Harmonizing welfare and externalities: unraveling the product versus process standards puzzle in regulatory policy

Difei Geng
University of Arkansas-Fayetteville

Doyoung Park
University of Arkansas-Fayetteville

Abstract

There are two types of regulatory standards depending on the externalities they are designed to address. One is product standards targeting negative consumption externalities; the other is process standards addressing negative production externalities. Notably, the institutional arrangements for the two types of standards can be different in practice. For instance, the World Trade Organization applies national treatment (NT) to product standards, but its case law favors mutual recognition (MR) for process standards. This paper evaluates the welfare implications of this well-known product/process distinction regarding regulatory standards. We show that, on welfare grounds, the rule of NT performs relatively better under product standards, while MR is relatively more desirable under process standards. This result provides a welfare-based justification for adopting differential institutional rules on regulatory standards of different nature.

1 Introduction

There are two types of regulatory standards depending on the purpose of use. One is product standards which are used to address negative consumption externalities (NCEs) like vehicle emissions. The other is process standards which target negative production externalities (NPEs) such as industrial pollution and deforestation. Such a product versus process distinction for regulatory standards is not only conceptual but also relevant to practical institutional arrangements. A well-known example is the World Trade Organization (WTO)'s differential approaches to regulatory standards. On one hand, the WTO adopts the rule of national treatment (NT) for product standards, which requires standards to be non-discriminatory against foreign firms.[1] On the other hand, the WTO's case law upholds mutual recognition (MR) for process standards, which requires countries to apply foreign countries' standards to their respective firms.[2] In the WTO's Tuna-Dolphin Case, for example, the U.S. required Mexican tuna products to meet certain criteria due to non-compliance with its process standards on tuna fishing. Although complying with NT, the U.S. was found by a WTO panel to have violated GATT Article XI which limits the use of import prohibitions or restrictions.[3] This product/process distinction made by the WTO has been widely discussed from the legal perspective (Howse and Regan (2000) and Schmidt (2007), among others). However, its welfare foundations have received limited scrutiny and this prevents a complete evaluation of its overall merit.

This paper fills in this important gap in the literature. Specifically, we characterize and compare the welfare implications of NT and MR under process standards, and contrast them with those under product standards. To this end, we introduce process standards that address NPEs into the oligopolistic trade model of Costinot (2008). Costinot (2008) assumes that firms produce a homogeneous good which has different versions. Consumption of the good may generate a negative externality, i.e. a NCE, the size of which depends on the version being sold. Governments can impose product standards on firms to affect the levels of the NCE. By contrast, we assume that

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[1]For example, the WTO recognizes that countries have the right to implement measures to protect public health, including imposing stricter product standards on tobacco products. However, these measures should be applied in a non-discriminatory manner, treating domestic and imported tobacco products equally.

[2]By design, NT and MR are mutually exclusive and cannot be implemented simultaneously. Specifically, the standards on foreign firms are chosen by domestic countries under NT but they are determined by foreign countries under MR.

[3]The WTO's decision emphasized the need for non-discriminatory application of labeling requirements, aligning with national treatment principles. However, the case also involved the concept of mutual recognition, with Mexico arguing for equivalence between its fishing methods and U.S. dolphin-safe standards. While the focus was on discrimination, mutual recognition was also relevant and crucial factor in the dispute.

production of the good may create a negative externality, i.e. a NPE, depending on the version being produced. Governments can impose process standards on firms to correct the levels of the NPE.

Our key finding is that the welfare performance of NT and MR depends crucially on the type of regulatory standards. Particularly, we show that NT and MR perform *relatively* better under product and process standards respectively. The intuition for this result is the following. In the case of NPEs, countries tend to *overuse* low process standards under both NT and MR. Nevertheless, countries overuse low standards to a lesser extent under MR than under NT. This is because relaxing standards on domestic firms under MR make the firms also receive lower standards abroad, which will increase domestic production with NPEs. This reduces countries' incentives to lower standards under MR. Hence MR unambiguously welfare-dominates NT under process standards. On the other hand, Costinot (2008) shows that MR can be welfare-dominated by NT over certain levels of NCEs when applied to product standards. Therefore, NT is relatively more welfare-improving under product standards. Importantly, this finding makes a case for applying NT and MR to product and process standards respectively, providing a welfare justification for the WTO's differential treatment of the two types of regulatory standards.

The welfare effects of NT and MR have been examined by the theoretical literature on international regulatory cooperation. However, this literature predominantly focuses on product standards with NCEs (e.g. Costinot, 2008; Staiger and Sykes, 2011; Edwards, 2012; Toulemonde, 2013; Grossman et al., 2021; Macedoni and Weinberger, 2022).[4] To our knowledge, we are the first to analyze NT and MR under process standards with NPEs, and to draw implications for the WTO's legal framework on regulatory standards.

2 Model

2.1 Basic Environment

There are two countries: A and B. Each country has one firm producing the same good that comes in two versions, H and L. Production of each unit of L generates a NPE of a magnitude $\theta > 0$ while producing H causes no externalities. The unit production costs for H and L are $c > 0$ and zero,

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[4]Maggi and Ossa (2022) consider both product and process standards. However, their focus is the political economy of regulatory standards, not NT or MR.

respectively: H (L) can be considered as the high (low) quality version of the good. We assume $c < 1/4$ following Costinot (2008).[5]

Each country has a continuum of consumers who differ in their willingness to pay, u: $u \sim U[0,1]$ where U is a uniform distribution. Consumers buy either one unit of the good regardless of the version or nothing. The consumer utility in country i is

$$\mathbb{U}_i = \begin{cases} u - p_i - \varphi_i & \text{if she buys either version at price } p_i \\ -\varphi_i & \text{if she buys nothing} \end{cases} \quad \text{for } i = A, B, \tag{1}$$

where φ_i is the aggregate NPE in country i associated with q_i^i and q_i^j, the quantities of the good sold by firm i in countries i and j,

$$\varphi_i = \theta^i q_i^i + \theta^j q_i^j \text{ for } i, j = A, B, \tag{2}$$

and the levels of NPEs from each unit sold in the two countries, θ^i and θ^j, are equal to θ or zero depending on the versions sold.

2.2 Policy Regime

To maximize welfare, country i sets process standards stipulating the version of the good. Let $\mathcal{S}_{ii}$ and $\mathcal{S}_{ij}$ denote the standards on the domestic and the foreign firm, with $\mathcal{S}_{ii}$ or $\mathcal{S}_{ij}$ being H or L. Let $\mathcal{S}_i = \{\mathcal{S}_{ii}, \mathcal{S}_{ij}\}$ be country i's standards profile.

We consider two policy regimes. The first follows NT where countries set identical standards on domestic and foreign firms: $\mathcal{S}_{ii} = \mathcal{S}_{ij}$. The second regime follows MR where a country's standard on its firm is also applied to the firm by the foreign country: $\mathcal{S}_{ii} = \mathcal{S}_{ji}$.

Define country i's welfare as

$$\mathbb{W}_i(\mathcal{S}_i, \mathcal{S}_j; \theta) = \mathbf{CS}_i(\mathcal{S}_i, \mathcal{S}_j; \theta) + \pi_i^i(\mathcal{S}_i, \mathcal{S}_j; \theta) + \pi_i^j(\mathcal{S}_i, \mathcal{S}_j; \theta), \tag{3}$$

where $\mathbf{CS}_i$ is the aggregate consumer surplus, π_i^i and π_i^j represent firm i's domestic and foreign

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[5]This assumption is made for two main reasons. First, it ensures that firms always sell positive quantities regardless of the standards being implemented. Second, it allows our results about process standards to be comparable to those about product standards from Costinot (2008).

profits. World welfare $\mathbb{W}^{\text{world}}$ is the sum of each country's welfare.

We consider a two-stage game. In stage one, countries simultaneously choose their standards either cooperatively to maximize world welfare, or non-cooperatively to maximize their national welfare. In stage two, firms compete à la Cournot in both countries. We solve the game using backward induction.

3 Equilibrium Process Standards and Welfare

3.1 Globally Optimal Standards

We first characterize the global optimum resulted from countries cooperatively and freely choosing their standards to maximize world welfare.[6] By symmetry, we focus on identical standards chosen by countries. It is demonstrable that given $c < 1/4$, only $\{L, L\}$ and $\{H, H\}$ can be globally optimal. Particularly, there exists a unique externality threshold $\theta^G = 2(2c - c^2)/3$ such that

$$\mathbb{W}^{\text{world}}(\{H, H\}, \{H, H\}; \theta) > \mathbb{W}^{\text{world}}(\{L, L\}, \{L, L\}; \theta) \text{ iff } \theta > \theta^G,$$

implying

Result G1. *The global optimum involves high (low) process standards on both firms when $\theta > \theta^G$ ($\theta < \theta^G$).*

Intuitively, the high standard is optimal for large NPEs as the social benefit from removing NPEs dominates that from maintaining low production costs. Comparing G1 with the globally optimal *product* standards under NCEs, established in Costinot (2008), we have

Result G2. *Globally optimal product and process standards are identical.*

G2 holds as the world's aggregate externality and welfare, conditioning on any standards, are independent of the origin of externalities. G2 is useful in indicating that the welfare benchmark is the same under product and process standards.

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[6]We omit the results on the Cournot competition embedded in the optimal choice of standards.
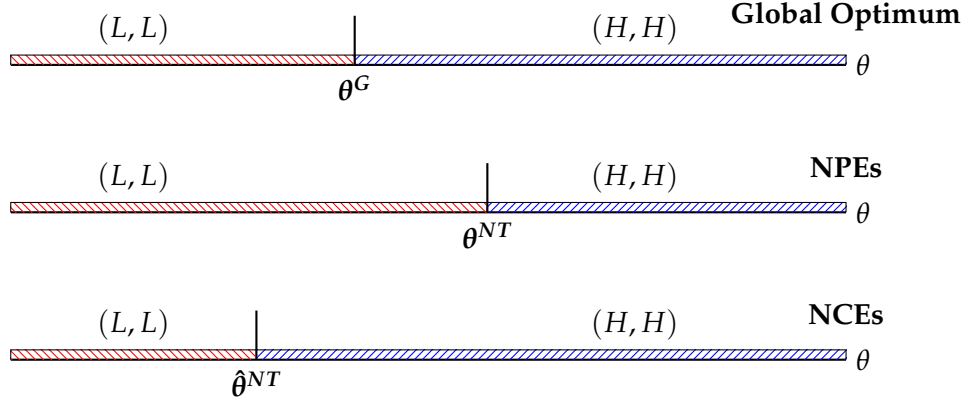
Figure 1: Equilibria under NT

3.2 Regime of NT

Now consider the non-cooperative equilibrium under NT. It can be shown that there exists a unique threshold $\theta^{NT} = c(2 - c)$ satisfying

$$\mathbb{W}_i(\{H, H\}, \{H, H\}; \theta) > \mathbb{W}_i(\{L, L\}, \{L, L\}; \theta) \ \text{iff} \ \theta > \theta^{NT}, \tag{4}$$

which yields

Result NT1. *Under NT, countries choose the high (low) process standard for $\theta > \theta^{NT}$ $(\theta < \theta^{NT})$.*

The welfare implications of NT can be seen by comparing θ^{NT} and θ^G, with

$$\theta^{NT} > \theta^G, \tag{5}$$

implying that countries implement the low standard for an inefficiently large range of θ. This yields

Result NT2. *Countries overuse the low process standard under NT.*

Intuitively, lowering process standards under NT creates a positive profit spillover on the foreign firm by reducing its production cost, but also a NPE spillover on the foreign consumers due to expanded production of the low quality version in the foreign country. The latter effect dominates leading to excessive use of the low standard by countries.

Notably, NT2 contrasts the finding in Costinot (2008) that NT causes overuse of the high product standard: $\hat{\theta}^{NT} < \theta^G$, where $\hat{\theta}^{NT}$ represents the threshold above which the high product standard is adopted (Figure 1). Intuitively, countries facing NCEs experience greater local externalities when lowering product standards on foreign firms, as the consumption of low-quality imports occurs domestically. Consequently, they have less incentives to lower product standards.

3.3   Regime of MR

Now consider the MR regime. By symmetry, countries choose identical standards in equilibrium. Specifically, there exists a threshold $\theta_1^{MR}=c(20-3c)/(12(1+c))$ such that $(\{L,L\},\{L,L\})$ arises as the equilibrium for $\theta < \theta_1^{MR}$. Similarly, there exists $\theta_2^{MR}=c(20-17c)/12$ which is larger than θ_1^{MR} such that $(\{H,H\},\{H,H\})$ is the equilibrium for $\theta > \theta_2^{MR}$. For $\theta_1^{MR} < \theta < \theta_2^{MR}$, the equilibrium can be either $(\{L,L\},\{L,L\})$ or $(\{H,H\},\{H,H\})$. We follow Costinot (2008) by assuming that countries choose "the most cooperative" standards which yield higher world welfare, implying $(\{H,H\},\{H,H\})$ as the unique equilibrium.

Figure 2: Equilibria under MR
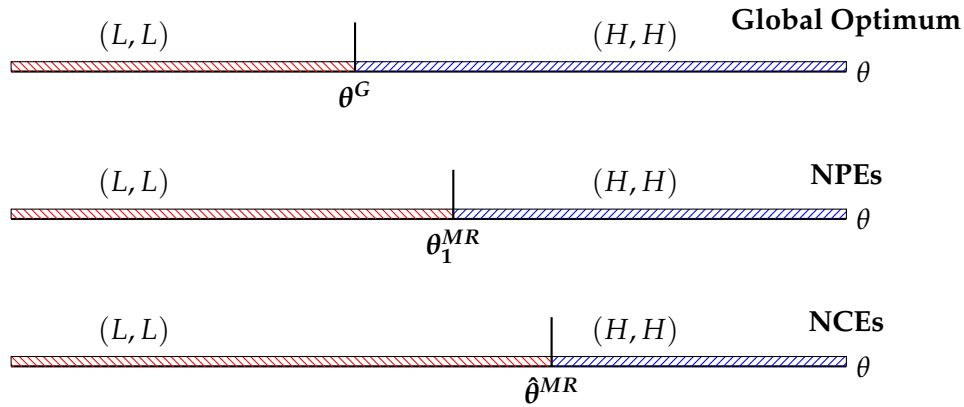
Result MR1. *Under MR, countries choose the high (low) process standard for $\theta > \theta_1^{MR}$ ($\theta < \theta_1^{MR}$).*

Moreover, it is readily checked that

$$\theta_1^{MR} > \theta^G,$$

indicating

Result MR2. *Countries overuse the low process standard under MR.*

MR2 holds as a country lowering the process standard on its firm makes the foreign country also loosen the standard on the firm. This creates a negative profit spillover on the foreign firm. Costinot (2008) demonstrates that the equilibrium product standards under MR follow a similar pattern but with a different threshold, $\hat{\theta}^{MR}$. Comparing the two thresholds, we find $\theta_1^{MR} < \hat{\theta}^{MR}$, indicating the overuse of the low process standard is less than that of the low product standard (Figure 2). Thus we have

Result MR3. *MR yields weakly higher world welfare over all θ under process standards than under product standards.*
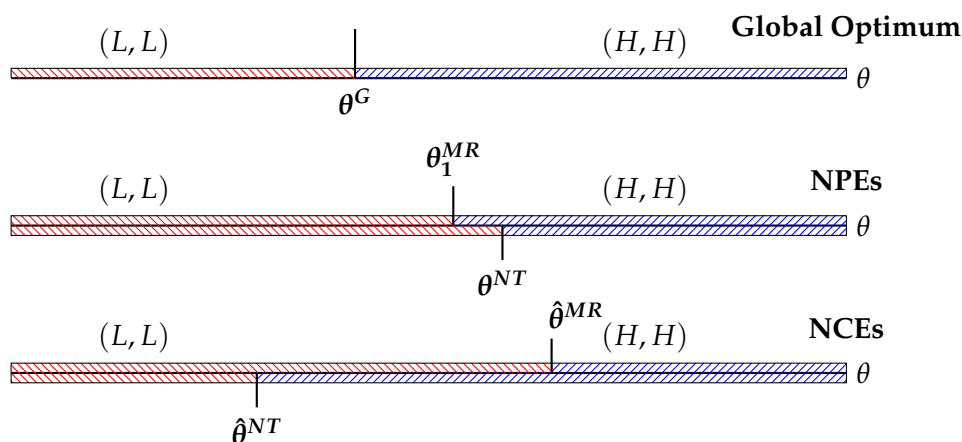

Figure 3: Comparison of equilibria by Regime and Source of Externality

3.4 Comparing MR and NT

We now compare the equilibria under MR and NT in the case of process standards. It is readily checked that

$$\theta_1^{MR} < \theta^{NT},$$

meaning that MR induces less overuse of the low standard than NT (Figure 3). This implies

Result MN. *Under process standards, MR yields weakly higher world welfare than NT over all θ.*

MN says that MR welfare dominates NT unequivocally under process standards. In contrast, according to Costinot (2008), MR dominates NT under product standards for moderately low levels

of θ, i.e., $\theta \in (\hat{\theta}^{NT}, \theta^G)$, but is dominated by NT for moderately high levels of θ, i.e., $\theta \in (\theta^G, \hat{\theta}^{MR})$. This indicates that the welfare performance of NT *relative to MR* is stronger under product standards. Hence NT and MR are relatively more desirable on welfare grounds for product and process standards respectively. Importantly, this key finding aligns with the WTO's adoption of NT for product standards and MR for process standards. More broadly, it provides welfare justification for adopting differential institutional rules to regulatory standards of different nature.

4   Conclusion

This paper shows that the rules of NT and MR have relatively better welfare performance under product and process standards respectively. This finding provides a welfare-based explanation for how the WTO's preferences for the two rules depend on the nature of regulatory standards. More generally, our analysis highlights the importance of drawing the product/process distinction in evaluating alternative regulatory frameworks.

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