Bilateralism, Multilateralism, and Most Favored Nation in International Regulatory Cooperation

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Abstract

This paper analyzes bilateral and multilateral cooperation over regulatory standards and how it is affected by the WTO's most favored nation (MFN) rule. To this end, we develop a simple three-country model of regulatory standards under negative consumption externalities. Two main questions are addressed: first, what are the welfare implications of international regulatory cooperation? Second, is bilateral cooperation over regulatory standards a building or stumbling block for multilateral regulatory cooperation? In particular, we examine the role of MFN in shaping the answers to these questions. We show that bilateral cooperation under MFN can induce Pareto improvement although not necessarily yielding higher global welfare. Furthermore, bilateral regulatory cooperation acts as a stumbling block for multilateral cooperation regardless of the presence of MFN.

Keywords: Regulatory standards, consumption externalities, most favored nation, WTO, welfare. *JEL Classifications*: F12, F13, L51.

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1 Introduction

International trade agreements used to revolve around the dismantling of tariff barriers. As global tariffs reduced significantly over the past decades, the focus of recent trade negotiations has shifted to deep integration featuring cooperation over internal measures. An important area of such cooperation is regulatory standards. For example, the World Trade Organization (WTO) administers two trade agreements over multilateral regulatory cooperation, one on the application of sanitary and phytosanitary (SPS) Measures and the other on technical barriers to trade (TBT). Major regional economic integrations such as the United States–Mexico–Canada Agreement (USMCA) and the EU's development of a single market also cover regulatory cooperation as an essential component.

There are at least two central policy issues related to international regulatory cooperation. The first is the relationship between bilateralism and multilateralism. In particular, with proliferating regional trade agreements being reached, a natural question that arises is whether this trend is a building or stumbling block for multilateral regulatory cooperation. The answer to this question can be complex: while many provisions regarding regulatory standards included in bilateral or regional trade agreements are aligned with the multilateral trading system, it is also possible for such provisions to undermine further cooperation with countries outside the agreements (Lesser, 2007). In such a case, it is pivotal to identify the circumstances under which bilateral regulatory cooperation may militate against further cooperation on a multilateral basis.

The second policy issue is the role of the most favored nation (MFN) rule in international regulatory cooperation. In short, MFN requires that a country should not discriminate among its trading partners provided they are granted by the country with the MFN status.[1] MFN is a core institutional rule of the WTO which applies to both border and internal measures. A major concern shared by academics and practitioners is that abiding by MFN can be challenged by regional economic integration, as the participating countries often give each other preferential treatment which may lead to policy outcomes discriminatory against the outside countries. Notably, in the case of tar-

[1] MFN is an institutional pillar of the WTO such that it underlies all the trade agreements administered by the WTO.

iffs, the WTO indeed grants exemption from MFN to its members pursuing free trade agreements, as stipulated in Article XXIV of the General Agreement on Tariffs and Trade (GATT). A provision analogous to Article XXIV is also included in the General Agreement on Trade in Services (GATS). However, such an exception is not provided in the WTO's agreements over regulatory standards such as SPS and TBT measures.[2] This implies that countries pursuing regional cooperation over these measures, at least on a de jure level, still have the obligation to abide by MFN. Such a contrast between the WTO's approaches to alternative types of policy instruments makes it especially relevant to study the implications of MFN for international regulatory cooperation.

It is worth noting that these two policy issues are not independent from each other. For instance, whether MFN is at work can affect the outcome of bilateral or multilateral regulatory cooperation. This may further shape the effect of bilateralism on multilateralism. In this paper, we provide the first analysis of the above-mentioned issues in a joint fashion. The main questions we address include: how do the welfare outcomes of bilateral and multilateral regulatory cooperation depend on MFN? Is bilateral regulatory cooperation a building or stumbling block for multilateral cooperation? How does MFN shape the effect of bilateral regulatory cooperation on countries' incentives for multilateral cooperation?

To answer these questions, we develop a simple three-country model of regulatory standards under consumption externalities.[3] Firms from different countries sell a homogeneous good across markets. The good has two versions: a low quality version whose consumption generates a negative externality, and a high quality version causing zero externalities but requiring a compliance cost to produce. Governments set regulatory standards that stipulate the version of the good that can be sold on their markets. Examples of such standards are SPS measures and emission standards on vehicles. We analyze two types of game. The first is a one-shot game where countries engage in bilateral or multilateral cooperation over regulatory standards, being possibly subject to the MFN rule. Analyzing this game allows us to characterize how MFN may shape

[2] See Howse (2015) for a discussion about this distinction in the WTO's application of Article XXIV from a legal perspective.

[3] The original model was developed by Brander and Krugman (1983) and was extended to incorporate consumption externalities by Costinot (2008). But both papers focus on the case of two countries.

the outcome and the welfare implications of international regulatory cooperation. We then extend this game to an infinitely repeated one in order to study the impact of bilateral cooperation on the prospect of multilateral cooperation. Specifically, we model multilateral cooperation as a self-enforcing agreement which can be sustained only when no members have a unilateral incentive to defect.

While our analysis yields various novel insights, two central findings are worth noting. First, the equilibrium outcome and welfare of bilateral cooperation depend importantly on the presence of MFN. Without MFN, bilateral cooperation benefits the members but hurts the nonmember. While MFN does not necessarily improve the efficiency effect of bilateral cooperation, it does make bilateral cooperation yield Pareto improvement by making all countries better off. This result provides one possible explanation for why Article XXIV is not included in the WTO's agreements on SPS and TBT: provided the WTO values the distributional effects of regional regulatory cooperation sufficiently, mandating the member countries to follow MFN can lead to a more equitable welfare outcome. The second main finding is that bilateral regulatory cooperation tends to be a stumbling block for multilateral cooperation, regardless of the presence of MFN. Specifically, bilateral cooperation without MFN weakens the cooperation incentives for the members, whereas that under MFN does so for the nonmembers. This finding is important by uncovering a potential tension between bilateralism and multilateralism in the process of deep economic integration. Furthermore, it suggests that mandating MFN is unlikely a panacea for resolving such a tension, and designing alternative institutional arrangements would be called for.

Our analysis starts with the one-shot game. We show that countries set identical standards on all firms under multilateral or no cooperation. Specifically, they choose the low (high) standard for small (large) externalities. Intuitively, countries face the trade-off between lowering production costs and reducing negative consumption externalities. For small externalities, the benefit from maintaining lower production costs dominates so that setting the low standard maximizes national welfare, and vice versa. A direct implication is that countries have incentives to follow MFN so long as they do not engage in bilateral cooperation. Second, relative to the non-cooperative equilibrium, multilateral cooperation induces countries to loosen their standards such that they choose the

low standard for a larger range of the externality. This is because one country's relaxing of its standards creates a positive profit spillover for foreign countries by increasing the profits their firms earn in its market. Hence countries impose too much of the high standard when acting non-cooperatively.[4]

We next analyze bilateral cooperation over regulatory standards. We first show that the equilibrium outcome of bilateral cooperation depends crucially on the presence of MFN. Without MFN, the member countries can discriminate against the nonmember by subjecting its firm to a higher standard. This occurs because of the profit-shifting motive: as the members do not take account of the nonmember's welfare, they impose a higher standard on the nonmember to extract profits out of its firm. Notably, such a *negative* profit spillover incurred by the nonmember resembles the well-known trade-diverting effect of bilateral cooperation over tariff policy. An important policy implication is that bilateral regulatory cooperation may pose a challenge to MFN by creating incentives for members in regional regulatory cooperation to discriminate between countries within and ouside the cooperation. By contrast, bilateral cooperation under MFN induces the members to loosen their standards in a non-discriminatory fashion, so as to internalize the profit spillovers they impose on each other under no cooperation. As opposed to the case absent MFN, this creates a *positive* profit spillover on the nonmember by raising the profits its firm earns in the members' markets.

The finding that MFN affects the outcome of bilateral cooperation has important welfare implications. Particularly, bilateral cooperation without MFN benefits the members but hurts the nonmember due to the negative profit spillover it imposes on the latter. By contrast, thanks to the positive profit spillover it generates for the nonmember, bilateral cooperation under MFN leads to Pareto improvement by raising welfare for *all* countries. This finding is broadly consistent with the evidence from Lee et al. (2023) that deep regional trade agreements in a non-discrimination fashion can yield positive spillovers on third-country firms. Meanwhile, we show that global welfare is not necessarily higher with MFN than without. This is because MFN does not eliminate the strategic incentives of the member countries: under MFN, the members still do not internalize the effect of their standards on the welfare of the nonmember. These welfare

[4]This result depends on consumption externalities being not too transboundary. We discuss the implications of transboundary externalities in Secion 5.

results suggest that the justification of MFN may rest primarily on its distributional effect rather than its efficiency impact.

We then extend the one-shot game to a repeated one in order to examine how bilateral cooperation may affect countries' incentives for multilateral cooperation. We first examine the non-cooperative game as the benchmark. In this case, defection from multilateral cooperation by any country leads to the non-cooperative equilibrium in all future periods. As expected, a country defects if it is sufficiently impatient, i.e. if its discount factor is sufficiently small. Intuitively, a defecting country weighs the benefit against the cost of defection: the former is the welfare gain from unilaterally reverting to the non-cooperative standards, which occurs at the period of defection; the cost is the future losses in the foreign profits once multilateral cooperation breaks down and the other countries also revert to the non-cooperative standards. The benefit ends up dominating the cost for a sufficiently impatient country who will choose to defect from multilateral cooperation.

We then show that relative to no cooperation, bilateral regulatory cooperation undermines the sustainability of multilateral cooperation. Moreover, this is true regardless of the presence of MFN although its cause varies with MFN. Particularly, bilateralism without MFN reduces the cooperation incentives for the members, while that under MFN does so for the nonmember. Absent MFN, bilateral cooperation makes the members more likely to defect from multilateral cooperation because their defection benefits are greater given they can revert to discriminatory standards that extract profits out of the nonmember's firm. Meanwhile, this negative profit spillover gives the nonmember a stronger incentive for engaging in multilateral cooperation. As the sustainability of multilateral cooperation depends on the countries with the lowest cooperation incentives, bilateralism without MFN makes multilateralism more likely to break down. When bilateral cooperation follows MFN, multilateral cooperation will also become less likely as the nonmember now has stronger incentives for defection relative to under no cooperation. This is because the nonmember enjoys the positive profit spillover under MFN-based bilateral cooperation which reduces its cost of defection from multilateral cooperation. The finding that bilateralism is a stumbling block for multilateralism resembles that in Saggi (2006) who examines cooperation over tariffs. Saggi shows that

bilateral tariff cooperation in the form of either custom unions (CU) or free trade agreement (FTA) can make multilateral tariff cooperation harder to sustain. Particularly, a CU (FTA) adversely affects the cooperation incentives of the members (nonmember).

Literature review

This paper contributes to several strands of the literature. First, it relates to the literature that examines how bilateral trade agreements may affect the prospect of multilateral trade policy cooperation. This literature predominantly focuses on cooperation over tariffs as a form of shallow integration. Various studies in this literature employ a repeated game approach to model multilateral cooperation as a self-enforcing trade agreement (e.g. Riezman, 1991; Bagwell and Staiger, 1997a, 1997b, 1998; Bond et al., 2001; and Saggi, 2006, 2009).[5] Like these studies, we also use the repeated game approach to model multilateral cooperation. Unlike this literature, we examine cooperation over regulatory standards. This allows us to shed new light on the linkage between bilateralism and multilateralism in the context of deep integration.

This paper also contributes to the theoretical literature on the economics of the MFN rule (e.g. Choi, 1995; McCalman, 2002; Ederington and McCalman, 2003; Saggi, 2004, 2009). Our paper is especially related to Saggi (2009) who also uses the repeated game approach to analyze how MFN may mediate the impact of bilateralism on multilateralism associated with tariff policy cooperation. However, Saggi (2009) along with other studies from this literature all focus on MFN in tariffs. To our best knowledge, this paper is the first formal economic analysis of MFN applied to regulatory standards. It is also the first to examine the role of MFN in shaping the linkage between bilateral and multilateral regulatory cooperation.

Finally, this paper contributes to a burgeoning theoretical literature on deep integration. This literature has focused mainly on cooperation over regulatory standards (e.g. Costinot, 2008; Grossman et al., 2021; Maggi and Ossa, 2022) and intellectual property protection (e.g. Grossman and Lai, 2004; Geng and Saggi, 2015, 2022). Particularly, the literature pays considerable attention to the institutional aspect of deep integration such

[5] Other related studies that use alternative approaches include but are not restricted to Krishna (1998), Ornelas (2005, 2008), Limao (2006, 2007), Stoyanov and Yildiz (2015), etc.

as the rules of national treatment and mutual recognition (e.g. Costinot, 2008; Edwards, 2012; Geng and Saggi, 2015, 2022; Geng, 2019; Grossman et al., 2021). However, this literature has not examined the relationship between bilateralism and multilateralism or the effect of MFN.

The paper is structured as follows. Section 2 describes the model setup. Section 3 analyzes the outcomes of bilateral and multilateral regulatory cooperation. Section 4 examines the the impact of bilateral on multilateral regulatory cooperation and how this effect may depend on the rule of MFN. Section 5 provides further discussions and section 6 concludes.

2 Model

Consider a reciprocal dumping model with three symmetric countries: h, i and j. There is one firm in each country that produces the same good. Consumption of each unit of the good can generate a negative externality, the level of which equals $\theta \geq 0$. One example of such externalities is pollution emissions by vehicles. The good has two versions: H and L. The levels of pollution associated with H and L are 0 and θ respectively, while the unit production costs of the two versions are $c > 0$ and 0. Thus H and L can be considered as the high and low quality versions of the good, and c can be referred to as the compliance cost. To facilitate the analysis, we assume that $c < 1/5$, which ensures that: (1) firms always have positive sales in foreign markets; (2) an outcome where firms sell different versions is not globally optimal.[6] All firms have the same production costs.

We next describe utility, profits and welfare for country h. The corresponding variables for countries i and j are defined analogously. Each consumer in country h buys at most one unit of the good regardless of the version. Individual consumer surplus in country h is given as

$$U_h = \begin{cases} u - p_h - \varphi_h & \text{if she buys either version at price } p_h \\ -\varphi_h & \text{if she buys nothing} \end{cases} \tag{1}$$

[6] This assumption resembles the assumption that $c < 1/4$ in Costinot (2008).

In (1), u denotes consumer's willingness to pay for the good, φ_h represents the aggregate externality incurred by country h which is given as

$$\varphi_h = \theta_{hh} q_{hh} + \theta_{ih} q_{ih} + \theta_{jh} q_{jh} \tag{2}$$

where q_{kh} represent the quantity of the good firm k sells in country h for $k = h, i$ and j, θ_{kh} equal to 0 or θ denotes the level of externality associated with the version sold by firm k in country h.

We follow the literature by assuming u to be uniformly distributed over $[0, 1]$. It follows that country h's consumers can be partitioned into two groups depending on their willingness to pay. Those in the range of $(p_h, 1]$ buy one unit of the good whereas those in $[0, p_h]$ do not make a purchase. The market price in country h can then be derived as

$$p_h = 1 - (q_{hh} + q_{ih} + q_{jh}) \tag{3}$$

Country h's aggregate consumer surplus can be calculated as

$$cs_h = \int_{p_h}^{1} (u - p_h) du - \varphi_h$$

Firm h maximizes its global profit π_h which equals the sum of its profit in each country

$$\pi_h = \sum_k \pi_{hk}, \quad \text{for } k = h, i \text{ and } j$$

Firms engage in Cournot competition in all countries. Markets across countries are segmented.

Country h chooses its regulatory standards which stipulate the versions of the good firms can sell on its market. A standard can be high (H) which mandates the supply of the high quality version, or low (L) which permits the sales of the low quality version. Denote country h's profile of standards with $\sigma_h \equiv \{\sigma_{hh}, \sigma_{hi}, \sigma_{hj}\}$ where σ_{hk} represent its standard on firm k for $k = h, i$ and j. Conditioning on the standards set by countries,

firm h's profit in country k can be calculated as

$$\pi_{hk} = (p_k - I(\sigma_{kh} = H)c)q_{hk} \quad \text{for } k = h, i \text{ and } j$$

where $I(\cdot)$ is an indicator function equal to one if the firm is subject to the high standard in a country and zero otherwise. Note that π_{hk} is a function of country k's standards σ_k only.

We examine and compare three scenarios depending on the form of policy cooperation between countries. The first scenario features no cooperation where countries simultaneously and non-cooperatively set their standards to maximize their own welfare. The second scenario is *bilateralism* where two countries coordinate their standards to maximize their joint welfare.[7] Particularly, we consider two cases depending on whether countries abide by MFN. When MFN is in place, each country in a bilateral cooperation must impose the same regulatory standards on its two trading partners. When MFN is absent, each country can freely set its standards on its trading partners. The third scenario reflects *multilateralism* such that the three countries coordinate their standards to maximize world welfare. We also assume that countries follow national treatment when setting their standards, that is, they cannot impose higher standards on foreign firms than on their own firms. This assumption helps isolate the effects of MFN by controlling for countries' incentives for discriminating between domestic and foreign firms.[8]

Specifically, the standards countries can choose are as follows. When MFN is absent, each country has five choices:

a. $\{L, L, L\}$ - low standards on all firms;

b. $\{H, L, L\}$ - high standard on the domestic firm and low standards on the foreign firms;

c. $\{H, H, L\}$ and $\{H, L, H\}$ - high standard on the domestic firm; one high and one low standards on the foreign firms;

[7] As will be seen, a country in this scenario has no incentives to simultaneously coordinate with two countries so that we can rule out the spoke-hub type outcome.

[8] For analysis of national treatment in environmental standards, see for example Costinot (2008) and Geng (2019).

d. $\{H, H, H\}$ - high standards on all firms.[9]

In the presence of MFN, each country cannot implement $\{H, H, L\}$ or $\{H, L, H\}$. This leaves countries with three choices: $\{L, L, L\}$, $\{H, L, L\}$ and $\{H, H, H\}$.

Country h's national welfare is defined as the sum of its consumer surplus and its firm's global profit

$$w_h(\sigma_h, \sigma_i, \sigma_j; \theta) = cs_h(\sigma_h; \theta) + \pi_h(\sigma_h, \sigma_i, \sigma_j; \theta) \tag{4}$$

where $\pi_h(\sigma_h, \sigma_i, \sigma_j) = \sum_k \pi_{hk}(\sigma_k)$. Note that country h's welfare is a function of the size of externalities, θ. This is actually the case for all the welfare functions defined in this paper. To economize space, we will omit θ in the expressions of welfare. Also note that given segmented markets, country h's consumer surplus and its firm's domestic profit depend only on its own standards σ_k. It is then useful to define these two components of country h's welfare as

$$\widehat{w}_h(\sigma_h) = cs_h(\sigma_h) + \pi_{hh}(\sigma_h) \tag{5}$$

Hence we can focus on $\widehat{w}_h$ when analyzing country h's choice of standards $\boldsymbol{\sigma}_h$. The same formulation can be made for countries i and j. It is worth noting that the impact of standards on welfare implies that there are *no* strategic interactions between countries in their choices of standards.

Without loss of generality, suppose countries h and i engage in bilateral cooperation. We can then write the joint welfare of the two countries as

$$w_{hi}(\sigma_h, \sigma_i, \sigma_j) = w_h(\sigma_h, \sigma_i, \sigma_j) + w_i(\sigma_h, \sigma_i, \sigma_j) \tag{6}$$

Again, the component of w_{hi} that depends only on the policies of countries h and i can be defined as

$$\widehat{w}_{hi}(\sigma_h, \sigma_i) = \widehat{w}_h(\sigma_h) + \widehat{w}_i(\sigma_i) + \pi_{hi}(\sigma_i) + \pi_{ih}(\sigma_h) \tag{7}$$

[9]Note that if a country chooses the low standard on its own firm, then under NT it must impose the low standard on foreign firms as well. This precludes (L, H, H), (L, L, H) and (L, H, L) as possible choices of standards.

that is, $\widehat{w}_{hi}$ equals the sum of $\widehat{w}_h$ and $\widehat{w}_k$ plus the profit each country's firm earns in the other country. It is sufficient to focus on $\widehat{w}_{hi}$ when analyzing the jointly optimal standards for countries h and i.

Finally, world welfare is defined as the sum of each country's welfare

$$ww(\sigma_h, \sigma_i, \sigma_j) \equiv w_h(\sigma_h, \sigma_i, \sigma_j) + w_i(\sigma_h, \sigma_i, \sigma_j) + w_j(\sigma_h, \sigma_i, \sigma_j) \tag{8}$$

The game proceeds in two stages. In the first stage, countries choose their regulatory standards depending on the presence of policy coordination and the MFN constraint. In the second stage, firms choose their sales across markets so that consumption and trade occur. We solve this game using backward induction.

3 Benchmark analysis

This section analyzes equilibrium outcome and welfare under different forms of policy coordination between countries. First, we specify the notation that will be used throughout the paper. As will be shown, standards chosen by countries depend on the level of θ. To facilitate exposition, we will use $\theta^R_{\boldsymbol{\sigma}'_k - \boldsymbol{\sigma}_k}$ to denote the threshold of θ above which country k switches its standards from $\boldsymbol{\sigma}_k$ to $\boldsymbol{\sigma}'_k$. In particular, R can be N, B and M which represent no cooperation, bilateral cooperation and multilateral cooperation respectively. Also, we will omit the subscript k when expressing the thresholds of θ as they apply to all countries by symmetry.[10] Second, to save space we will omit the standard analysis of the first-stage game with the understanding that the equilibrium market outputs and prices are embedded in the welfare functions of the second stage.

3.1 No cooperation

We start by characterizing the equilibrium standards in the non-cooperative case. To this end, assume that the MFN constraint is absent so that all countries can freely choose their standards. First consider each county's choice between uniformly low and

[10] We collect and present the expressions of the key thresholds of θ in the appendix.

high standards, i.e. $\{L, L, L\}$ and $\{H, H, H\}$. It can be checked that

$$\widehat{w}_k(\{H, H, H\}) - \widehat{w}_k(\{L, L, L\}) > 0 \text{ iff } \theta > \theta^N_{HHH-LLL}$$

which says that each country chooses the high (low) standard for sufficiently large (small) externalities. The intuition for this result is straightforward. In choosing its standards, each country faces a trade-off between lowering local externalities and reducing its firm's production cost. For large externalities the benefit from eliminating them dominates so that it is optimal to implement the high standard. The opposite holds for small externalities.

Next, we can show that $\{H, L, L\}$ are never chosen. To see this, we have

$$\widehat{w}_k(\{H, L, L\}) - \widehat{w}_k(\{L, L, L\}) > 0 \text{ iff } \theta > \theta^N_{HLL-LLL}$$

$$\widehat{w}_k(\{H, L, L\}) - \widehat{w}_k(\{H, H, H\}) > 0 \text{ iff } \theta < \theta^N_{HHH-HLL}$$

so that each country prefers $\{H, L, L\}$ to $\{L, L, L\}$ and $\{H, H, H\}$ for high and low externalities respectively. Hence (H, L, L) are preferred for $\theta^N_{HLL-LLL} < \theta < \theta^N_{HHH-HLL}$. But it is readily checked tat $\theta^N_{HHH-HLL} < \theta^N_{HLL-LLL}$ so that the range of θ over which $\{H, L, L\}$ are optimal vanishes. Hence $\{H, L, L\}$ does not maximize national welfare. The intuition for this result is the following. In our model, regulatory standards serve two purposes: reducing externalities and shifting profits from foreign to domestic firms. On one hand, $\{H, L, L\}$ can be more desirable than $\{L, L, L\}$ and $\{H, H, H\}$ over *intermediate* levels of externalities, since they are differentiated and thus more cost-effective for moderate externalities. On the other hand, $\{H, L, L\}$ undermines the profits of domestic firms as they are less strict on foreign firms. It turns out that the profit effect dominates so that $\{H, L, L\}$ is not optimal. The same logic applies to showing that $\{H, H, L\}$ and $\{H, L, H\}$ are not optimal as well. It follows that countries will choose between $\{L, L, L\}$ and $\{H, H, H\}$, which implies the following:

Proposition 1. *Suppose countries non-cooperatively and freely choose their standards. Then the Nash equilibrium is as follows:*

(i) each country chooses uniformly low standards, $\{L, L, L\}$, for small externalities, i.e. for $\theta < \theta^N_{HHH-LLL}$;

(ii) each country chooses uniformly high standards, $\{H, H, H\}$*, for large externalities, i.e. for* $\theta > \theta^N_{HHH-LLL}$*.*

Two remarks about Proposition 1 are worth making. First, the proposition shows that countries automatically follow MFN without policy coordination. This may not appear surprising given countries being symmetric. But from the viewpoint of curtailing externalities, even identical countries may have an incentive to choose differential standards that violate MFN (i.e. (H, L, H) and (H, H, L)) for moderate externalities. The reason these standards are not chosen is the profit-shifting motive - they lead to lower profits for domestic firms. An important implication is that Proposition 1 would carry over in the presence of political economy where governments value profits more than consumer surplus. Second, previous research shows in two-country models that identical countries can choose discriminatory standards against foreign firms absent NT (e.g. Costinot, 2008; Staiger and Sykes, 2011). Comparing that finding with Proposition 1, we see that countries have stronger incentives for discriminating between domestic and foreign firms than across foreign firms. To the WTO, this suggests that enforcement of NT may deserve more attention and effort than that of MFN in the pursuit of non-discrimination in national product standards.

3.2 Multilateral cooperation

We now examine multilateral cooperation where countries choose their product standards to maximize world welfare. Given that countries are symmetric and their policy decisions are independent, we can focus on the case where they choose identical standards. First, we have

$$ww(\{H, H, H\}, \{H, H, H\}, \{H, H, H\}) - ww(\{L, L, L\}, \{L, L, L\}, \{L, L, L\}) > 0 \text{ iff } \theta > \theta^W_{HHH-LLL}$$

so that from the efficiency point of view, uniformly high and low standards dominate for large and small externalities respectively. Moreover, it can be shown that $\{H, L, L\}$ is dominated by $\{L, L, L\}$ or $\{H, H, H\}$ for $c < 1/5$. Intuitively, multilateral cooperation eliminates the profit-shifting incentive so that countries simply balance reduced externalities against increased production costs. Given a small enough compliance cost (i.e. $c < 1/5$), it is globally optimal to switch directly from uniformly low to uniformly

high standards as the externality increases. By similar reasoning, we can also show that $\{H, H, L\}$ and $\{H, L, H\}$ do not maximize world welfare. This leads to the following proposition:

Proposition 2. *Suppose countries cooperate multilaterally and set their standards to maximize world welfare. Then:*

(i) each country chooses uniformly low standards for small externalities, i.e. $\theta < \theta^W_{HHH-LLL}$;

(ii) each country chooses uniformly high standards for large externalities, i.e. $\theta > \theta^W_{HHH-LLL}$.

Proposition 2 indicates that multilateral cooperation leads to product standards that conform to MFN. By comparing $\theta^W_{HHH-LLL}$ and $\theta^N_{HHH-LLL}$, we can see how the Nash equilibrium differs from the global optimum:

$$\theta^W_{HHH-LLL} > \theta^N_{HHH-LLL} \tag{9}$$

Hence, multilateral cooperation loosens regulatory standards by raising the threshold of θ for countries to switch between the low and the high standard (see Figure 1). Intuitively, a country lowering its standards on all firms creates a positive profit spillover for foreign firms by raising their profits earned in the country. When countries act non-cooperatively, they do not take into account this profit spillover. As a result, countries enforce too much of the high standard in the Nash equilibrium.

Figure 1 here

3.3 Bilateral cooperation without MFN

3.3.1 Equilibrium outcome

We now examine bilateral cooperation. Without loss of generality, suppose countries h and i coordinate their standards to maximize their joint welfare. We can refer to h and i as the member countries and j as the nonmember. To simplify the analysis, also assume that the member countries coordinate their standards on all firms including that from the nonmember.

First consider bilateral cooperation absent MFN. Given there are no strategic interactions between countries in their choices of standards, country j as the nonmember will not change its standards in response to the cooperation between h and i: its standards will remain as the Nash ones. Hence we only need to examine the standards chosen by countries h and j. , Let us focus on h without loss of generality. First note that $\{H, L, L\}$ are dominated by $\{L, L, L\}$ or $\{H, H, H\}$ and thus are not bilaterally optimal. Intuitively, $\{H, L, L\}$ cannot be chosen as they involve a low standard on the nonmember's firm, the profit of which does not accrue to the joint welfare of the members. The same logic implies that $\{H, H, L\}$ are not bilaterally optimal as they also involve a lower standard on the nonmember's firm. This leaves the members with three choices of standards: $\{H, L, H\}$, $\{L, L, L\}$ and $\{H, H, H\}$. It can be shown that

$$\widehat{w}_{hi}(\{H, H, H\}, \{H, H, H\}) - \widehat{w}_{hi}(\{L, L, L\}, \{L, L, L\}) > 0 \text{ iff } \theta > \theta^B_{HHH-LLL}$$

where $\widehat{w}_{hi}$, as defined in (7), is the joint welfare of h and j that depends only on their own standards. Hence country h chooses $\{L, L, L\}$ and $\{H, H, H\}$ for low and high externalities respectively. Now comparing $\{H, L, H\}$ with $\{L, L, L\}$ and $\{H, H, H\}$ yields

$$\widehat{w}_{hi}(\{H, L, H\}, \{H, L, H\}) - \widehat{w}_{hi}(\{L, L, L\}, \{L, L, L\}) > 0 \text{ iff } \theta > \theta^B_{HLH-LLL}$$

and

$$\widehat{w}_{hi}(\{H, L, H\}, \{H, L, H\}) - \widehat{w}_{hi}(\{H, H, H\}, \{H, H, H\}) > 0 \text{ iff } \theta < \theta^B_{HHH-HLH}$$

which say that $\{H, L, H\}$ dominates $\{L, L, L\}$ and $\{H, H, H\}$ for high and low externalities respectively. Moreover, it can be checked that $\theta^B_{HLH-LLL} < \theta^B_{HHH-LLL} < \theta^B_{HHH-HLH}$. This implies that $\{H, L, H\}$ is indeed bilaterally optimal over $\theta^B_{HLH-LLL} < \theta < \theta^B_{HHH-HLH}$. The above reasoning leads to the following proposition:

Proposition 3. *Suppose countries h and i engage in bilateral cooperation that is exempt from MFN. Then:*

(i) the members choose uniformly low and high standards for small and large externalities, and choose differential standards that favor each other for moderate externalities. That is, countries h and i choose $\{L, L, L\}$, $\{H, H, H\}$ and $\{H, L, H\}$ for

$\theta < \theta^B_{HHH-LLL}$, $\theta > \theta^B_{HHH-LLL}$ and $\theta^B_{HLH-LLL} < \theta < \theta^B_{HHH-HLH}$ respectively;

(ii) the nonmember chooses the same standards as in the Nash equilibrium, i.e. country j chooses $\{L, L, L\}$ for $\theta < \theta^N_{HHH-LLL}$ and $\{H, H, H\}$ for $\theta > \theta^N_{HHH-LLL}$.

The intuition for Proposition 3 is clear. Under cooperation, the member countries take into account the profits of each other's firm. This makes them extend "preferential" (i.e. low) standards to each other's firm while imposing "unfavorable" (i.e. high) standards on the nonmember's firm. Thus, bilateral cooperation without MFN creates a *negative* profit spillover on the nonmember by shifting profits from its firm to the members'. Notably, such an outcome resembles the trade-diverting effect examined by the literature on regional trade agreements over tariffs (see for example Krishna, 1998). While that literature emphasizes cooperation-induced tariff changes as the cause of trade diversion, our analysis suggests that trade diversion can also arise from regional cooperation over internal measures such as regulatory standards.

Proposition 3 has direct policy implications. First, it demonstrates that bilateral cooperation can cause the member countries to violate MFN by choosing discriminatory standards against the nonmember. This implies that whether regional regulatory cooperation allows for exemption from MFN such as Article XXIV of the GATT can indeed matter for the policy outcome. Moreover, it suggests that maintaining MFN is likely facing a growing challenge in today's world with a proliferation of regional economic integration. Second, Proposition 3 indicates that bilateral cooperation can also engender violation of international *harmonization* of product standards as it makes standards diverge between the member and the nonmember countries.[11] This observation is especially relevant to regional trade blocs like the EU, which aims toward harmonizing regulatory measures among its member states. Particularly, for such policy harmonization to be successful, it is important to restrict subgroups of the bloc members from engaging in regulatory coordination, as such coordination could militate against harmonization of standards within the trade bloc as a whole.

[11] Perhaps not surprisingly, we will show that even bilateral coordination under MFN can cause differences in standards between the member and the nonmember countries. Nevertheless, such differences are larger when MFN is absent, which implies a greater deviation from harmonization of standards.

3.3.2 Welfare analysis

We now examine the welfare impact of bilateral cooperation without MFN. As shown before, cooperation induces the member countries to adjust their standards over $\theta^B_{HLH-LLL} < \theta < \theta^B_{HHH-HLH}$. Hence welfare only changes over this range of θ. It is readily seen that cooperation must improve the welfare of the members, as the nonmember does not change its standards so that the profits of the members' firms do not change in the nonmember country. On the other hand, the nonmember necessarily loses from the cooperation: the domestic component of its welfare remains the same given its standards being unchanged, but its firm's profits in the member countries fall due to the trade-diverting effect.

To see how world welfare is affected, first consider $\theta^B_{HLH-LLL} < \theta < \theta^N_{HHH-LLL}$ as shown in Figure 1. Over this range of θ, we need to compare world welfare under $\{H, L, H\}$ with that under $\{L, L, L\}$. It can be shown that

$$ww(\{H, L, H\}, \{H, L, H\}, \sigma_j) < ww(\{L, L, L\}), \{L, L, L\}, \sigma_j) \text{ iff } \theta^B_{HLH-LLL} < \theta < \theta^N_{HHH-LLL}$$

so that bilateral cooperation without MFN lowers world welfare when the externality is relatively small. The intuition for this result is straightforward. The profit-shifting motive induces the member countries to tighten the standard on the nonmember's firm. For small externalities however, this tends to reduce welfare as uniformly low standards are more efficient.

Next consider $\theta^N_{HHH-LLL} < \theta < \theta^B_{HHH-HLH}$ over which we need to compare world welfare under $\{H, L, H\}$ with that under $\{H, H, H\}$. In this case, we have

$$ww(\{H, L, H\}, \{H, L, H\}, \sigma_j) > ww(\{H, H, H\}), \{H, H, H\}, \sigma_j) \text{ iff } \theta^N_{HHH-LLL} < \theta < \theta^W_{HHH-HLH}$$

where it can be shown that $\theta^W_{HHH-HLH} < \theta^B_{HHH-HLH}$ so that bilateral cooperation increases world welfare if and only if the externality is not too large. Intuitively, strict standards are desirable over large externalities, but bilateral cooperation induces the members to lower their standards on each other's firm for extracting profits out of the nonmember's firm. This implies that the standards chosen by the members are too

loose relative to the global optimum under large externalities. We summarize the above results in the following proposition:

Proposition 4. *Suppose bilateral cooperation is exempt from MFN. Then:*
(i) it weakly increases the welfare of the member countries;
(ii) it weakly lowers the welfare of the nonmember country;
(iii) it improves world welfare for moderate externalities, i.e. for $\theta^N_{HHH-LLL} < \theta < \theta^W_{HHH-HLH}$.

Importantly, Proposition 4 indicates that regional regulatory cooperation absent MFN is likely beggar-thy-neighbor: it can benefit the members at the cost of the nonmembers and possibly the world as a whole. This makes it relevant to examine the effect of imposing MFN on bilateral cooperation, which we will examine next. Before proceeding, it is useful to look into the mechanism underlying how the member countries gain from bilateral cooperation without MFN. A key observation is that

$$\widehat{w}_k(\{H,L,H\}) - \widehat{w}_k(\{L,L,L\}) < 0 \quad \text{iff } \theta^B_{HLH-LLL} < \theta < \theta^B_{HHH-HLH} \text{ with } k = h,i \tag{10}$$

that is, bilateral cooperation lowers the domestic component of each member country's welfare, $\widehat{w}_k$. This occurs as cooperation makes the members give each other's firm better market access via lower standards. As a result, the key source of the welfare gains for each member is the increase in its firm's profit earned in the other member's market. As expected, reciprocity is vital for making such cooperation mutually beneficial, as countries have no incentives to unilaterally make concessions on their market access. Such a mechanism resembles that of tariff cooperation as studied in Bagwell and Staiger (1999), where reciprocity is necessary for tariff concessions to be mutually beneficial for the cooperating countries. As will be seen, this mechanism plays an important role in shaping the incentives for countries to defect from multilateral cooperation.

3.4 Bilateral cooperation with MFN

3.4.1 Equilibrium outcome

Now consider bilateral cooperation under MFN. In this scenario, the member countries cannot choose $\{H,L,H\}$ which discriminates against the nonmember. Moreover,

$\{H, L, L\}$ is not jointly optimal as it is dominated by $\{L, L, L\}$ or $\{H, H, H\}$ when MFN is absent. Hence the members will choose between $\{L, L, L\}$ and $\{H, H, H\}$. But we already show that the members choose $\{H, H, H\}$ for large externalities such that $\theta > \theta^B_{HHH-LLL}$. Given the nonmember does not change its standards, we can state the following proposition:

Proposition 5. *Suppose bilateral coordination abides by MFN. Then*

(i) the member countries choose uniformly low and high standards for small and large externalities, i.e. they choose $\{L, L, L\}$ *for* $\theta < \theta^B_{HHH-LLL}$ *and* $\{H, H, H\}$ *for* $\theta > \theta^B_{HHH-LLL}$.

(ii) the nonmember country chooses the same standards as in the Nash equilibrium.

How does MFN change the outcome of bilateral cooperation? To see this, note that we have

$$\theta^N_{HHH-LLL} < \theta^B_{HHH-LLL}$$

which says that starting with the Nash equilibrium, cooperation under MFN makes the member countries loosen their standards over $\theta^N_{HHH-LLL} < \theta < \theta^B_{HHH-LLL}$. This occurs because the members internalize the profit externalities when maximizing their joint welfare subject to MFN. Next, we have

$$\theta^B_{HHH-LLL} < \theta^W_{HHH-LLL}$$

so that the member countries choose weakly higher standards than that under multilateral cooperation. Intuitively, the members under bilateral cooperation with MFN do not take into account the profits of the nonmember's firm, so they still overuse the high standard, although to a less extent than that in the Nash equilibrium.

3.4.2 Welfare analysis

We now examine the welfare effect of bilateral cooperation under MFN. Given that the nonmember's standards remain unchanged, the member countries must be better off from such cooperation. More importantly, the nonmember is also better off. To see this, note that the member countries lower their standards on all firms over $\theta^B_{HHH-LLL} < \theta < \theta^W_{HHH-LLL}$, which increases the profits earned by the nonmember's

firm in the members' markets. In other words, bilateral coordination under MFN creates a *positive* profit spillover on the nonmember. Moreover, given the nonmember's standards unchanged, its consumer surplus and its firm's profit at home remain unchanged. Hence the nonmember's welfare must rise over $\theta^B_{HHH-LLL} < \theta < \theta^W_{HHH-LLL}$. Since all countries are better off, world welfare must rise. These results are summarized in the following proposition:

Proposition 6. *Bilateral cooperation under MFN improves world welfare by making all countries better off.*

Comparing Propositions 4 and 6 shows that MFN can substantively affect the welfare implications of bilateral cooperation. Specifically, MFN prevents the trade-diverting effect and thus leads to Pareto improvement from bilateral cooperation. Notably, this result is broadly consistent with the evidence from Lee et al. (2023) who show that regional deep trade agreements that are non-discriminatory can yield positive spillovers on third-country firms. Nevertheless, our analysis indicates that such agreements do not necessarily yield higher world welfare than the discriminatory ones (i.e. those without MFN). To see this, note from Figure 1 that the two forms of regulatory cooperation induce different standards chosen by the members over $\theta^B_{HLH-LLL} < \theta < \theta^B_{HHH-HLH}$. For the lower segment of this interval $\theta^B_{HLH-LLL} < \theta < \theta^B_{HHH-LLL}$, it can be shown that

$$ww(\{L,L,L\}),\{L,L,L\},\sigma_j) > ww(\{H,L,H\},\{H,L,H\},\sigma_j)$$

which says that world welfare is higher under bilateral cooperation with MFN. For large θ such that $\theta^B_{HHH-LLL} < \theta < \theta^B_{HHH-HLH}$, recall that we have shown that world welfare is higher under MFN if and only if $\theta > \theta^W_{HHH-HLH}$. Moreover, it can be checked that $\theta^B_{HHH-LLL} < \theta^W_{HHH-HLH} < \theta^B_{HHH-HLH}$ which says that bilateral cooperation without MFN yields higher world welfare for intermediate levels of θ, i.e. $\theta^B_{HHH-LLL} < \theta < \theta^W_{HHH-HLH}$. Thus we can state the following:

Corollary 1. *Imposing MFN on bilateral cooperation improves world welfare over relatively low and high externalities, i.e. over* $\theta^B_{HLH-LLL} < \theta < \theta^B_{HHH-HLH}$ *and* $\theta^W_{HHH-HLH} < \theta < \theta^B_{HHH-HLH}$*, but reduces world welfare for moderate externalities, i.e. for* $\theta^B_{HHH-LLL} < \theta < \theta^W_{HHH-HLH}$.

To summarize, from a static point of view, the effect of MFN on world welfare is ambiguous. Nevertheless, MFN can have a distributional effect by ensuring Pareto improvement from bilateral cooperation. This result provides a possible explanation for why Article XXIV is not included in the WTO's agreements on SPS and TBT: provided the WTO cares sufficiently about the impact of regional regulatory cooperation on the outside countries, requiring the member countries to abide by MFN can lead to a beneficial outcome for *all* countries. In the next section, we will extend the above one-shot game to a repeated one in order to examine the role of MFN in shaping the effect of bilateralism on countries' incentives for multilateral cooperation.

4 Bilateralism and multilateralism: the role of MFN

This section addresses the question about whether bilateral cooperation is a building or stumbling block for multilateral regulatory cooperation. We are particularly interested in how this relationship may depend on the presence of MFN. To this end, we model multilateral cooperation over product standards as a stationary repeated game. Specifically, multilateral cooperation is assumed to be sustainable only when it is incentive compatible for all countries, that is, when no countries have incentives for unilateral defection. Such an approach has been taken to study tariff policy cooperation (e.g. Bagwell and Staiger, 1997, 1998; Saggi, 2006, 2009). Moreover, we assume bilateral cooperation is permanent once started. This implies that defection by any country will result in a permanent trade war wherein countries revert to the Nash equilibrium or bilateral cooperation.

4.1 Cooperation incentives under no bilateral cooperation

First consider the case of no bilateral cooperation. In this case, multilateral cooperation lasts until some country defects, which induces countries to revert to the Nash equilibrium in all future periods. Specifically, when country k defects, it switches to the Nash equilibrium standards by raising its standards to high over $\theta^N_{HHH-LLL} < \theta < \theta^W_{HHH-LLL}$. This will lead to a change in the domestic component of country k's welfare as

$$\Delta \widehat{w}^n_k(\theta) = \widehat{w}_k(\{H,H,H\}) - \widehat{w}_k(\{L,L,L\}) \quad \text{for } \theta^N_{HHH-LLL} < \theta < \theta^W_{HHH-LLL}$$

As $\Delta\widehat{w}_k^n$ varies with θ, we assume that country k takes account of the *overall* welfare change from defection, which is the sum of $\Delta\widehat{w}_k^n$ over $\theta_{HHH-LLL}^N < \theta < \theta_{HHH-LLL}^W$ given as

$$\Delta\widehat{ow}_k^n = \int_{\theta_{HHH-LLL}^N}^{\theta_{HHH-LLL}^W} \Delta\widehat{w}_k^n(\theta)d\theta = \frac{1}{96}c^2(2-c)^2 > 0$$

As expected, the instantaneous overall welfare change for country k is positive. Moreover, as compared to no defection, country k can enjoy $\Delta\widehat{ow}_k^n$ in all future periods if defecting. Hence its benefit from defection is the present value of its welfare increases

$$B_k^n = \frac{1}{1-\delta_k}\Delta\widehat{ow}_k^n$$

where δ_k is country k's discount factor.

On the other hand, defection makes other countries revert their standards to the Nash levels over all future periods. This will cause a per-period profit change for country k's firm in the other two countries over $\theta_{HHH-LLL}^N < \theta < \theta_{HHH-LLL}^W$. By symmetry, the profit changes can be written as

$$\Delta\pi_k^n(\theta) = 2(\pi_{k\widetilde{k}}(\{H,H,H\}) - \pi_{k\widetilde{k}}(\{L,L,L\})) \quad \text{for } \theta_{HHH-LLL}^N < \theta < \theta_{HHH-LLL}^W$$

As before, we can calculate the per-period overall profit change for country k as the sum of its profit changes over $\theta_{HHH-LLL}^N < \theta < \theta_{HHH-LLL}^W$

$$\Delta o\pi_k^n = \int_{\theta_{HHH-LLL}^N}^{\theta_{HHH-LLL}^W} \Delta\pi_k^n(\theta)d\theta = -\frac{1}{48}c^2(2-c)^2 < 0$$

Hence country k's firm incurs a profit loss in all future periods. Hence country k's cost of defection is the present value of the profit losses for its firm

$$C_k^n = \frac{\delta_k}{1-\delta_k}|\Delta o\pi_k^n|$$

Country k chooses to not defect if the present value is high for the benefit than for the cost of defection

$$B_k^n > C_k^n$$

Solving the above inequality yields $\delta_k < \delta^n = \frac{1}{2}$, which says that a country defects if it is sufficiently impatient. This leads to the following lemma:

Lemma 1. *Absent bilateral cooperation, multilateral cooperation is sustained if all countries are sufficiently patient, i.e. if* $\delta_k > \delta^n = \frac{1}{2}$.

Thus δ^n serves as our benchmark critical value of δ. We will compare it with that obtained under bilateral cooperation (with or without MFN) in order to examine how bilateralism may affect the prospect of multilateralism.

4.2 Cooperation incentives under bilateral cooperation absent MFN

We now study how bilateral cooperation without MFN may affect countries' incentives for multilateral cooperation. To this end, suppose that countries h and i coordinate their product standards while being free from the MFN constraint. Consider first the defection incentives of the member countries (h and i). Without loss of generality, let us focus on country h. If h defects, it would revert to bilateral cooperation with i, changing its standards from (L, L, L) to (H, L, H) over $\theta^W_{HHH-LLL} < \theta < \theta^B_{HHH-HLH}$ and from (H, H, H) to (H, L, H) over $\theta^B_{HLH-LLL} < \theta < \theta^W_{HHH-LLL}$. This will affect the domestic component of h's welfare at the period of defection, which can be written as

$$\Delta \widehat{w}^{bn}_{h1}(\theta) = \widehat{w}_h(\{H, L, H\}) - \widehat{w}_h(\{L, L, L\}) \quad \text{for } \theta^B_{HLH-LLL} < \theta < \theta^W_{HHH-LLL}$$

and

$$\Delta \widehat{w}^{bn}_{h2}(\theta) = \widehat{w}_h(\{H, L, H\}) - \widehat{w}_h(\{H, H, H\}) \quad \text{for } \theta^W_{HHH-LLL} < \theta < \theta^B_{HHH-HLH}$$

The overall instantaneous welfare change for h can then be calculated as

$$\begin{aligned} \Delta \widehat{\sigma w}^{bn}_h &= \int_{\theta^B_{HLH-LLL}}^{\theta^W_{HHH-LLL}} \Delta \widehat{w}^{bn}_{h1}(\theta) d\theta + \int_{\theta^W_{HHH-LLL}}^{\theta^B_{HHH-HLH}} \Delta \widehat{w}^{bn}_{h2}(\theta) d\theta \\ &= -\frac{c^2(56 - 16c + 39c^2 + 100c^3 - 35c^4)}{256(1 + 2c)(1 - c)} < 0 \end{aligned}$$

given the assumption that $c < 1/5$. Hence a defecting member would incur an instantaneous welfare drop under bilateral cooperation without MFN. The intuition for this result is that absent MFN, countries engaged in bilateral cooperation exchange market access by offering a lower standard to each other's firm than to other firms. Therefore, as country h defects and switches to the bilaterally optimal standards that favor country i's firm, its welfare falls despite an increase in i's welfare.

Now consider the welfare changes for country h after multilateral cooperation breaks down. First, the overall instantaneous welfare change for h would occur in all future periods. Second, as country i also reverts to the bilaterally optimal standards, this would lead to a per-period profit increase for country h's firm given as

$$\Delta\pi^{bn}_{hi1}(\theta) = \pi^{bn}_{hi}(\{H, L, H\}) - \pi^{bn}_{hi}(\{L, L, L\}) \quad \text{for } \theta^{B}_{HLH-LLL} < \theta < \theta^{W}_{HHH-LLL}$$

and

$$\Delta\pi^{bn}_{hi2}(\theta) = \pi^{bn}_{hi}(\{H, L, H\}) - \pi^{bn}_{hi}(\{H, H, H\}) \quad \text{for } \theta^{W}_{HHH-LLL} < \theta < \theta^{B}_{HHH-HLH}$$

where all the standards in π^{bn}_{hi} are country i's. The overall per-period profit change can be shown to be positive

$$\Delta o\pi^{bn}_{hi} = \int_{\theta^{B}_{HLH-LLL}}^{\theta^{W}_{HHH-LLL}} \Delta\pi^{bn}_{hi1}(\theta)d\theta + \int_{\theta^{W}_{HHH-LLL}}^{\theta^{B}_{HHH-HLH}} \Delta\pi^{bn}_{hi2}(\theta)d\theta = \frac{c^2(5c^4 + 7c^3 + 32c^2 - 16c + 20)}{64(1 + 2c)(1 - c)} > 0$$

Third, defection makes country j, the nonmember, change its standards to the Nash levels. This causes the profit of country h's firm in country j to change by

$$\Delta\pi^{bn}_{hj} = \pi^{bn}_{hj}(\{H, H, H\}) - \pi^{bn}_{hj}(\{L, L, L\}) \quad \text{for } \theta^{N}_{HHH-LLL} < \theta < \theta^{W}_{HHH-LLL}$$

which implies the overall per-period profit change as

$$\Delta o\pi^{bn}_{hj} = \int_{\theta^{N}_{HHH-LLL}}^{\theta^{W}_{HHH-LLL}} \Delta\pi^{bn}_{hj}d\theta = -\frac{1}{96}c^2(2 - c)^2 < 0$$

Thus country h would incur a profit loss in the nonmember over all future periods.

To sum up, under bilateral cooperation without MFN, a member's defection allows its firm to make a higher per-period profit in the other member after multilateral cooperation terminates. Then the benefit from defection for the member is present value of the increases in its future profits

$$B_h^{bn} = \frac{\delta_h}{1-\delta_h}\Delta o\pi_{hi}^{bn}$$

On the other hand, the cost of defection is the present value of two components. One is the fall in the defecting member's welfare due to the changes in its standards, which occurs in all periods. The other is the per-period profit loss in the nonmember after multilateral cooperation breaks down. The cost can then be written as

$$C_h^{bn} = \frac{1}{1-\delta_h}\Delta\widehat{ow}_h^{bn} + \frac{\delta_h}{1-\delta_h}\Delta o\pi_{hj}^{bn}$$

A member chooses to defect if

$$B_h^{bn} > C_h^{bn}$$

which yields the condition that

$$\delta_h < \delta_h^{bn} = \frac{3(56-16c+39c^2+100c^3-35c^4)}{4(52-48c+118c^2+3c^3+19c^4)}$$

Hence a member defects if it is sufficiently impatient. Importantly, it can be checked that

$$\delta_h^{bn} > \delta^n$$

for all $c < 1/5$. Thus, relative to the non-cooperative case, bilateral cooperation without MFN makes the member countries *more* likely to deviate from multilateral cooperation. Intuitively, the member countries can enjoy relatively large welfare gains from bilateral cooperation as they can implement discriminatory standards that extract profits out of the nonmember's firm. This increases the members' defection incentives.

Now consider the defection incentives for the nonmember, j. Defection induces country j to choose the Nash standards. This leads to an instantaneous increase in the

domestic component of j's welfare as

$$\Delta\widehat{ow}_j^{bn} = \int_{\theta^N_{HHH-LLL}}^{\theta^W_{HHH-LLL}} \Delta\widehat{w}_j^{bn}(\theta)d\theta = \frac{1}{96}c^2(2-c)^2 > 0$$

where

$$\Delta\widehat{w}_j^{bn}(\theta) = \widehat{w}_j(\{H,H,H\}) - \widehat{w}_j(\{L,L,L\}) \quad \text{for } \theta^N_{HHH-LLL} < \theta < \theta^W_{HHH-LLL}$$

Now consider how defection affects the nonmember j's welfare in the future. First, the instantaneous welfare increase will recur in all future periods. Second, as multilateral cooperation breaks down, the members revert to their bilaterally optimal standards absent MFN. As Figure 1 shows, this would lead to a per-period profit fall for country j's firm in the members as

$$\Delta o\pi_j^{bn} = \int_{\theta^B_{HLH-LLL}}^{\theta^W_{HHH-LLL}} \Delta\pi_{j1}^{bn}(\theta)d\theta + \int_{\theta^W_{HHH-LLL}}^{\theta^B_{HHH-HLH}} \Delta\pi_{j2}^{bn}(\theta)d\theta = -\frac{c^2(12-8c+12c^2+5c^3)}{32(1+2c)} < 0,$$

where

$$\Delta\pi_{j1}^{bn}(\theta) = \sum_{k=h,i}(\pi_{jk}(\{H,L,H\}) - \pi_{jk}(\{L,L,L\})) \quad \text{for } \theta^B_{HLH-LLL} < \theta < \theta^W_{HHH-LLL},$$

$$\Delta\pi_{j2}^{bn}(\theta) = \sum_{k=h,i}(\pi_{jk}(\{H,L,H\}) - \pi_{jk}(\{L,L,L\})) \quad \text{for } \theta^B_{HLH-LLL} < \theta < \theta^W_{HHH-LLL}$$

To summarize, the nonmember's benefit from defection is the present value of the increase in its domestic welfare that occurs in all periods

$$B_j^{bn} = \frac{1}{1-\delta_j}\Delta\widehat{ow}_j^{bn}$$

The nonmember's cost of defection is the present value of its profit losses in the member countries which occur over all the periods after multilateral cooperation breaks down

$$C_j^{bn} = \frac{\delta_j}{1-\delta_j}|\Delta o\pi_j^{bn}|$$

The nonmember defects if

$$B_j^{bn} > C_j^{bn}$$

which yields

$$\delta_j < \delta_j^{bn} = \frac{(1+2c)(2-c)^2}{3(12-8c+12c^2+5c^3)}$$

so that the nonmember defects if it is sufficiently impatient. Comparing δ_{nm}^{bn} with δ^n, we have

$$0 < \delta_j^{bn} < \delta^n$$

for $c < 1/5$. Importantly, this implies that bilateral cooperation without MFN makes the nonmember country *less* likely to deviate from multilateral cooperation. Intuitively, bilateral cooperation absent MFN makes the nonmember face unfavorable standards from the members. This raises the cost of defection for the nonmember and therefore weakens its incentives to defect from multilateral cooperation. We may state the following proposition:

Proposition 7. *Relative to the non-cooperative case, bilateral cooperation absent MFN reduces the member countries' incentives for multilateral cooperation, but increases the corresponding incentives for the nonmember.*

Note that the sustainability of multilateral cooperation depends on the country with the largest incentive to defect. Therefore, Proposition 7 implies that bilateral cooperation absent MFN *undermines* the prospect of multilateral cooperation by increasing the defection incentives for the members. As a result, bilateral cooperation without MFN tends to be a stumbling block for multilateral cooperation. This finding makes it relevant to investigate if such a mitigating effect can be changed by mandating MFN on bilateral cooperation. The next section examines this important question.

4.3 Cooperation incentives under bilateral coordination with MFN

Now assume that bilateral cooperation is subject to MFN. Consider first the member countries' defection incentives. When a member (say h) defects, it reverts to the bilaterally optimal standards under MFN. As can be seen from Figure 1, its standards

will change from (L,L,L) to (H,H,H) over $\theta^B_{HHH-LLL} < \theta < \theta^W_{HHH-LLL}$. By similar reasoning as before, country h's overall instantaneous welfare change is

$$\Delta\widehat{ow}^{bm}_h = \int_{\theta^B_{HHH-LLL}}^{\theta^W_{HHH-LLL}} \Delta\widehat{w}^{bm}_h(\theta)d\theta = \frac{1}{128}c^2(2-c)^2 > 0,$$

where

$$\Delta\widehat{w}^{bm}_h(\theta) = \widehat{w}_h(\{H,H,H\}) - \widehat{w}_h(\{L,L,L\}) \quad \text{for } \theta^B_{HHH-LLL} < \theta < \theta^W_{HHH-LLL}$$

Hence h's welfare increases at the period of defection.

On the other hand, as multilateral cooperation breaks down in the next period, the other member i follows suit while the nonmember j changes its standards to the Nash levels. It is easily seen that this will reduce the profits of the defecting member's firm in the other two countries. In particular, we have

$$\Delta\pi^{bm}_{hi}(\theta) = \pi_{hi}(\{H,H,H\}) - \pi_{hi}(\{L,L,L\}) \quad \text{for } \theta^B_{HHH-LLL} < \theta < \theta^W_{HHH-LLL}$$

and

$$\Delta\pi^{bm}_{hj}(\theta) = \pi_{hj}(\{H,H,H\}) - \pi_{hj}(\{L,L,L\}) \quad \text{for } \theta^N_{HHH-LLL} < \theta < \theta^W_{HHH-LLL}$$

both of which are negative over their corresponding ranges of θ. The overall per-period profit drop following the defection can then be calculated as

$$\begin{aligned}\Delta o\pi^{bm}_h &= \int_{\theta^B_{HHH-LLL}}^{\theta^W_{HHH-LLL}} \Delta\pi^{bm}_{hi}(\theta)d\theta + \int_{\theta^N_{HHH-LLL}}^{\theta^W_{HHH-LLL}} \Delta\pi^{bm}_{hj}(\theta)d\theta \\ &= -\frac{1}{64}c^2(2-c)^2\end{aligned}$$

To summarize, for the defecting member, its benefit from defection is the present value of its welfare increase $\Delta\widehat{ow}^{bm}_h$ occurring in all periods

$$B^{bm}_h = \frac{1}{1-\delta_h}\Delta\widehat{ow}^{bm}_h$$

Analogously, its cost of defection is the present value of its profit declines in all future periods

$$C_h^{bm} = \frac{\delta_h}{1-\delta_h}|\Delta o\pi_h^{bm}|$$

The member country defects if

$$B_h^{bm} > C_h^{bm}$$

which yields

$$\delta_h < \delta_h^{bm} = 1/2$$

It is readily seen that $\delta_h^{bm} = \delta_k^n$, i.e. bilateral cooperation under MFN does not change the member countries' incentives for defection relative to the non-cooperative case. Intuitively, while bilateral cooperation under MFN lowers the benefit from defection for the member countries, it also reduces the associated cost as the defecting member's profit losses in the other member are smaller given the latter reverts its standards to the bilaterally optimal rather than the Nash ones. The reductions in the benefit and the cost of defection offset each other so that the members' net incentives for defection remain unaltered as compared to the non-cooperative case.

Now consider the nonmember country j. As j does not engage in bilateral cooperation, it would switch to the Nash standards if defecting. Hence its instantaneous welfare changes from defection are the same as that for a defecting country in the non-cooperative case

$$\Delta\widehat{w}_j^{bm}(\theta) = \Delta\widehat{w}_k^n(\theta) \quad \text{for } \theta_{HHH-LLL}^N < \theta < \theta_{HHH-LLL}^W$$

and

$$\Delta\widehat{ow}_j^{bm} = \Delta\widehat{ow}_k^n$$

Also note that these welfare changes also occur in all future periods.

On the other hand, as multilateral cooperation breaks down, the members switch to the bilaterally optimal standards subject to MFN, changing their standards from $\{L, L, L\}$ to $\{H, H, H\}$ over $\theta_{HHH-LLL}^B < \theta < \theta_{HHH-LLL}^W$. As a result, the nonmember's

firm sees its per-period profits in the members change as

$$\Delta\pi_{jh}^{bm}(\theta) = \pi_{jh}(\{H,H,H\}) - \pi_{jh}(\{L,L,L\}) \quad \text{for } \theta_{HHH-LLL}^{B} < \theta < \theta_{HHH-LLL}^{W}$$

and

$$\Delta\pi_{ji}^{bm}(\theta) = \pi_{ji}(\{H,H,H\}) - \pi_{ji}(\{L,L,L\}) \quad \text{for } \theta_{HHH-LLL}^{B} < \theta < \theta_{HHH-LLL}^{W}$$

It is easily checked that these profit changes are negative, and the overall per-period profit loss for the nonmember can be calculated as

$$\begin{aligned} \Delta o\pi_{j}^{bm} &= \int_{\theta_{HHH-LLL}^{B}}^{\theta_{HHH-LLL}^{W}} \Delta\pi_{jh}^{bm}(\theta)d\theta + \int_{\theta_{HHH-LLL}^{B}}^{\theta_{HHH-LLL}^{W}} \Delta\pi_{ji}^{bm}(\theta)d\theta \\ &= -\frac{1}{96}c^{2}(2-c)^{2} < 0 \end{aligned}$$

As a result, the nonmember's benefit from defection is the present value of its welfare increases $\Delta\widehat{ow}_{j}^{bm}$ over all periods

$$B_{j}^{bm} = \frac{1}{1-\delta_{j}}\Delta\widehat{ow}_{j}^{bm}$$

Similarly, the nonmember's cost of defection is the present value of its profit losses from the second period on

$$C_{j}^{bm} = \frac{\delta_{j}}{1-\delta_{j}}|\Delta o\pi_{j}^{bm}|$$

The nonmember defects if

$$B_{j}^{bm} > C_{j}^{bm}$$

It is readily checked that $B_{j}^{bm} > C_{j}^{bm}$ for all $0 < \delta_{j} < 1$, which means that the nonmember country always chooses to defect from multilateral cooperation. The intuition for this result is that the nonmember enjoys a positive profit spillover from bilateral cooperation under MFN, which would reduce its losses of foreign profits if defecting. The above results can be summarized in the following proposition:

Proposition 8: *Relative to the non-cooperative case, bilateral cooperation under*

MFN makes multilateral cooperation infeasible by eliminating the cooperation incentives for the nonmember, while having no impact on that for the members.

Propositions 7 and 8 combined have important policy implications. First, bilateral regulatory cooperation tends to be a stumbling block for multilateral cooperation when the coordinated policy instrument is product standards. Specifically, bilateral cooperation always reduces some country's incentives for multilateral cooperation regardless of the presence of MFN. This result resembles that about tariff cooperation as in Saggi (2006), who shows that bilateral tariff cooperation, being a free trade agreement (FTA) or custom union (CU), always undermines the prospect of multilateral cooperation. Second, there exists a potential tension between the static and dynamic effects of MFN in regulatory standards. While MFN in the short-run can make regional cooperation induce Pareto improvement and thus benefit the nonmember countries, it may reduce the incentives for the nonmembers from further pursuing multilateral cooperation. That being said, it is well-known that regulatory cooperation on a multilateral basis can be more difficult to attain than that on a regional basis, as it involves coordinating internal measures which may weaken the independence and sovereignty of the participating countries. As a result, regional regulatory cooperation may be a more relevant concern to international economic organizations such as the WTO. This provides a possible explanation for why the WTO's agreements over regulatory standards do not exempt countries engaged in regional cooperation from MFN: if the WTO cares sufficiently about the effect of regional cooperation relative to its consequences for multilateral cooperation, then mandating MFN is desirable as it can induce a more equitable outcome of regional cooperation.

5 Further discussions

5.1 Political economy

To model the political economy of product standards, assume that firms can lobby their governments so that countries assign an additional weight $s > 0$ to the profits of their

firms. Country h's national welfare can then be defined as

$$w_h(\sigma_h, \sigma_i, \sigma_j) = cs_h(\sigma_h) + (1+s)\pi_h(\sigma_h, \sigma_i, \sigma_j)$$

where the welfare for countries i and j are defined analogously. A higher s reflects a stronger impact of firm lobbying on governments' choices of standards. Assume also that s is not too large: as the paper concerns regulation under consumption externalities, it implicitly presupposes that governments sufficiently value consumer surplus. Let us assume for this section that $s < \overline{s} = \frac{1-5c}{2(3+c)}$, which ensures that the presence of political economy does not quantitatively affect the equilibrium outcome.

Introducing political economy yields two novel results. First, political economy can make MFN more valuable for hedging against discriminatory standards induced by bilateral cooperation. Intuitively, when the members value profits more, enforcing more discriminatory standards allows them to extract larger profits from the nonmember. Notably, this would create a larger negative profit spillover on the nonmember. On the other hand, as countries cannot discriminate under MFN, political economy makes the members more likely to lower their standards. This will generate a greater positive profit spillover for the nonmember. It follows that the welfare effect of bilateral cooperation would become relatively more equitable with MFN than without. Therefore, political economy strengthens the case for MFN in terms of its distributional welfare effect.

The second result is that political economy can make bilateralism more likely a stumbling block for multilateralism. To see this, it can be shown that political economy does not change a country's defection incentives under no bilateral cooperation, as it affects the country's benefit and cost of defection proportionally. This is also the case when bilateral cooperation follows MFN, so that the nonmember always defects from multilateral cooperation as in the benchmark case. On the other hand, when bilateral cooperation is not subject to MFN, it can be shown that political economy increases the incentives for the members to defect as the net profit gains from doing so carry a greater weight in their welfare. Therefore, political economy makes bilateral cooperation more likely to induce defection from multilateral cooperation. Despite this, if the welfare effect of bilateral cooperation is the central concern, as discussed before, then the presence of political economy will make MFN more desirable.

5.2 Transboundary externalities

Suppose negative consumption externalities can cross borders so that they can affect foreign countries but to a less degree. Then the total externality incurred by consumers in country h can be written as $\varphi_h + \delta(\varphi_i + \varphi_j)$ with $0 < \delta < 1$. Such transboundary externalities can make bilateral cooperation less likely a stumbling block for multilateral cooperation. To see this, note first that transboundary externalities do not change the benchmark non-cooperative equilibrium, because when countries maximize their own welfare, they do not take into account how their standards may affect other countries. On the other hand, transboundary externalities makes internalizing the externalities a more important consideration for cooperation relative to internalizing the profit spillovers. This will make countries' incentives for setting regulatory standards more aligned under bilateral and multilateral cooperation, which will in turn weaken the incentives for countries to defect from multilateral cooperation. To see this, note that if consumption externalities are highly transmissible across borders, then bilateral and multilateral cooperation would coincide by involving countries always choosing the high standard. Hence the presence of transboundary externalities would lessen the undermining effect of bilateral cooperation on the prospect of multilateral cooperation.

6 Conclusion

This paper analyzes international regulatory cooperation and how its outcome may be shaped by the WTO's MFN rule. We find that bilateral cooperation following MFN prevents the member countries from imposing discriminatory standards on the nonmember and thus induces Pareto improvement. Moreover, such a distributional effect of MFN is stronger when there exists political economy of regulatory standards. Our analysis thus identifies two rationales behind the WTO's exclusion of Article XXIV from its agreements over regulatory standards: one, it can help induce a more equitable outcome of regional regulatory cooperation; two, it can hedge against the impact of the political economy of regulatory standards. Meanwhile, we find that bilateral cooperation tends to be a stumbling block for multilateral cooperation whether MFN is present. This suggests that MFN is unlikely a solution to addressing the tension between bilateralism and multilateralism in international regulatory cooperation. As a result, alternative ap-

proaches such as well-negotiated transfers between countries may be necessary to induce across-the-board incentives for multilateral regulatory cooperation.

Our paper is only the first step towards understanding the linkage between international regulatory cooperation and MFN. There is ample room for further research. First, we have focused on country symmetry so as to identify some key mechanisms at work. It would be important to explore the robustness of our results under asymmetric countries. Second, we have abstracted from alternative policy instruments such as import tariffs. A useful direction of future research is to study the questions we address here assuming countries can employ multiple policy measures at the same time.[12]

7 Appendix

Table A1 Thresholds of θ

Key thresholds of θ
$\theta^N_{HHH-LLL} = 11c(2-c)/24$
$\theta^W_{HHH-LLL} = 5c(2-c)/8$
$\theta^B_{HHH-LLL} = 13c(2-c)/24$
$\theta^B_{HHH-HLH} = 7c(2+c)/8(1+2c)$
$\theta^B_{HLH-LLL} = c(3-5c)/4(1-c)$

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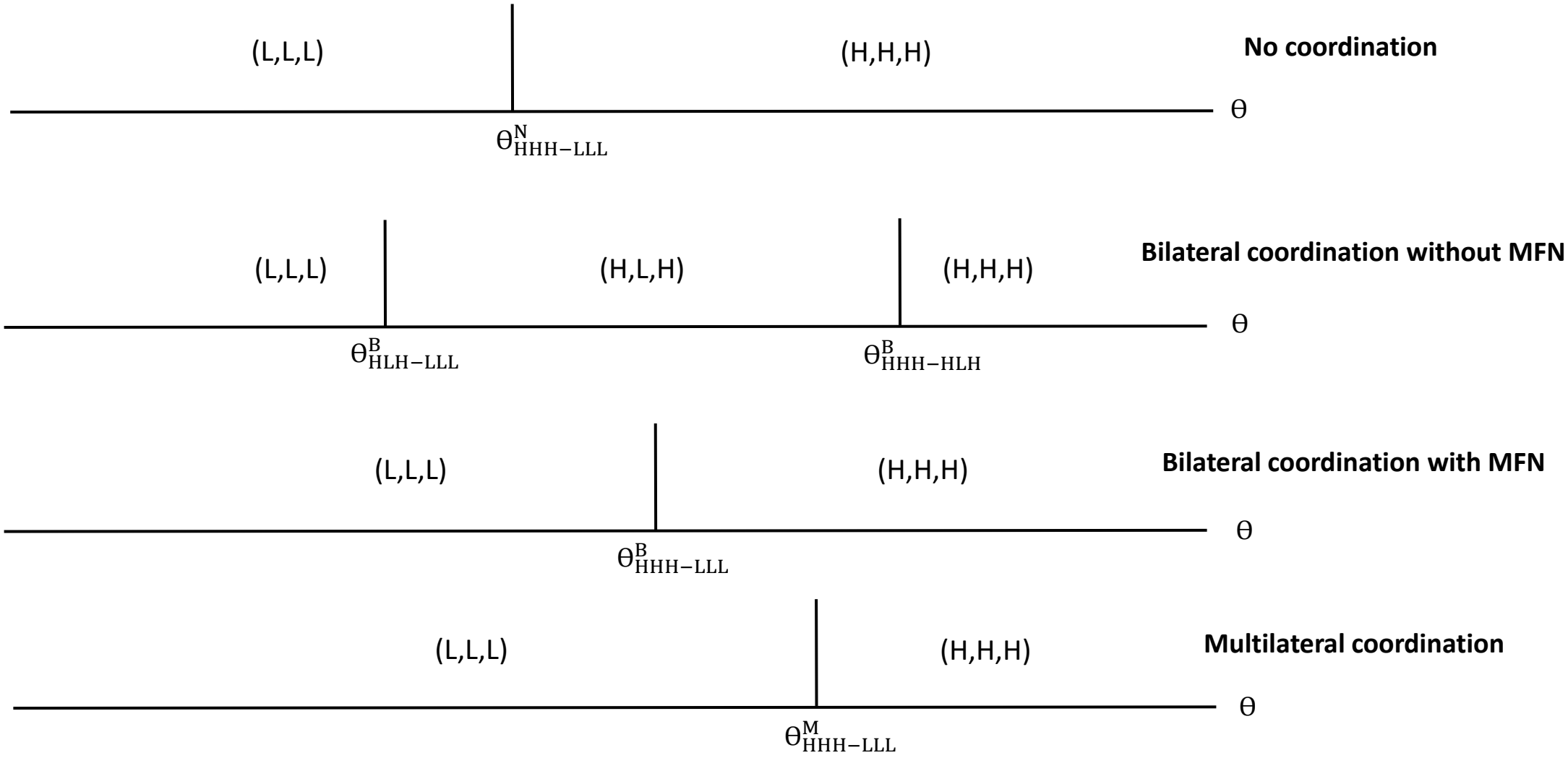

Figure 1: Standards chosen by member countries