” and consumption externality. First we will use the definition by Fischer & Serra (2000). We can redefine the welfare of F when both firms are in F,

$$\begin{aligned} W_{PE}^D &= (2a - c_f - c_h)^2/18b' + (a - 2c_f + c_h)^2/9b' + (a - 2c_h + c_f)^2/9b' \\ &\quad + (l(\tau) - d)(2a - c_f - c_h)/3b' \end{aligned} \quad (4.2.29)$$

Social welfare of F when of firm is in D and another in F,

$$W^d_{PE} = (2a - c_f - c_h)^2 / 18b' + (a - 2c_f + c_h)^2 / 9b' + (l(\tau) - d)(a - 2c_f + c_h) / 3b' \quad (4.2.30)$$

$$\frac{d(W^D_{PE} - W^d_{PE})}{d\tau} = \frac{(a - 2c_h + c_f)(-4c'_h + 2c'_f + 3l')}{9b'} + \frac{(l(\tau) - d)(-2c'_h + c'_f)}{3b'} \quad (4.2.31)$$

The sign of the above term is ambiguous. Contrary to “imposed” externality (equation 3.5.4.) and consumption externality (equation 4.2.16) the term is likely to be positive in the above situation if initial negative externality (and/or l') is sufficiently large. In that case the benefit of increase in standard for Foreign will be higher in case **of local duopoly as local duopoly leads to entire production within the “Foreign” country**. So the Standard may not be “protectionist”.

For using Engle (1996) definition of protectionist standard we define world welfare,

$$W^w_{PE} = \frac{(2a - c_f - c_h)^2}{18b'} + \frac{(a - 2c_f + c_h)^2}{9b'} + \frac{(a - 2c_h + c_f)^2}{9b'} + \left\{ \frac{3(a - c_h)^2}{8b'} \right\} + (l(\tau) - d) \left\{ \frac{(7a - 2c_f - 5c_h)}{6b'} \right\} \quad (4.2.32)$$

$$\begin{aligned} \frac{d(W^w_{PE} - W^d_{PE})}{d\tau} &= \frac{2(a - 2c_h + c_f)(-2c'_h + c'_f)}{9b'} + \frac{3(a - c_h)(-c'_h)}{4b'} + \frac{(l(\tau) - d)(-7c'_h + 2c'_f)}{6b'} \\ &+ l' \frac{(5a + 2c_f - 7c_h)}{6b'} \end{aligned} \quad (4.2.33)$$

The sign of the above term is again ambiguous and can be positive if initial negative externality (and/or l') is sufficiently large.

Proposition 4.3:-*In the presence of production externality minimum standard used by importing country is not necessarily “protectionist” when we consider the definition by Fischer and Serra (1999)⁶⁵ as well as the definition given by Engle.(1996) ⁶⁶*

4.2.2.2 Finding out optimum τ :-

Assuming the gains from trade is inverted u shaped for the exporting country, the standard at which gains from trade will be maximized is:⁶⁷

$$\tau_e(G_{max})_{production} = \sqrt{\frac{(-8ab'^2\bar{c}_f + 12b'^2d\bar{c}_f + 18d\bar{c}_h - 24b^2d\bar{c}_h + 43ab'^2\bar{c}_h - 12ab'^2\bar{b})}{(8b'^2\bar{c}_f^2 - 32b'^2\bar{c}_h\bar{c}_f + 24b'^2\bar{b}\bar{c}_f + 59b'^2\bar{c}_h^2 - 48b'^2\bar{b}\bar{c}_h)}} \quad (4.2.35)$$

4.2.2.3 Production Externality and Welfare:-

The welfare function of Foreign country, under production externality,

$$W_{PE}^F_d(\tau) = (2a - \bar{c}_f\tau^2 - \bar{c}_h\tau^2)^2/18b' + (a - 2\bar{c}_f\tau^2 + \bar{c}_h\tau^2)^2/9b' + (\bar{b}\tau^2 - d)(a - 2\bar{c}_f\tau^2 + \bar{c}_h\tau^2)/3b', \text{ if } \tau^2 < d/\bar{b} \quad (4.2.36)$$

$$W_{PE}^F_d(\tau) = (2a - \bar{c}_f\tau^2 - \bar{c}_h\tau^2)^2/18b' + (a - 2\bar{c}_f\tau^2 + \bar{c}_h\tau^2)^2/9b', \text{ if } \tau^2 \geq d/\bar{b} \quad (4.2.36a)$$

If W^d initially falls (which is less likely compared to no externality case but more likely than consumption externality case) it will be minimized at:⁶⁸

⁶⁵ See the definition in chapter 2

⁶⁶ See the definition in chapter 2

⁶⁷ Calculated by “equation solver” software (Annex 4.3) & taking only positive value. Assuming $G(\tau)$ is inverted U shaped.

$$\hat{\tau}_{PE} = \sqrt{[d(\bar{c}_h - 2\bar{b}) + a(2\bar{c}_f - \bar{b})]/[\bar{c}_h^2 - 2\bar{c}_h\bar{c}_f - 2\bar{b}\bar{c}_f - 2\bar{b}\bar{c}_h + 3\bar{c}_f^2]} \quad (4.2.37)$$

Proposition 4.4: *The value of τ after which the welfare of importing country starts to increase will be higher in case of production externality as the benefit of increase in standard is less for production externality than for consumption externality for the importing country.*

$$\text{i.e. } \hat{\tau}_{PE} > \hat{\tau}_{CE} \quad (4.2.38)$$

Proof: Follows from (4.2.19) & (4.2.37) ■

Finally the government of the importing country sets,

$$\begin{aligned} \tau^* = \tau_e(\text{prohibitive})_{\text{production}} \text{ iff } \tau_e(\text{prohibitive})_{\text{production}} \geq \hat{\tau}_{PE} \text{ and } W^d(\tau_e) \\ > W^d(\tau = 0) \end{aligned} \quad (4.2.39)$$

$$= 0, \text{ otherwise} \quad (4.2.40)$$

Proposition 4.5: *For importing country, the possibility of following “null standard” is higher under production externality than under consumption externality.*

Proof: - Follows from (4.2.38) & (4.2.39) ■

For importing country the social welfare under duopoly can be an increasing function of standard under a less stringent condition than no externality, but under a more stringent condition than consumption externality. As the social welfare of exporting country $W^H(\tau)$ can be initially increasing in τ , can reach a maximum and then decrease there is a possibility that exporting

⁶⁸ Calculated by “equation solver” software (Annex 4.4) & taking only positive value

country can improve upon with the imposition of “standard” (up to a certain τ) but the importing country is following the null standard if condition 4.2.39 is not fulfilled.

Lemma 4.26: $\frac{\partial W^H_{PE}(\tau)}{\partial \tau} > 0$ is neither necessary nor sufficient for $\frac{\partial W^F_{PE}(\tau)}{\partial \tau} > 0$

Proof:-Differentiating 4.2.22 and 4.2.23 w.r.t τ

$$\begin{aligned} \frac{\partial W^H_{PE}(\tau)}{\partial \tau} = & 3(a - c_h)(-c_h') / 4b' + 2(a - 2c_h + c_f)(c_f' - 2c_h') / 9b' + \left[\frac{(5a - 7c_h + 2c_f)}{6b'} \right] l'(\tau) \\ & + (l(\tau) - d)(-7c_h' + 2c_f') / 6b' \end{aligned} \quad (4.2.41)$$

$$\begin{aligned} \frac{\partial W^F_{PE}(\tau)}{\partial \tau} = & (2a - c_h - c_f)(-c_h' - c_f') / 9b' + 2(a - 2c_f + c_h)(-2c_f' + c_h') / 9b' + \left[\frac{(a - 2c_f + c_h)}{3b'} \right] l'(\tau) + \\ & (l(\tau) - d)(-c_h' - 2c_f') / 3b' \end{aligned} \quad (4.2.42)$$

The peculiarity of production externality is that increase in τ leads to increase in negative externality for the importing country (due to indirect effect)⁶⁹ as it leads to net increase in production(as $c_h' > 2c_f'$); whereas for exporting country both effects (direct and indirect) leads to reduction in negative externality. As the total production is more in exporting country (taking into account production for local market) the effect of increase in standard will be more welfare improving for exporting country due to direct effect also. Therefore if the negative externality is not very small it is likely that 4.2.41 will be increasing in τ but 4.2.42 will be falling in τ .

⁶⁹Though due to “direct effect” it decreases.

Interestingly even if we don't consider the local market of exporting country still direct and indirect effect work in the same direction (and improves welfare). If condition 4.2.39 is fulfilled then the standard set under production externality will be higher than under consumption externality. The importing country under production externality is less likely to set a positive standard than under consumption externality as the marginal gain of rise in standard is more for importing country under consumption externality. But from exporting country's side prohibitive standard is higher under production externality. So when the positive standard is there, it is likely to be higher under production externality than under consumption externality will be welfare improving for exporting country and welfare reducing for importing country.

Table 4.2:- Game Theoretic Presentation (Production Externality)

		Exporting Country	
		Trade (Export)	Autarky (No export)
Importing Country	$\tau=0$ (free Trade)	$a^2/3b' + (l(\tau) - d)a/3b'$, $3a^2/8b' + a^2/9b' + (l(\tau) - d)(5a/6b')$	$3a^2/8b' + (l(\tau) - d)a/2b'$, $3a^2/8b' + (l(\tau) - d)a/2b'$
	$\tau=\tau_c$ (NTB)	$(2a - c_f - c_h)^2/18b' + (a - 2c_f + c_h)^2/9b'$ $+ (l(\tau) - d)(a - 2c_f + c_h) /3b'$, $(a - 2c_h + c_f)^2/9b' + 3(a - c_h)^2/8b' +$ $(l(\tau) - d)\{(5a - 7c_h + 2c_f)/6b'\}$	$3(a - c_f)^2/8b' +$ $(l(\tau) - d)(a - c_f) /2b'$, $3a^2/8b' + (l(\tau) - d)(a/2b')$

As long as $G(\tau) > 0$, and condition (4.2.33) is fulfilled ($\tau = \tau_e$, Export) will be the Nash equilibrium. Moreover contrary to the other two situations (“imposed” externality & consumption externality) “Export” may not be a dominant strategy because the country may not choose to export under free trade if the initial negative externality is very high.⁷⁰

Self Imposition of Standard:

Why can't the exporting country follow the standard by itself? The exporting country is the “standard taker” not the “standard maker”. So even if the exporting country follows the standard for its production, the importing country can be reluctant to follow that standard (as it will increase the cost of production) and as a result exporting country will lose competitiveness.

The problem also lies in the valuation of externality as we have assumed that the exporting country is the developing country. For the exporting country generally the valuation of the externality will be different and there can be under valuation of externality (though we have assumed away that possibility). In that case actually the prohibitive standard will be lower than what we have derived (both in the case of consumption externality & production externality) and a particular measure may simply be a ‘perceived barrier’ and may not actually be a barrier.

4.3 Concluding remarks:-

Presence of real negative externality makes the situations different for consumption externality and production externality. The analysis in this chapter specifically shows that the adoption and imposition of “standard” by importing country will depend of what kind of externality it targets.

⁷⁰ This is under some restrictive assumption like the “exporting” country’s ability to adopt some standard to combat externality is constrained by some factor or it will not be a gainful trade if it adopts the standard alone and the importing country continues to follow null standard.

- i) **With huge difference in compliance cost** the possibility is always there (whether production or consumption externality) that importing country's welfare will be increasing in τ and exporting country's welfare will be decreasing in τ and the importing country will adopt the **"prohibitive standard"**.
- ii) But when the initial negative externality is very high there is a possibility that importing country's welfare is initially decreasing in τ though that of exporting country is increasing in τ .
- iii) The above situation is possible with negative consumption externality as we have assumed that exporting country is also following the same standard for its local market.
- iv) Similar kind of situation is possible with production externality even if we don't take the above mentioned assumption.
- v) In case of "consumption externality" ($\tau = \tau_{CEe}$, **Export**) is likely to be Nash equilibrium and **"export" is the dominant strategy** for exporting country contrary to which **"export" may not be a "dominant" strategy in case of "production externality"**, as the exporting country may choose "no export" under free trade.
- vi) The **"optimum standard"** under consumption externality is necessarily **"protectionist"** if we assume a local duopoly instead of global duopoly, (Fisher&Serra,2000), whereas if we follow the global welfare maximization criterion (Engle 1996) **"optimum standard" might not be "protectionist"**. Under production externality the **"optimum standard" might not be protectionist by either of the two definitions.**

Appendix 4.1:

$$G_{CE}(\tau) = (a - 2c_h + c_f)^2/9b' - c_h(l(\tau) - d)/2b' - (2ac_h - c_h^2)/8b'$$

$$\begin{aligned} \frac{dG_{CE}(\tau)}{d\tau} &= 2(a - 2c_h + c_f)(c_f' - 2c_h')/9b' - (a - c_h)/4b' - c_h'(l(\tau) - d)/2b' \\ &\quad - c_h(l'(\tau))/2b' \end{aligned}$$

If $(l(\tau) - d)$ is sufficiently high then L.H.S can be initially increasing (for small value of τ), can reach a maximum and then it will fall.

Appendix 4.2:

The welfare of the importing country under duopoly and monopoly (with prohibitive standards) i.e. in the presence of externality are,

$$\begin{aligned} W^F_d(\tau) &= (2a - c_f - c_h)^2/18b' + (a - 2c_f + c_h)^2/9b' \\ &\quad + \left[\frac{(2a - c_f - c_h)}{3b'} \right] (l(\tau) - d) \end{aligned} \quad A. 4.1$$

$$W^F_m(\tau) = (a - c_f)^2/8b' + (a - c_f)^2/4b' + [(a - c_f)/2b'](l(\tau) - d) \quad A. 4.2$$

A.4.1 is increasing in τ under a less stringent condition than no externality and A.4.2 is decreasing in τ unless the initial negative externality is very large and/or l' is sufficiently high.

$$W^F_d(\tau) = (2a - c_f - c_h)^2/18b' + (a - 2c_f + c_h)^2/9b'$$

$$\frac{dW^F_d(\tau)}{d\tau} > 0 \text{ iff } (c_h' - 2c_f') > (2a - c_f - c_h)(c_h' + c_f')/2(a - 2c_h + c_f) \quad A. 4.3$$

$$W_{CE}^F = (2a - c_h - c_f)^2 / 18b' + (a - 2c_f + c_h)^2 / 9b' + [(2a - c_f - c_h) / 3b'] (l(\tau) - d)$$

$$\frac{dW_{CE}^F}{d\tau} > 0 \text{ iff } (c_h' - 2c_f')$$

$$> (2a - c_f - c_h) + 9b'(l(\tau) - d)(c_h' + c_f')$$

$$- 3l'(\tau)(2a - c_f - c_h) / 2(a - 2c_h + c_f)$$

A.4.4

Appendix 4.3

$$\frac{d}{d(d)} \{ \tau_e(G_{max})_{consumption} \} = 9\bar{c}_h / (8b'^2\bar{c}_f^2 - 32b'^2\bar{c}_f\bar{c}_h + 59b'^2\bar{c}_h^2 - 36\bar{b}\bar{c}_h) \tau_e(max) \text{ A.4.5}$$