Chapter – 3: Standards and "imposed" negative externality

3.1 Introduction:

Standards and technical regulations are increasingly mentioned as a factor driving trade costs. The 1947 GATT accords allowed the use of minimum standards to protect human, animal and plant health, as well as to bring order in the market. Although the accords stated that standards should not be used as covert forms of protectionism, GATT jurisprudence shows that it is not easy to prove that a minimum standard has a protectionist aim. The Marrekesh accords setting up the World Trade Organization (WTO) established that standards can differ from internationally accepted levels only when there is scientific evidence supporting the decision. Despite the agreement, the US National Research Council correctly predicted that the use of standard as a tool of protection will become more and more important. Standards imposed by importing country which is linked with some "imposed" negative externality. [26] There is empirical evidence of imposition of such kind of standards by different importing countries in different times for different imported items. Singapore, one of the major importer of Peanuts for India demands 0% aflatoxin (below the traceable limits) for any exporter of groundnut in the country whereas the aflatoxin limit for ground nut in EU is 2 ppb and in case of Asian countries like Indonesia and Malaysia limit stands at 5ppb.The limit set by Singapore is clear case of setting up a standard without any scientific justification and risk assessment which is advocated in SPS agreement.[27]Another example of such kind of barrier has been identified through a case study. Import of Indian meat is banned in Singapore and Indonesia. Indonesia has banned the Indian

[26] Purely "protectionist" standards
[27]Saqib and Taneja (2005)

meat on the pretext of the foot and mouth disease prevalent in India. Even after numerous certificates and declaration from the Ministry of Health, Indian meat is banned in these countries on a false allegation of foot and mouth disease.[28] Indian exporters of mangoes believe that while setting the standard the acceptable level of risk defined by New Zealand is too stringent and could not be justified scientifically. In the case of rice as well, Indian producers have complained that aflatoxin standards serve protectionist purposes. The problems are larger in the case of basmati or premium grade rice rather than for non-basmati rice. Exporters were of the opinion that USFDA standards and the relative stringency of the basmati rice standards were primarily on account of protection provided to domestic producers in the United States.[29] The EU has always been a major source of SPS-related problems for India. This is not unexpected given that the EU is generally known to have the strictest SPS regulations in the world. Developing countries at large have been severely affected due to its non-acceptance of established international standards and the application of its own higher standards on grounds of observance of higher safety norms. It is widely believed that often there is not enough justification for such higher standards. More so because very often it is found that lower standards exist in several other developed countries. The EU does not always provide sufficient evidence to justify those stricter requirements also. In many cases, the scientific justification of the EU requirements has been called into questions too. **All these evidences prove that there exist export standards with purely "protectionist" intentions imposing a real challenge for the exporters specially those who target developed country export markets.**

In this chapter we develop a simple two country two firm model where the foreign country (importing) imposes a minimum "standard" on a good which is exported by domestic firm.

[28] *ibid*.
[29] Jha (2002)

Though the importing country may argue for justification of the standard as reducing negative externality but actual externality related to consumption of this product is zero. Costs rise with "standard" for both the countries but the marginal compliance cost is higher and more responsive to changes in "standard" for exporting (Home) country. Moreover there is a high fixed set up cost for producing at two standard levels which compels the exporting country to produce at the "standard" (specified by the importing country) even for its own market. Under such conditions the net gain from trade for the exporting country will be a decreasing function of the standard whereas for importing country it can be an increasing function of standard even if higher standard does not abate any negative externality. While the importing country's firm will lobby for the lowest minimum standard which will exclude the exporting firm, the standard actually chosen by government (Local Social Planner/ Policy maker) of importing country can be lower than that but "Protectionist" in nature.

As norms and standards usually apply to both national and foreign production, they do not correspond to the classical forms of protectionism, which openly discriminate against imports. However it may cloak protectionist intentions. Moreover it is even possible protection is the only goal of standard In particular, there has been considerable discussion of whether standards and regulations affect trade costs and export prospects for developing countries. Whether an NTB ("standard" here) is protectionist is sometimes difficult to identify in the presence of market failure. If an NTB is equal to the measure that a social planner would implement for domestic purposes (i.e., all firms are domestic firms or all agents belong to a single economy), the NTB is presumably non- protectionist (Fisher and Serra, 2000).

The rest of the chapter is organized as follows. Section 2 presents the theoretical model to track the role of standards and technical regulations in explaining a Firm's export performance. The

structure of the model has been framed following Fischer and Serra (2000) where the importing country imposes a standard and the costs rise with standard. Contrary to Fischer and Serra, we have assumed cost of compliance with standard (and its responsiveness too) differs across countries depending on the efficiency of the firm. Section 3 shows the comparison of welfare effect of NTB (standard here) and "equivalent tariff". Section 4 defines the "protectionist" standard and formally proves "imposed" standard is "protectionist". Section 5 finds out the optimum standard under "imposed" negative externality[30] and section 6 concludes.

3.2The Model:-

We analyze a profit-maximizing firm's export behavior by modeling its decision to export to a set of differentiated markets. For simplicity, let us suppose the world consists of 2 countries, labeled as ***j= Home (H), Foreign (F),*** where F is the importing country and H is the exporting country.[31]

The importing country imposes varied standards and technical requirements on the good (described as τ in this model and taken as continuous) that is marketed in its market such as emission standards and regulations, to reduce the "imposed" negative externality arising from consumption, such as pollution. Because of the nature of the standards as the provision of a public good, a firm's compliance with the standards has no effect on consumers' demand for the regulated product. Moreover in this model we assume the externality shown by importing country is "imposed" externality i.e. the actual externality generated by consumption or production of the commodity is zero. Firm 1 is domiciled in country H, in which it sells q units of output in its own market while it exports q_h to country F. Firm 2, domiciled in country F sells

[30] Which is necessarily zero

[31] Again the reason for trade can be difference in some fixed cost (chapter2) and we can assume $R_H < R_F$

q_f **in own market**. We further assume that standard has no effect on demand for the good, as probably occurs for many environmental standards. The compliance with foreign country's technical requirements implies a differentiated cost to the domestic as well as foreign firm.

Domestic firm does not specify any technical requirement but has to incur a fixed setup cost to maintain the two different standards in two different markets. If the set up cost (F) exceeds the cost of maintaining different standards then, domestic firm will go for same standard.[32] The demand functions which are assumed to be linear are for both home and foreign country are respectively given by

$$p = a - bqandp* = a - b'(q_f + q_h) \quad (3.3.1)$$

The profit functions of domestic and foreign firms are respectively,

$$\pi = max_{\{q,q_h\}}[(a - bq)q - \{a - b(q_h + q_f)\}q_h - c_h(\tau)(q + q_f)] - R_H \quad (3.2.2)$$

$$\pi^* = max_{\{q_f\}}[\{a - b(q_h + q_f)\}q_f - c_f(\tau)q_f] - R_F \quad (3.2.3)$$

Where Π and Π*are Home and Foreign firm's profit functions. The parameter τ represents the minimum standard set in Foreign Market (F). We use $c_h(\tau)$ & $c_f(\tau)$ to denote constant unit production cost at standard level τ (compliance cost) for Home and Foreign country respectively. Unit production costs rise with the standard and are convex in standard. The unit compliance cost for Home is greater than that of foreign country and more responsive to changes in τ. These conditions can be expressed as,

$$c_i \geq 0, c'_i > 0, i = H, F; c_h > c_f; c'_h > c'_f \quad (3.2.4)$$

[32] Or else we can carry the same analysis by assuming the domestic firm is catering two different export markets one with requirement of "high standard" and another with requirement of "null standard". Further we can assume there is duopoly in the first market (as the firm in the importing country is also supplying) and monopoly in the second market (no local firm in the second country).

We can justify this assumption assuming that foreign country is technically more equipped to adopt the "standard" compared to Domestic country which is very common when the standard imposed by the importing country has some "protectionist" intention and so designs it in its own favour. The importing country can impose those standards which are nearer to its local standards so becomes less expensive to adopt. The unit costs are an increasing function of standard, and as standard does not alter the demand for the good firms will always produce at a minimum permitted standard.

Therefore assuming constant marginal utility of income and that no cost involved in whether the good complies with minimum standard, social welfare in Home can be expressed as consumer surplus plus the producer surplus from local market as well as from foreign market, i.e.,

$$W^H(\tau) = \frac{3(a-c_h)^2}{8b} + \frac{(a-2c_h+c_f)^2}{9b'} + E(q,\tau) \quad (3.2.5)$$

$E(q,\tau) < 0$ is the loss associated with externality. For Foreign country the social welfare under monopoly (i.e. when high standard keeps the imports out) is:

$$W^m{}_F(\tau) = \frac{(a-c_f)^2}{8b'} + \frac{(a-c_f)^2}{4b'} + E(q_f + q_h, \tau) \quad (3.2.6)$$

The social welfare under duopoly,

$$W^d{}_F(\tau) = \frac{(2a-c_f-c_h)^2}{9b'} + \frac{(a-2c_f+c_h)^2}{9b'} + E(q_f + q_h, \tau) \quad (3.2.7)$$

With no standard i.e. under free trade,

$$q_h = \frac{a}{3b'}, q_f = \frac{a}{3b'}, q = \frac{a}{2b} \quad (3.2.8)$$

With standard i.e. under protected trade,

$$q_h = \frac{\left(a-2c_h(\tau)+c_f(\tau)\right)}{3b'}, q_f = \frac{\left(a-2c_f(\tau)+c_h(\tau)\right)}{3b'}, q = \frac{(a-c_h)}{2b} \quad (3.2.9)$$

The solution shows for Home country the output for local market as well as export market is more under free trade. The output of the foreign firm after the imposition of standard can exceed its free trade output if$c_h(\tau) > 2c_f(\tau)$ (3.2.10)

Comparing 3.2.9 with 3.2.8 we can see the reduction in the "volume" of trade with trade regulations through increase in the cost of compliance.

3.2.A Effect of tightening of standard on output:-

Proposition 3.1:-*When the importing country (H) tightens the standard (τ),*

i) The output in the local market of exporting country falls, where as that in the importing country increase.

ii) The amount of export falls.

Proof:

$$-\frac{\partial q}{\partial \tau} < 0 \; as, c'_h(\tau) > 0 \quad (3.2.11)$$

$$\frac{\partial q_h}{\partial \tau} < 0 \;\; as, \left|c'_h(\tau)\right| > \left|c'_f(\tau)\right| \quad (3.2.11a)$$

$$\frac{\partial q_f}{\partial \tau} > 0 \;\; if, \left|c'_h(\tau)\right| > \left|2c'_f(\tau)\right| \quad (3.2.12)$$

It shows if the responsiveness of cost of compliance of domestic firm is too high compared to its trading partner then the output of foreign firm can increase with increase in τ, and export from

domestic country will always fall with the tightening of standard. We will do our rest of the analysis assuming 3.2.10 and 3.2.12 holds.

3.3Tariff vs NTB

Tariffs on manufacturing goods have been reduced to low levels through eight successive rounds of the World Trade Organization (WTO) and its predecessor, the General Agreement on Tariffs and Trade (GATT).**The reason for phasing out of tariff is it crates unnecessary distortions and loss of world welfare as it has a sharp negative effect on consumption.** As tariffs have been lowered, demands for protectionism have induced new NTBs, such as TBT (Technical Barriers to Trade)[33]interventions. The United Nations Conference on Trade and Development (UNCTAD, 2005) estimates that the use of NTBs based on quantity and price controls and finance measures has decreased dramatically, from a little less than 45% of tariff lines faced by NTBs in 1994 to 15% in 2004, reflecting commitments made during the Uruguay Round. However, the use of NTBs other than quantity and price controls and finance measures increased from 55% of all NTB measures in 1994 to 85% in 2004. The use of TBT almost doubled, from 32% to 59% of affected tariff lines during the same period.

This new protectionism also affects welfare, may reduce the consumer surplus and distorts trade. The comparison between tariff and NTB shows sometimes NTB may lead to worse situation than that of tariff. To make the effects comparable first of all we should calculate the "equivalent tariff**"** for a specific NTB (standard in this case).

3.3.A Calculation of equivalent Tariff (for a given τ)

Instead of taking the most often used "Price –wedge method"(price that would prevail without the NTB, to the price that would prevail in the presence of the NTB if the price paid to suppliers

[33] Minimum Standard falls in this category

were to remain unchanged[34] is the tariff equivalence[35]) "trade equivalence"[36] method has been chosen to calculate the equivalent tariff. The idea is instead of maintaining the same price if the importing country maintains the same volume of trade (i.e. the same amount of import) what amount of tariff it should impose on trading partner. The equivalent tariff [37]is of the amount= $(2c_h\text{-}c_f)/2$(3.3.1)**[38]**

3.3. B Welfare effect: - NTB vs "equivalent tariff"

This section does a comparative study between welfare effects of two different forms of protectionism i.e. tariff and non –tariff barrier (minimum standard), when there is no true negative externality (the reason for which standard has been imposed), i.e. a situation in which standards are purely "Protectionist".

We take the standard case of total surplus (consumer surplus and producer surplus) maximization as welfare maximization. In the given framework if we compare between NTB (here "standard" henceforth mentioned as NTB in this section) and "equivalent tariff" (henceforth mentioned as tariff), there is a **loss of consumer surplus for** exporting country from NTB **of the amount**

$$c_h(2a - c_h) \,/\, 8b \qquad (3.3.2)$$

This is the loss in consumer surplus from its own local market as it is compelled to produce at a high standard though it does not have any technical requirement for its own market. Similarly there is a loss of producer surplus (due to high cost of production and low demand) from local market of the amount$c_h(2a - c_h)/\ 4b$. (3.3.3)

[34]in this model price paid to the suppliers will change as the net price of the product in importing country will fall with the fall in world demand for the good. (due to tariff or Non-tariff barrier)
[35]Deardorff and Stern, 1998
[36] which is also known as quantity impact calculation
[37] assuming the tariff improves the welfare of the importing country
[38] See Appendix3. 1

Though there will not be any change of profit for exporting firm from the foreign market under tariff and NTB but definitely there is loss from home market and consumers are also negatively affected. Therefore under this situation NTB leads to positive welfare loss for exporting country compared to "equivalent tariff". In that context, the exporting country will prefer to be "discriminated" by tariff than that of NTB.

Next we find out what happens to importing country. It also faces a loss of consumer surplus and producer surplus[39]under NTB (compared to tariff) of the following amount respectively,[40]

$$c_f(8a - 4c_h - c_f)/\ 24b' \qquad (3.3.4)$$

$$c_f(4a + 4c_h - 5c_f)\ /12b' \qquad (3.3.5)$$

In this case the importing country will prefer to "protect" its firm by tariff than by NTB.

Lemma 3.1:-Importing country's welfare necessarily improves with "tariff" which is not the case with "standard" (NTB).

Proof:-With the tariff the net gain in welfare[41] for importing country is $(2c_h - c_f)^2\ /24b'$which is always positive whereas with "Standard" the net welfare gain is $\left[(c_h - c_f)^2 + c_f(2c_f - 4a)\right]/6b'$which is positive if the difference between c_h & c_f is sufficiently high.

However if the importing country is not free to impose tariff and its welfare increase with increase in standard importing country will go for imposition of positive standard instead of zero

[39] the potential tariff revenue inflates the amount of loss
[40] See Appendix3.2
[41] Calculated on the basis of gain in producers' surplus-loss in consumer surplus and excluding the tariff revenue.

standard (i.e. free trade) though the exporting country's welfare is maximized at zero standard. Here NTB is the second best tool of protection.

3.4 .Welfare effect of Free Trade and Protected trade:

This section studies decision taking by the Govt. We begin our analysis by considering the welfare functions of exporting country, importing country under duopoly as well as under monopoly (result of prohibitive standard).

With no externality the social welfare function of exporting country$W^H(\tau)$is decreasing ,as standard does not have any positive effect on Home country's welfare function as the Home country is losing consumer as well as producer's surplus from local market (due to increase in cost of production) and producer's surplus from Foreign market also. Social welfare of importing country under monopoly (i.e. either under autarky situation or after imposition of prohibitive standard on exporting country) is also decreasing in τ but the social welfare under duopoly can be increasing in τ provided there is large difference between$c_h(\tau) and c_f(\tau)$[42]. Moreover it can be initially decreasing in τ ,can reach a minimum (τ_{min})and then increasing in τ[43],as the difference between $c_h(\tau) and c_f(\tau)$ increases with increase in τ.So the intuition suggests that though the foreign firm may always lobby for the standard$\tau = \tau_e$which excludes the domestic firm from the export market, the actual standard imposed by the gov't will depend on the behavior of welfare function. It will maintain the standard τ^*such that $\tau^* = \tau_e$, in the first situation (when welfare function is increasing) but in the second situation (i.e. the welfare function is "u" shaped) the policy maker of importing country will go for null standard or prohibitive standard depending on the behavior of welfare function.

[42] See Appendix 3.3
[43] See Fig A.1 and A.2 in Appendix

Next we should find out what is the highest minimum standard τ_e 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,

$$G(\tau) = \left(a - 2c_h + c_f\right)^2/9b' - 3(2ac_h - {c_h}^2)/8b \qquad (3.5.1)$$

The first term shows the gain in producer's surplus (as trade gives access to foreign market) and the second term shows the loss in consumer surplus as well as producer surplus in domestic economy. The latter term also can be interpreted as the welfare loss of the exporting country as the domestic firm fails to maintain two different standards for two markets (due to high set up cost).However $G(\tau)$is decreasing and once it reaches to 0 the Domestic firm will reach to break even between export or not. Moreover this break-even will also depend on the elasticity of demand in two markets. Trade will be welfare improving for exporting country (at least up to a certain level of τ) iff $b > b'$i.e. demand in exporting country should be less elastic than that in importing country. This assumption can be given sound intuitive explanation. If the demand in exporting country is relatively more elastic then demand in local market will fall sharply due to increase in price as a result of additional cost (compliance) incurred in the process of production. On the other hand the revenue from Foreign market will not be substantial (and so the producer surplus earned by domestic firm from export market) due to fall in foreign price with the entry of domestic firm in the foreign market. In that case the loss in consumer and producer surplus from home will outweigh the gain from export market. As the trade will be gainful for exporting country only if the additional producer's surplus earned from export market exceeds the loss in producer and consumer surplus from home market, in the above case the exporting country will stop export under any positive standard.

Therefore, to get any positive optimum standard the assumption $b > b'$ has to be maintained. As long as the additional profit from foreign market outweighs the loss from local market the domestic firm will continue to export. Assuming domestic firm exports at the break even standard[44] and the importing country's welfare is increasing in standard (which we will relax in section 5) the govt of importing country will set the standard at $\tau = \tau_e$.[45]

Definition of Protectionist Standard:

In the literature there is variety of opinion on when government measure or action is protectionist. According to Baldwin (1970), a measure is protectionist if it lowers real global income. Engel (1996) defines a measure to be protectionist if it differs from the choice of a world welfare maximizing social planner. Fisher and Serra (2000), characterize a standard (in an open economy) as non-protectionist if the social planer would use it if all firms were local and in this model additionally we have to assume they produce for the local market only.

Proposition 3.2:- ***The standard followed by importing (standard imposing) country will be "protectionist" by either***

- ***i) the comparison between Local (importing country)and global (one firm in importing country and another in exporting country) duopoly (Fischer &Serra ,2000)***
- ***ii) local (importing) and global (importing and exporting country) welfare (Engle 1996)[46]***

[44] Even if it does not export at τ_e welfare of foreign country remains unchanged if domestic firm is able to produce at two different standards. (see appendix3.4)
[45] τ_e in the present case will be lower compared to when domestic firm can produce at two different standard levels.
[46] Mentioned by Fischer and Serra (2000)

Proof:-

Following that definition let us compare the standards that result from maximizing social welfare when both firms are in the same country with what pertains when one firm is domestic and another firm is foreign.

The social welfare of foreign country under duopoly when both firms are in foreign country,

$$W^D = \left(2a - c_f - c_h\right)^2/18b' + \left(a - 2c_f + c_h\right)^2/9b' + \left(a - 2c_h + c_f\right)^2/9b' \qquad (3.5.2)$$

The social welfare of foreign country under duopoly when one firm is in foreign country and another in domestic country,

$$W^d = \left(2a - c_f - c_h\right)^2/18b' + \left(a - 2c_f + c_h\right)^2/9b' \qquad (3.5.3)$$

The difference $W^D - W^d = \left(a - 2c_h + c_f\right)^2/9b'$ satisfies,

$$\frac{d(W^D - W^d)}{d\tau} = \{2\left(a - 2c_h + c_f\right)/9b'\}\left(-2c_h' + c_f'\right) \qquad (3.5.4)$$

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. Note that any positive standard imposed here is "protectionist" as there is no real negative externality.

Following Engle (1996) definition of "protectionist standard" we define world welfare as,

$$W^w = \left(2a - c_f - c_h\right)^2/18b' + \left(a - 2c_f + c_h\right)^2/9b' + \left(a - 2c_h + c_f\right)^2/9b' + 3(a - c_h)^2/8b' \qquad (3.5.5)$$

$$\frac{d(W^w - W^d)}{d\tau} = \frac{2\left(a - 2c_h + c_f\right)\left(-2c_h' + c_f'\right)}{9b'} + \frac{3(a - c_h)(-c_h')}{4b'} \qquad (3.5.6)$$

This term is again negative (and large in magnitude). This means the marginal benefit of rise in minimum standard is greater under duopoly for importing country than the world as a whole. So the minimum standard used in the former case is always high and protectionist by definition. Note that any positive standard imposed here is "protectionist" as there is no real negative externality.

This result reflects two important facts. Firstly in the given framework if the standard is imposed without any externality it will be always protectionist by definition. More interestingly the Gov't of importing country clearly has an incentive towards the imposition of a positive standard even if that is actually not linked to any negative externality, provided there is large difference between cost of compliance as well as its responsiveness of that to changes in standard between two countries. This standard leads to net welfare loss for the exporting country compared to free trade as it creates distortion in local market by raising the production cost which leads to loss in producer surplus as well as consumer surplus. Higher the Cost of compliance for exporting firm higher is the welfare loss. At a too high standard domestic firm quits exporting.

3.5Finding out optimum τ

We have taken compliance cost as explicit function of τ.

$$c_h = \bar{c_h}\tau^2 \tag{3.5.1}$$

$$c_f = \bar{c_f}\tau^2 \tag{3.5.2}$$

$$[\bar{c_h}] > 2[\bar{c_f}] \tag{3.5.3}$$

$$b = \bar{b}\tau^2 \tag{3.5.4}$$

We can reconstruct the welfare function of the importing country under duopoly as follows,

$$W_F{}^d(\tau) = \left(2a - \bar{c_f}\tau^2 - \bar{c_h}\tau^2\right)^2/18b' + \left(a - 2\bar{c_f}\tau^2 + \bar{c_h}\tau^2\right)^2/9b' \quad (3.5.5)$$

If W^d is throughout increasing in τ then it will be minimized at $\hat{\tau} = 0$ and Gov't will set $\tau > 0$

When W^d is first decreasing and then increasing, it will be minimized at ;

$$\hat{\tau} = \sqrt{4a\bar{c_f}/\left(\bar{c_f}^2 - 2\bar{c_h}\bar{c_f} + \bar{c_h}^2\right)} \quad (3.5.6)^{47}$$

Lemma 3.2:-Higher the difference between $\bar{c_f}$ and $\bar{c_h}$ lower will be $\hat{\tau}$.

Proof:- $\frac{d\hat{\tau}}{d(\bar{c_h} - \bar{c_f})} < 0$ (3.5.7)

Condition (3.5.7) indicates that higher the difference between cost of compliance with standard τ, lower will be $\hat{\tau}$ i.e.The welfare of the foreign country under duopoly will start increasing for a smaller value of τ.

Next we should find out what is the highest minimum standard τ_e 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,

$$G(\tau) = \left(a - 2\bar{c_h}\tau^2 + \bar{c_f}\tau^2\right)^2/9b' - 3[2a\bar{c_h}\tau^2 - (\bar{c_h}\tau)^2]/8b \quad (3.5.8)$$

$G(\tau)$ is decreasing and once it reaches to 0 the Domestic firm will reach to break even between exporting or not. Moreover this break even will also depend on the elasticity of demand in two markets.

[47] Calculated by "equation solver" software (Annex 3.1) & taking only positive value.

$$\tau_e = \sqrt{3^{3/2}a\left(\sqrt{\left(-16bb'\bar{c_h}\bar{c_f} + 24bb'\bar{c_h}^2 + 27b^2\bar{c_h}^2\right)} - 8ab'\bar{c_f} + 16ab'\bar{c_h} + 27ab\bar{c_h}\right)} / \sqrt{\left(8b'\bar{c_f}^2 - 32b'\bar{c_h}\bar{c_f} + 32b'\bar{c_h}^2 + 27b\bar{c_h}^2\right)} \quad (3.5.9)^{48}$$

Finally what should be the optimum standard will depend on the nature of welfare function of the foreign country under duopoly with standard and the net gain of exporting country after imposition of standard.

Proposition 3.3:-*If $W^d{}_F$ is increasing in τ, Foreign country sets*

$$\tau^* = \tau_e \quad (3.5.9)$$

Proposition 3.4:-*If $W^d{}_F$ first falls, reaches minimum value at $\hat{\tau}$ and then increases then Foreign Country sets:*

$$\tau^* = \tau_e if \tau_e > \hat{\tau} and W^d{}_F(\tau = \tau_e) > W^d{}_F(\tau = 0) \quad (3.5.10)$$

$$\tau^* = 0, otherwise \quad (3.5.11)$$

Therefore even if the firm in the importing country will lobby for prohibitive standard, the Govt in importing country may prefer Null standard i.e. no NTB. The difference in the cost of compliance leads to difference in the policy adopted by importing country Govt.

[48] Calculated by "equation solver" software (Annex 3.2) & taking only positive real value. Assuming G(τ) is positive up to a certain value of τ and then reaches to zero

Table 3.1 Game Theoretic Presentation (No externality)

		Exporting Country	
		Trade (Export)	Autarky (No Export)
Importing Country	τ=0(free Trade)	$a^2/3b', 3a^2/8b + a^2/9b'$	$3a^2/8b', 3a^2/8$
	$\tau=\tau_{e(NTB)}$	$(2a - c_f - c_h)^2/18b' + (a - 2c_f + c_h)^2/9b',$ $(a - 2c_h + c_f)^2/9b' + 3(a - c_h)^2/8b,$	$3(a - c_f)^2/8b',$ $3a^2/8b$

The Home country has two available strategies (Export, No Export) and the Foreign country has two available strategies (Free Trade, Protected Trade).Assuming (3.5.10) is fulfilled and domestic firm exports at breakeven; ($\tau=\tau_e$, export) is the Nash equilibrium[49] though it is not the Pareto efficient situation. (τ=0, export) is the Pareto efficient situation but it is not a Nash equilibrium as the importing country can do better by switching to $\tau=\tau_e$. **If either of two above mentioned conditions are not fulfilled then the latter will be Nash equilibrium.**

3.6: Concluding remarks:

Standards dealing with pseudo negative externality leads to huge welfare and trade loss for the exporting country. If the exporting country has to incur huge cost of compliance then it becomes detrimental for exporting country and on the contrary higher the difference in cost of compliance higher will be the welfare gain for the importing country. So the importing country can extract the possibility of raising the standard up to "prohibitive level". In the earlier chapter imposition of standard was always beneficial (at least in bilateral trade) for the importing country, but under

[49] Note though $\tau=\tau_e$ is not a dominant strategy for importing country but "export" is the dominant strategy also for the exporting country if the given conditions are fulfilled.

these circumstances the imposition of standard is beneficial only when the exporting country is relatively less efficient. The simple model developed in this chapter shows the following important results like,

a) The significant difference in cost of compliance leads to adoption of **"prohibitive standard"** by importing country without the **presence of any true negative externality** created by the production/consumption of the commodity.
b) Though the reduction of tariff is expected to enhance the world welfare but the presence of this kind of NTB may lead to worse situation than tariff.(for importing country less welfare gain and for exporting country more welfare loss).
c) **(Prohibitive standard, export)** is a probable Nash equilibrium which is not pareto efficient.
d) The "standard" imposed by the importing country is "protectionist" by definition.
e) "Standard" (NTB) is not a dominant strategy for the importing country implying that the decision to impose standard for the importing country depends on the strategy chosen by the exporting country showing that here standard works as a trade strategy tool with purely protectionist intention.

Appendix3.1:

Suppose the amount import is kept fixed at $\overline{q_h}$

$$\pi_1 = (a - bq)q + \left(a - b'\left(q_f + \overline{q_h}\right)\right)\overline{q_h} - t\overline{q_h} - R_H$$

$$\pi_2 = \left(a - b'\left(q_f + \overline{q_h}\right)\right)q_f - R_F$$

F.O.C:

$$\frac{\partial \pi_1}{\partial q} = a - 2bq = 0 \qquad (A.3.1)$$

$$\frac{\partial \pi_1}{\partial q_h} = a - b'q_f - 2b'\overline{q_h} - t = 0 \qquad (A.3.2)$$

$$\frac{\partial \pi_2}{\partial q_f} = a - 2b'q_f - b'\overline{q_h} = 0 \qquad (A.3.3)$$

Putting the value of q_h in (3.A.2), $q_f = (a + t)/3b'$ $(A.3.4)$

Substituting 3.A.4 in 3.A.3 the value of equivalent tariff comes.

Appendix3.2:

From 3.A.2,

$$q_f = \left(2a + 2c_h - c_f\right)/6b' \qquad (A.3.5)$$

The consumer surplus under "equivalent tariff" for importing country,

$$\left(4a - 2c_h + c_f\right)^2/72b' \qquad (A.3.6)$$

Consumer surplus under NTB is: $\left(2a - c_f - c_h\right)^2/18b'$ (A.3.7)

Loss in consumer surplus (under NTB): $c_f\left(8a - 4c_h - c_f\right)/24b'$ (A.3.8)

The producer surplus under "equivalent tariff" for importing country,

$\left(2a + 2c_h - {c_f}^2\right)/36b'$ (A.3.9)

Producer surplus under NTB is$\left(a - 2c_f + c_h\right)^2/9b'$

Loss in producer surplus under NTB for importing country :$\frac{c_f\left(4a+4c_h-5c_f\right)}{12b'}$ (A.3.10)

Comparing between Free Trade and Tariff,

The gain in Producer surplus for importing country after tariff,

$\left[\left(2a - 2c_h - c_f\right)^2/36b'\right] - a^2/9b' = \left(4a + 2c_h - c_f\right)\left(2c_h - c_f\right)/36b'$ (A.3.11)

The loss in Consumer surplus=$\left(8a - 2c_h + c_f\right)\left(2c_h - c_f\right)/72b'$ (A.3.12)

Appendix3.3:

The welfare of the importing country under duopoly and monopoly (with prohibitive standards) are respectively,

$W_F{}^d(\tau) = \left(2a - c_h - c_f\right)^2/18b' + \left(a - 2c_f + c_h\right)^2/9b'$ $(A.3.13)$

$W_F{}^m(\tau) = \left(a - c_f\right)^2/8b' + \left(a - c_f\right)^2/4b'$ $(A.3.14)$

$\frac{dW_F{}^d(\tau)}{d\tau} > 0\ iff\left({c_h}' - 2{c_f}'\right) > \left(2a - c_f - c_h\right)\left({c_h}' + {c_f}'\right)/2\left(a - 2c_h + c_f\right)$ $(A.3.15)$

Otherwise it will be initially decreasing will reach a minimum and then increasing.

$$At\widehat{\tau}, \qquad \frac{dW^{d}{}_{(F)}}{d\tau} = 0 \; and \frac{d^{2}W^{d}{}_{(F)}}{d\tau^{2}} > 0$$

Appendix3.4:

If the exporting country can maintain two different standards, then

At $\tau = \tau_e, a = 2c_h - c_f$

$W_F{}^{d}(\tau_e) = W_F{}^{m}(\tau_e)$

Diagrams:-

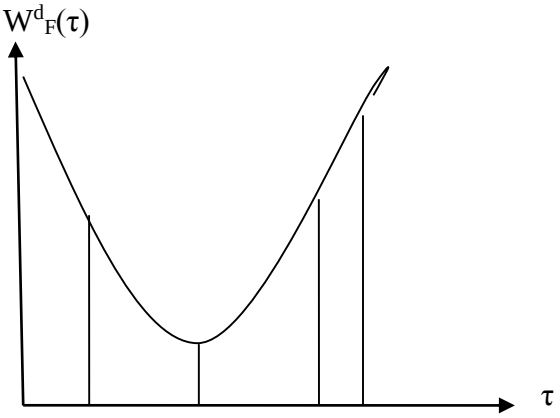

Figure:-3.A.1 Foreign welfare function under duopoly (u-shaped)

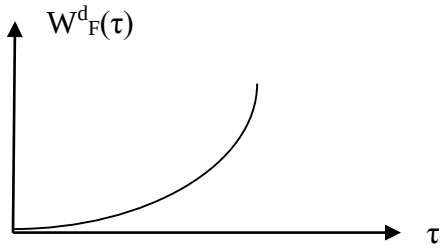

Figure:-3.A.2:- Foreign welfare function under duopoly (increasing)

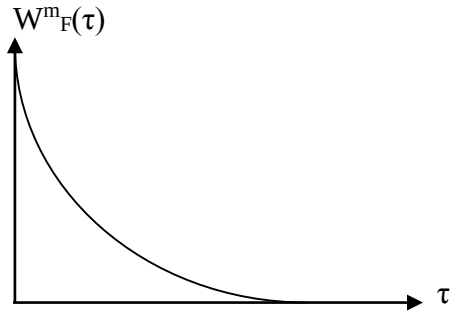

Figure3.A.3:-Foreign welfare function under monopoly