Regionalism in Standards: Good or Bad for Trade?*

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Abstract

Regional agreements on standards have been largely ignored by economists and unconditionally blessed by multilateral trade rules. We find theoretically and empirically that such agreements do boost trade between participating countries but not necessarily with the rest of the world. Adopting a common standard in a region, i.e. harmonization, significantly increases intra-regional trade in affected industries as well as exports to the region of excluded developed countries. But exports of excluded developing countries decline - possibly because developing country firms are hurt more by an increase in the stringency of standards and benefit less from economies of scale in integrated markets. Mutual Recognition Agreements (MRAs) promote trade, but if they contain restrictive rules of origin then intra-regional trade increases at the expense of trade with other, especially developing, countries.

Key words: standard, harmonization, MRA, rules of origin, scale economies
JEL codes: F12, F13, F15

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1 Introduction

In their recently launched trade talks, the European Union and Association of Southeast Asian Nations (ASEAN) agreed to focus not on tariffs and quotas but on harmonizing standards, calling them "the real 21st century trade issues".[1] This agreement is only the latest example of a process of deep integration that is most advanced within the European Union and also underway in many other regions. The shift in emphasis away from conventional barriers is not surprising. Multilateral negotiations have achieved remarkable reductions in tariffs and quotas but done relatively little to reduce the trade restrictive impact of technical barriers. At the same time, multilateral trade rules treat regional agreements on standards as always benign and worthy of encouragement[2] - in contrast to the rules governing tariffs which seek to balance the interests of integrating countries and the rights of excluded countries.[3]

Are regional agreements on technical barriers indeed an unambiguous blessing for global trade? The voluminous research on regionalism with its almost exclusive focus on tariffs and quotas provides no answer. This paper takes a first step in the theoretical and empirical analysis of regional initiatives on technical barriers to trade. Using a simple analytical model, it asks: How must the conventional analysis of free trade areas and customs unions be modified to apply to agreements on standards? And what elements of international agreements on standards are relevant to predicting their impact on patterns of trade? Then employing a specially constructed panel dataset that directly identifies different types of policy initiatives in each manufacturing industry, the paper addresses two empirical questions: Do regional agreements on standards lead to significant increase in trade between participating countries? What happens to trade with those that are left

[1] The two groups of countries have ageed to begin by harmonizing sanitary standards in the agricultural and fisheries sector, as well as technical standards for electronics and wood-based industries. Pascal Lamy, the EU trade commissioner said that the choice was driven by the belief that "the real 21st century trade issues were standards and rules in areas such as safety, health or consumer protection", rather than tarriffs or quotas ("EU and Asean to pave way for trade pact talks", Financial Times, 7 September 2004.)

[2] Article 2.7 of the WTO's Agreement on Technical Barriers to Trade encourages members to "give positive consideration to accepting as equivalent technical regulations of other members, provided they are satisfied that these regulations adequately fulfill the objectives of their own regulations." This provision would seem to allow a country to selectively recognize standards of other countries, without violating the fundamental obligation not to discriminate between its trading partners. There is no mention of the rights of, or obligations vis-à-vis, countries that happen not to receive "positive consideration."

[3] These rules are in Article XXIV of GATT 1994 .

out?

Agreements on standards raise issues that are both politically and analytically challenging. Unlike tariffs, standards cannot be simply negotiated away because the original reason for their existence is not trade protection but the enhancement of welfare by remedying market failure - arising, for example, from invisible safety attributes of products, negative environmental externalities, or product incompatibility due to the producers' failure to coordinate. Agreements on standards must therefore secure the gains from integrated markets without unduly compromising the role of standards as remedies for market failure. Not only are the motives for standards ostensibly honourable, so in principle is their implementation: unlike tariffs, the same standards are imposed on both foreign and domestic firms. However, in spite of the supposed symmetry of treatment, the impact on trade may turn out be highly asymmetric because the costs of compliance are likely to differ across countries.

There are in fact three main types of agreements dealing with technical barriers to trade. The simplest, and potentially most powerful is the mutual recognition of existing standards, whereby a country grants unrestricted access of its market to products that meet any participating country's standards. This was the approach taken in principle by the European Union, with the spur of the Cassis de Dijon judgement of the European Court of Justice. Mutual recognition agreements (MRAs) are, however, not likely to be an option if there is a significant difference in the initial standards of the countries, as became evident in the context of the European Union.[4]

In such cases, a certain degree of harmonization is a precondition for countries to allow products of other countries to access their markets. The most important example of such harmonization is the New Approach of the European Union, which resulted in a set of directives from the European Commission setting out essential health and safety requirements for most regulated products.[5] Available evidence suggests that harmonization

[4] The central problem in the EU mutual recognition approach is the overarching exemption contained in Article 36 of the EC treaty. This provision preserves the member countries' rights to restrict or prohibit imports on grounds of health and safety and other policy objectives, as long as this is not "a means of arbitrary discrimination or a disguised restriction on trade". This provision substantially dilutes the effects of implementing mutual recognition because it allows a country with stringent regulations not to recognize as equivalent the regulations of other countries with lower levels.

[5] In practice, most of the broad manufacturing product areas where technical regulations are important

within the EU tended towards the high range of initial standards. Vogel (1995) points out that the role of the Union's richest and most powerful members, which impose the most stringent standards, has been critical in setting the EU standards agenda; their political and economic importance has served to make EU standards progressively stricter.[6]

In many other cases, neither mutual recognition nor harmonization of substantive standards may be deemed feasible or desirable. Countries may nevertheless choose at least to mutually recognize each other's conformity assessment requirements, i.e. country A trusts country B to certify that the products made by country B conform to country A's standards. Examples of such initiatives are the intra-EU MRAs on some unharmonized industries and the EU's agreements with a number of other countries. A key element of these agreements is the rules of origin.[7] The MRAs between the EU and USA and the EU and Canada specify that conformity assessment done in one of the MRA countries, in which products are manufactured or through which they are imported, is accepted throughout the entire agreement region. Other agreements, such as the MRAs the EU has concluded with Australia and New Zealand, impose restrictive rules of origin by requiring third country products to continue to meet the conformity assessment of each country in the region.

As a prelude to our empirical investigation of the effects of these agreements on trade patterns, a simple analytical model is used to generate certain testable hypotheses. The main analytical results can be explained by drawing a partial analogy between standards harmonization and mutual recognition, on the one hand, and a customs union and a free trade area, on the other. As in the case of customs union, the economic impact of standards harmonization depends on the level at which the harmonized standard is set. Unlike the case of customs union, standards harmonization has a market integration effect

have now been harmonized, particularly product areas where the mutual recognition approach was seen to be failing.

[6] The Single Market Review (1998) concludes that the harmonized standards in most reviewed industries have been set higher than initial levels in most member countries. The history of EU automobile emission, chemical, and packaging standards also demonstrates that these standards have frequently been harmonized at a level slightly lower than that preferred by the Union's most stringent states, including Germany, Denmark, and Netherlands, but higher than favored by less strict members such as Italy, UK, and Spain (Vogel, 1995).

[7] "Rules of origin" are defined by the WTO as "the criteria used to define where a product was made. They are an essential part of trade rules because a number of policies (such as preferential trade agreements) discriminate between exporting countries."

that creates scale economy benefits for firms of both participating and third countries. The impact on the firms of a specific country depends on how the costs of meeting the new harmonized level of the standard compare with the benefits from economies of scale in integrated markets. We find that if one set of countries find it more costly to meet a stricter standard and reap fewer scale economy benefits in integrated markets than another set of countries, then the former are likely to suffer a decline in exports to the integrated market when harmonization raises some destination countries' standards.

As in the case of a free trade area, the economic impact of a standards MRA depends critically on the choice of rules of origin. For the participating countries, an MRA is virtually a downward harmonization of standards since firms are now free to meet the least costly of the initial standards: trade is stimulated not only by market integration but also by the reduced stringency of the standard. The analytical implications for imports from third countries differ dramatically with rules of origin. If firms of third countries are denied the benefits of the MRA and must continue to meet the original standard in each market, then they will face unchanged absolute conditions but suffer a decline in relative competitiveness - and hence a decline in exports to the region. In contrast, if the firms of non-participating countries are also entitled to access the entire region by conforming to the least costly standard, then they too reap benefits. In this case, it is shown that firms that find it more costly to meet a standard will benefit more, because there is a greater reduction in their compliance costs thanks to the decline in the stringency of the standard.

In order to test the empirical validity of these propositions, we construct the first dataset that directly identifies policy initiatives of different types on standards for manufacturing industries in 42 countries over the period of 1986-2001.[8] These include all OECD countries and 14 developing countries who are the largest exporters of manufactured goods outside the OECD and account for over 80% of non-OECD manufactured exports. The policy measures include each harmonization directive and MRA concluded between the countries in the set. We concord the policy measures, which often pertain to a specific attribute (e.g. safety) of a variety of products, with trade data at the SITC (revision 2) 3-digit industry level. We then estimate the significance of the impacts of these measures

[8] In contrast, the existing Perinorm dataset describes standards and technical regulations, but does not allow an unambiguous measurement of harmonization or mutual recognition.

on bilateral trade across countries and over time, controlling for other determinants of bilateral sectoral trade within a specific industry at a particular point of time in importing and exporting countries, as well as any time-invariant bilateral sectoral elements.

Our evidence broadly confirms the conclusions drawn from the model. Regional harmonization leads to an increase in overall trade flows but the increases are unevenly distributed across countries. The trade rise is stronger for participating countries that initially imposed stricter standards than for countries that initially had less strict standards. In the latter countries, some of the gains from market integration are likely to be offset by the increase in the stringency of standards. Exports of developed third countries to countries with stricter initial standards increase more substantially than those of developing third countries. There is a decline in the exports of excluded developing countries to countries that raise their standards, possibly because they benefit less from economies of scale in integrated markets and are hurt more by any increase in the level of standards. Supposedly innocent harmonization turns out to favor exporters of developed countries while harm those of developing countries. Mutual recognition of conformity assessment, equivalent to downward harmonization in testing requirements, turns out to enhance trade flows within the bloc, as well as with the rest of the world unless it specifies restrictive rules of origin. When an MRA is discriminatory against third country firms, intra-regional trade increases at the expense of imports from third countries, in particular, developing countries.

To place our contribution in the context of the existing literature, to our knowledge only two previous studies have empirically explored the impact of shared standards on trade.[9] Swann et al (1996) regressed British net exports, exports and imports or over the period 1985-1991 on counts of voluntary national ("idiosyncratic") and international standards recognized by the United Kingdom and Germany. They discovered that international standards to which Britain was a party had little impact on imports but a positively significant effect on exports while British national standards tended to raise both imports and exports. Moenius (1999) regressed bilateral trade volumes in 4-digit SITC sectors on counts of shared standards and found a positive and highly significant relationship. Our paper differs in a number of aspects. First, instead of relying on ap-

[9] Refer to Maskus and Wilson (2001) for a review of previous studies.

proximate measures of shared standards, we directly identify harmonization directives and mutual recognition initiatives in specific industries across countries, and also distinguish the impact of these two types of measures. Second, we examine not only the impact on trade between participating countries, but also on trade with excluded countries. Third, we allow for distinctive impacts of harmonization across destination markets, depending on whether they previously had more or less stringent standards, and across source countries, depending on the level of development.

The rest of this paper is organized as follows. In section 2, we present the analytical model and identify the main implications for trade of different types of initiatives. We discuss the data in section 3, and present the empirical evidence in section 4. In section 5 we deal with the potential empirical issues. Section 6 concludes the paper.

2 Model

To analyze the effects of regional agreements on standards, we construct a model that captures the essence of these initiatives and the heterogeneity of the affected countries.[10] Each country imposes a mandatory standard s_j on all goods sold to domestic consumers.[11] To keep the model fairly general, we do not specify a particular rationale for the standard. To motivate the analysis, it is convenient to think of a safety standard which pertains to an attribute (e.g. inflammability) of the product that cannot be observed by consumers.[12] But the assurance that a particular product meets a higher standard has a positive impact on consumer demand for the product and thus a firm's revenue function.[13]

Before the products can be sold in the market, firms must meet the related product

[10] This model builds on Ganslandt and Markusen (2001), and Baldwin (2000) which assumes identical countries and identical fixed costs (only) of complying with standards.

[11] We take s_j as given in this paper, even though the level of s_j in each country could be treated as endogenously determined, based on factors such as preferences, market size, income, and technology. Allowing standards to be optimally set, initially and after harmonization, would significantly complicate the analysis without providing much additional insight into the issues addressed here.

[12] The EU harmonization has set out essential requirements that are targeted at the safety of the product user and protecting the user's health (from infection, toxins, explosion, cuts or wounds from mechnical parts, electric shock, burning, falls, etc.).

[13] One exception in the EU New Approach is the "Packaging and Packaging Waste Directive". This directive aims at reducing a negative consumption externality, such as pollution, and thus does not cause shift in consumers' demand. However, our findings established in later this section also apply to this type of standards.

standard, which is assumed to affect both the marginal and fixed costs of firms. The marginal cost of production is identical for all firms in a particular country i and assumed to be linear in the level of the standard in the destination market j, s_j, i.e. $c_i(s_j) \equiv c_i s_j$.[14] Furthermore, a representative firm in country i must incur an individual fixed cost of production, denoted by F_i^a, to meet each distinct standard imposed by its destination markets.[15] An example of such standard-specific fixed cost may be the design cost or the setup cost. F_i^a is assumed to be independent of the level of the standard in the destination market, s_j. There is a continuum of $\bar{n}$ potential firms in each country i with their fixed cost, F_i^a, uniformly distributed between F_i and $F_i + \Delta F$, i.e., $F_i^a \sim UNIF\left[F_i, F_i + \Delta F\right]$.[16]

Markets with different standards are segmented.[17] By contrast, markets with the same standard are assumed to be identical in the demand and price for the considered product. Hence, firms treat markets with the same standard as a single market when making entry decisions, and subsequently compete in quantity in these markets. Solving backwards, a representative firm that is located in country i and sells in all markets with the same standard as market j, chooses its q_{ij} to solve the following profit-maximization problem:

$$\max_{q_{ij}} \ \pi_{ij}^a = R_{ij}\left(s_j, \sum_z q_{zj}, q_{ij}\right) - c_i s_j q_{ij} - F_i^a, \tag{1}$$

where R_{ij} denotes the revenue that is a function of s_i.The first-order condition is:

$$\frac{\partial R_{ij}\left(s_j, \sum_z q_{zj}, q_{ij}\right)}{\partial q_{ij}} - c_i s_j = 0, \tag{2}$$

which yields the profit-maximizing reaction function, i.e., $q_{ij} = q_{ij}\left(q_{zj}|_{z \neq i}\right)$. By solving

[14] In this model, we consider $c_i > \tilde{c}$, where $\tilde{c}$ is defined in Appendix B.1, to ensure a negative net effect of an increase in the stringency of the standard on output.

[15] For instance, a firm has to incur two fixed costs of production, if the two markets it supplies impose two different standards.

[16] Alternative to the uniform distribution, we may assume firms in country i are identical in the fixed cost. The current setup is adopted for it enables us to analyze market entry with less algebraic complication and yet wthout loss of generality.

[17] Two possibilities may justify such assumption. First, when the difference in the standards is sufficiently significant (as observed in the context of the EU), firms will not comply with the most stringent standards to supply all markets just to save fixed costs. Second, in many cases, although some markets' standard is more costly to comply with than others', products proven to satisfy more costly standards are not necessarily accepted in markets that require less costly standards for reasons such as incompatibility.

all reaction functions simultaneously, we find q_{ij}^* for each i as a function of n_{zj} $(\forall z)$. Denote $V_{ij}^* = R_{ij}\left(s_j, \sum_z q_{zj}^*, q_{ij}^*\right) - c_i s_j q_{ij}^*$ as the revenue less the variable cost at the profit maximum.

Suppose N_j number of markets set the same standard as country j. The number of firms from country i that supply these N_j markets can be found according to the nonnegative total profit condition, i.e., $N_j V_{ij}^* - F_j^a \geqslant 0$, where we recall $F_i^a \sim UNIF\left[F_i, F_i + \Delta F\right]$. Therefore, we are able to find $n_{ij} = n_{ij}(n_{zj}|_{z\neq i})$ by solving the following equation for n_{ij}:

$$n_{ij} = \bar{n} \cdot \frac{N_j V_{ij}^* - F_i}{\Delta F}. \tag{3}$$

Differentiating equation (3), we obtain:

$$dn_{ij}(n_{zj}|_{z\neq i}) = \frac{1}{\gamma_{ij}}\left(V_{ij}^* \cdot dN_j + N_j \cdot \frac{\partial V_{ij}^*}{\partial s_j} \cdot ds_j\right), \tag{4}$$

which measures the change in n_{ij} given the number of rival firms from other countries, where $\gamma_{ij} \equiv -N_i(\partial V_{ij}^*/\partial n_{ij}) + \Delta F/\bar{n} > 0$ and $\partial V_{ij}^*/\partial s_j = \partial R_{ij}^*/\partial s_j - c_i < 0$ by assumption.[18] The above change is a consequence of two opposing factors: the positive effect of market integration (dN_j), and the negative effect of increased stringency of the standard (ds_j). But these factors also induce a change in the number of rival firms from other countries, which in turn affects the equilibrium number of firms from country i in these N_j number of markets including market j. So we have:

$$dn_{ij}^* = dn_{ij}(n_{zj}|_{z\neq i}) + \sum_{z\neq i}\left[\frac{\partial n_{ij}}{\partial n_{zj}} dn_{zj}(n_{mj}|_{m\neq z})\right] = \sum_z \left[\frac{\partial n_{ij}}{\partial n_{zj}} dn_{zj}(n_{mj}|_{m\neq z})\right], \tag{5}$$

where $dn_{zj}(n_{mj}|_{m\neq z})$ is defined in equation (4).

Thus, the overall impact on the imports of market j from country i, namely $Q_{ij} =$

[18] In our model, the standard is adopted to pertain some unobserved attribute of a product. Therefore, it is reasonable to assume that the optimal profit is strictly decreasing with the required level of the standard. This assumption is in alignment with Akerlof (1970), which finds that, in the presence of information asymmetry in qualities, all firms would produce the lowest quality possible at equilibrium. When a positive level of standard is adopted to partially correct the market failure, firms are forced to meet the standard. Moreover, firms would not produce a quality that exceeds the level of the standard, because the positive signaling effect is not sufficient to compensate the negative cost effect.

$n_{ij}q^*_{ij}$, is characterized as:

$$dQ^*_{ij} = \sum_z \left[\frac{\partial q^*_{ij}}{\partial n_{zj}} \cdot n^*_{ij} \cdot dn^*_{zj} \right] + q^*_{ij} dn^*_{ij} + \left(\frac{\partial q^*_{ij}}{\partial s_j} \cdot n^*_{ij} \right) ds_j. \tag{6}$$

Taking into account equations (4) and (5), equation (6) can be rewritten as:

$$\begin{aligned} dQ_{ij} &= \frac{1}{\gamma_{ij}} \sum_z \left[\phi_{ij} \sum_m \left(\frac{\partial n_{zj}}{\partial n_{mj}} V^*_{mj} \right) + \varphi_{ij} V^*_{mj} \right] dN_j \\ &\quad + \left\{ \frac{N_j}{\gamma_{ij}} \left[\phi_{ij} \sum_m \left(\frac{\partial n_{zj}}{\partial n_{mj}} \frac{\partial V^*_{mj}}{\partial s_j} \right) + \varphi_{ij} \frac{\partial V^*_{zj}}{\partial s_j} \right] + \frac{\partial q^*_{ij}}{\partial s_j} n_{ij} \right\} ds_j, \end{aligned} \tag{7}$$

where $\phi_{ij} \equiv n_{ij}(\partial q^*_{ij}/\partial n_{iz})$ and $\varphi_{ij} \equiv q^*_{ij}(\partial n_{ij}/\partial n_{iz})$.

Upon the implementation of any policy initiative that deals with standards as well as integrates the markets, the impact on imports of country j from i is again inherently driven by the two forces: the effect of markets integration (dN_j) and the effect of change in the standard (ds_j). The first argument reflects the aggregate impact of markets integration on imports through the change in the number of supplying firms. When $dN_j > 0$, the number of destination markets one individual fixed cost serves is expanded, which promotes economies of scale and thus spurs market entry. The second argument in the above equation reflects the direct and indirect effects of a change in the level of the standard, respectively, on the number of firms and firms' output. Assessing the relative strengths of these two effects helps us determine the overall impact of any regional initiatives that deal with standards on imports.

In this paper, we are interested in exploring the potentially asymmetric effects of regional agreements in standards. We assume that the world consists of two types of countries: type K and type L, which differ in terms of their firms' costs of complying with standards, i.e., c_i and F_i. Aware that the heterogeneity between K and L may comprise of the following possible cases: (i) $c_K < c_L$ and $F_K > F_L$ or (ii) $c_K < c_L$ and $F_K \leqslant F_L$, we selectively present our predictions based on case (i) in the rest of the section for the following reasons (while predictions based on case (ii) can be similarly derived). First, case (i) allows us to explore potential asymmetry in the impacts of regional policy initiatives across exporters to the fullest extent. With (i), exporters with a disadvantage

in their variable production cost of compliance may benefit more from the decrease in the stringency of standards, but their advantage in fixed cost of compliance in turn implies less benefit from the market integration. Second, it is observed both in theory and in practice that, when producing the same product, firms from capital-abundant countries (type K) tend to adopt capital-intensive technology that requires a relatively large F_i, while firms from labor-abundant countries (type L) tend to adopt labor-intensive technology that requires a relatively large c_i. In fact, based on the World Bank Technical Barriers to Trade survey, we find that a firm's percentage of compliance cost spent on product redesign for each export market (corresponding to F_i in our paper) is positively correlated with its country's GDP per capita, whereas that spent on hiring additional labor for production and testing (corresponding to c_i in our paper) is negatively correlated with its country's GDP per capita. However, it is noteworthy to emphasize that we do not intend to map type K with the developed countries and type L with the developing countries nor draw any prior belief of (i) over (ii) here; instead we treat (i) as a hypothesis to be tested in the empirical section.[19]

In the rest of the section, we respectively examine the impact on both intra-regional trade and trade with excluded countries of various regional policy initiatives, namely upward harmonization and downward harmonization (with or without rules of origin).

2.1 Upward harmonization

In the first scenario, we investigate the impact on trade when a subset of type K countries, denoted by $H \equiv \{h\}$, decide to harmonize their standards upward at the level of $\max\{s_j : j \in H\}$. The objective of this approach is often, in the abstract, to integrate markets without unduly compromising the role of the standard as remedies for market failures.

First, we look at the set of countries within H for which $ds_j = 0$, i.e. the countries with the most stringent initial standard in the harmonizing region. The impact on firms selling in these markets is solely the market integration benefit (i.e., the increase in N_j). All exporters to these markets reap economies of scale since they now serve the entire region

[19] As seen later in section 4.2, our empirical evidence not only is consistent with predictions based on case (i) but also indeed suggests the correspondence of type K with developed country as well as type L with developing country.

incurring one single fixed cost, which in turn dilutes the portion of fixed cost each market shares. In particular, such market integration benefits are greater for countries of type K, given $F_k > F_l$, as firms located in these countries enjoy a more significant reduction in the per-market fixed cost. So we shall certainly see increased entry and imports from type K countries. However, to firms from type L countries, the direct benefits from increased economies of scale may be offset by the more intense competition from the rival countries when their relative disadvantage in c_l is considerably large, leading to a decrease in the number of firms and imports from type L countries.

Then we look at the set of countries within H for which $ds_j > 0$, i.e. the countries with initial standards less stringent than the eventual harmonized level. Intuitively, the benefit from scale economies and the subsequent effect in stimulating trade may be partially or even completely eroded by the increased cost of complying with stricter standards. When the upward adjustment of standards is below a certain threshold value, the imports of harmonizing markets from type K countries increase, whereas those from type L countries may decrease for two reasons: the latter reap greater benefits from economies of scale (because of higher fixed costs) and are hurt less by the increase in the level of the standard (because of lower costs of meeting a standard). When the upward adjustment of standards exceed the threshold value, imports from both type K and type L countries decrease, because the positive scale economy effect are staggeringly shadowed by the production cost increase due to a stricter standard.

The overall impacts on imports of harmonizing countries are thus summarized below:

Proposition 1 *When region H harmonizes standards at* $\max\{s_j : j \in H\}$,

(i) imports from type K countries of harmonizing markets with $ds_j < \Delta\underline{s}$ increase, whereas those with $ds_j > \Delta\underline{s}$ decrease;

(ii) imports from type L countries of harmonizing markets with $ds_j = 0$ increase if $c_l < \underline{g}(c_k)$, whereas those with $ds_j \geqslant 0$ decrease if $c_l > \underline{g}(c_k)$.

Proof. See Appendix B.1. ■

Moreover, we compare the impacts of upward harmonization across destination markets and find:

Proposition 2 *The increase in imports of harmonizing market j, i.e., dQ_{ij}, from any exporter i is a strictly decreasing function of ds_j.*

Proof. See Appendix B.2. ■

2.2 Downward harmonization (mutual recognition)

In this second scenario, we address the impact on trade when region H alternatively decides to mutually recognize one another's standards. In other words, products that comply with a standard set by any participating country can be freely sold in the entire region. It is straightforward to establish that such mutual recognition is equivalent in effect to the downward harmonizing of standards at the level of $\min\{s_j : j \in H\}$, since firms are free to comply with the least strict standard in the region. By definition, mutual recognition is prospectively the attempt to address technical barriers to trade in its most impotent form. The impact on trade with third countries, however, is drastically conditional on whether or not such benefits are extended to third country firms, i.e., whether or not the rules of origin are imposed.

When the benefits of mutual recognition are restricted to firms within region H, countries in this region remain segmented, with the same initial standards, to firms outside the region. Although the absolute conditions are nominally unchanged, excluded firms, especially those from type L countries unavoidably face a decline in relative competitiveness. The implications of such mutual recognition are therefore contrary between firms within the region and those in excluded countries, as summarized below:

Proposition 3 *If region H harmonizes standards at* $\min\{s_j : j \in H\}$ *and imposes restrictive rules of origin, then*

(i) intra-regional trade increases at the expense of imports from the rest of world;

(ii) in the rest of the world, type L countries see a larger decline in their exports to region H when $c_l > \underline{g}'(c_k)$.

Proof. See Appendix B.3. ■

By contrast, when the benefits of mutual recognition are open to all firms, the results for markets which initially had the least strict standards (i.e., $ds_j = 0$) mirror those obtained in Proposition 1. In a similar vein, the only present impact arises from market integration, and the relative benefits are greater for countries of type K which have higher fixed costs. In markets with $ds_j < 0$, improved economies of scale are accompanied by the reduced cost from downward adjustment of the standard. Although both of these effects may boost more entry and total trade, they are asymmetrically distributed between exporter countries. Type K firms with larger fixed costs tend to benefit more from scale economies whereas firms with a higher variable production cost of compliance derive greater benefits from reduced levels of the standard. When there is a considerably significant downward adjustment of the standard, the rise in exports of countries of type L may exceed those of type K.

Proposition 4 *If region H harmonizes standards at* $\min\{s_j : j \in H\}$ *and does not impose restrictive rules of origin, then*

(i) imports of any harmonizing market from type K countries – both within the region and in the rest of the world – increase, whereas those from type L countries increase if $c_l < \underline{g}(c_k)$;

(ii) given $c_l > \underline{g}(c_k)$ imports of harmonizing markets with $ds_j < -\Delta\bar{s}$ from excluded type L countries increase whereas those of markets with $ds_j > -\Delta\bar{s}$ decrease;

(iii) given $c_l > \bar{g}(c_k)$ the increase in the imports of harmonizing markets with $ds_j < -\Delta\bar{s}'(< -\Delta\bar{s})$ from excluded type L countries is greater than that of type K countries.

Proof. See Appendix B.4. ■

To sum up, in Table 1 we list the predicted impacts of the alternative initiatives on imports of countries.[20] These results serve as our hypotheses in section 4.

[20] + and - respectively denote positive and negative impacts, while ++ and - - respectively denote relatively larger positive and negative impacts. +/- represents ambiguity in prediction.

Table 1: Model predictions

Trade flow	Importer's initial standards	Exporter	Upward Harmonization	Downward Harmonization	
				Rules of origin	No RO
Intra-regional Imports	stricter	type K	+	++	++
	less strict	type K	+/-	+	+
Imports from ROW	stricter	type K	+	-	+
	stricter	type L	+/-	- -	++
	less strict	type K	+/-	-	+
	less strict	type L	-	- -	+/-

3 Data

We employ a balanced dataset, from COMTRADE, covering the trade of 42 countries at the SITC rev. 2 3-digit level of manufacturing industries from 1986 to 2001. The sample consists of 28 OECD countries and 14 developing countries that are the largest manufacturing exporters outside the OECD (and have complete sectoral import data).[21] Inevitably, there exist some null observations since not all countries trade in each industry every year, and so it is appropriate to use the Tobit model for estimation.

We identify the industries, countries and the time period that are affected by each directive or MRA drawing upon the relevant official documents, and then construct the variables displayed in Table 2. The harmonization directives and MRAs are not directly related to specific products but to product attributes.[22] Thus a single industry (e.g. electronic products) may be affected by multiple directives (e.g. those pertaining, respectively, to low voltage equipment and electromagnetic compatibility). Different approaches can be taken to quantify the harmonization measures, depending on how these measures are believed to affect trade. It is simplest, and seems reasonable, to assume that the impact is linearly related to the number of directives in each industry, i.e. each additional directive in any industry has an identical incremental affect on trade. Alternative assumptions are possible, e.g. that additional directives have a diminishing effect on trade, or that the nature of the impact differs in each industry. We established that the results are not

[21] Czech Republic and Slovak Republic are excluded because of the lack of sectoral trade data in 1993 while Belgium and Luxembourg are considered as one unit throughout the period.

[22] The lists of EU directives and MRAs are provided Table A.1 and Table A.2 in Appendix A.

Table 2: Notations in estimation

Regressand	
$\ln(\text{import}_{ijrt})$	the natural logarithm of the imports of country j from country i in industry r in year t
Fixed effects	
α_{irt}	importer-industry-year
η_{jrt}	exporter-industry-year
γ_{ijr}	importer-exporter-industry
Regressors	
HAR_{ijrt}	the number of directives implemented to harmonize i and j's standards in industry k in year t
HAR_M_{ijrt}	the number of directives implemented to harmonize j's standards in industry k with any country other than i
HAR_E_{ijrt}	the number of directives implemented to harmonize i's standards in industry k with any country other than j
MRA_RO_{ijrt}	1 if an MRA with rules of origin is in place between i and j in industry k, and 0 otherwise
MRA_RO_M_{ijrt}	1 if an MRA with rules of origin is in place between j and any country other than i in industry k, and 0 otherwise
MRA_RO_E_{ijrt}	1 if an MRA with rules of origin is in place between i and any country other than j in industry k, and 0 otherwise
MRA_NRO_{ijrt}	1 if an MRA without rules of origin is in place between i and j in industry k, and 0 otherwise
MRA_NRO_M_{ijrt}	1 if an MRA without rules of origin is in place between j and any country other than i in industry k, and 0 otherwise
MRA_NRO_E_{ijrt}	1 if an MRA without rules of origin is in place between i and any country other than i in industry k, and 0 otherwise
RTA_{ijt}	1 if a RTA is in place between i and j, and 0 otherwise
RTA_M_{ijt}	1 if a RTA is in place between j and any country other than i, and 0 otherwise
RTA_E_{ijt}	1 if a RTA is in place between i and any country other than j, and 0 otherwise

sensitive to the choice of approach.

HAR_{ijrt} counts the number of directives applicable to industry r between exporter i and importer j in year t. HAR_M_{ijrt} counts the number of directives applicable to industry r between importer j and any country other than exporter i in year t. For instance, $HAR\_M_{ijrt} = 1$ for imports of United Kingdom from China in the sector of machinery tools since 1995, because the United Kingdom has implemented a single directive applicable to machinery tools along with other EU members at the end of 1994. HAR_E_{ijrt} measures the number of directives implemented in industry r between exporter i and any country other than importer j in year t.

MRA_RO_{ijrt} and MRA_NRO_{ijrt} are dummy variables that reflect the existence of an effective MRA, respectively, with or without the rules of origin between exporter i and importer j at industry r in year t. The cases where importer j reaches an MRA with or without the rules of origin with any country other than exporter i are respectively represented by $MRA\_RO\_M_{ijrt}$ and $MRA\_NRO\_M_{ijrt}$. Same definitions apply to $MRA\_RO\_E_{ijrt}$ and $MRA\_NRO\_E_{ijrt}$ except that the party involved in an MRA is the exporter. The rest of the regressors are dummy variables constructed in a similar fashion to capture the existence of Regional Trade Agreements (RTAs).[23]

4 Empirical evidence

In this section, we examine empirically the impact of the different approaches that deal with technical barriers to trade. The main equation we estimate takes the following form:

$$\ln(import_{ijrt}) = \begin{cases} \lambda + \alpha_{irt} + \eta_{jrt} + \gamma_{ijr} \\ +\delta_1 HAR_{ijrt} + \delta_2 HAR\_M_{ijrt} + \delta_3 HAR\_E_{ijrt} \\ +\delta_4 MRA\_RO_{ijrt} + \delta_5 MRA\_RO\_M_{ijrt} + \delta_6 MRA\_RO\_E_{ijrt} \\ +\delta_7 MRA\_NRO_{ijrt} + \delta_8 MRA\_NRO\_M_{ijrt} + \delta_9 MRA\_NRO\_E_{ijrt} \\ +\delta_{10} RTA_{ijt} + \delta_{11} RTA\_M_{ijt} + \delta_{12} RTA\_E_{ijt} + \varepsilon_{ijrt}, \end{cases}$$

[23] We include RTAs effective in our sample countries over the period of 1986-2001, including the EC, EFTA, CEFTA, NAFTA, and the CER (the Closer Economic Relations agreement between Australia and New Zealand).

which can be denoted as $y = X\beta + \varepsilon$ with y representing $\ln(import_{ijrt})$, X the vector of explanatory variables, β the vector of coefficients and ε the error term.

Three types of fixed effects are included: the nested *exporter-industry-year* fixed effect captures factors such as sectoral output in the exporting country at a particular time, the nested *importer-industry-year* fixed effect controls for factors such as sectoral demand and domestic competition in the importing country at a particular time, while the nested *importer-exporter-industry* fixed effect includes any time-invariant bilateral sectoral elements such as distance. The use of these extensive fixed effects enables us to isolate the role of agreements on technical regulations in explaining the changes in the pattern of trade over time.

4.1 The estimated effects of harmonization and MRAs

Table 3 reports the estimation results using the Tobit model. Coefficients on all variables are statistically significant at the 1% level and exhibit the signs predicted in section 2. Column I reveals that the harmonization directives unambiguously stimulate intra-regional trade, as well as trade with excluded countries. In fact, the magnitudes of the estimated impacts are quite large. It would appear that a directive implemented in an industry between two countries on average raises their imports from each other by 32% ($e^{0.2749} = 1.32$), and imports from a country outside the harmonizing region by nearly 10% ($e^{0.0950} = 1.096$). The boost to trade is attributable to the positive impact of increased scale economies which outweighs, on average, the possible negative effect on trade of increased stringency in some countries' standards.

The impact of an MRA, as predicted in section 2, turns out to be sensitive to whether it includes restrictive rules of origin. MRAs with rules of origin provide a powerful stimulus to intra-regional trade but at the expense of imports from countries outside the region.[24] The negative coefficient on MRA_RO_M, -0.4768, implies that imports from an excluded country suffer a 38% decline in affected industries. However, when an MRA does not include restrictive rules of origin, imports from both member countries and

[24] The substantial magnitude of the coefficient on MRA_RO may be explained by the trivial amount of initial trade in the affected industries before the implementation of MRAs.

third countries increase, indicated by the positive coefficients on both MRA_NRO and MRA_NRO_M. Finally, regional trade agreements are found on average to increase trade not only between participating countries but also with the rest of the world.[25]

In section 2, Proposition 2 predicted that trade stimulus is negatively correlated with the extent by which the importing country raises its standard - because an increase in the stringency of the standard may partially or completely offset the benefit from markets integration and dampens imports. As noted in the introduction, the European Union's richest members generally imposed the most stringent standards, and used their influence to ensure that the EU's harmonized standards were set close to their own levels. The available evidence suggests that the core set of countries with relatively strict initial standards consists of Germany, Denmark, and the Netherlands (Vogel, 1995). We also considered alternative definitions, e.g. the top third of EC and EFTA countries ranked by GDP per capita in 2001, and the results were similar.

An additional interactive term, *strictness*, was generated to test Proposition 2. For the harmonizing countries which can be presumed to have stricter initial standards, *strictness* is equal to 1; 0 for the rest of harmonizing importers. In column II of Table 3, the significant coefficient on the variable "$HAR \times strictness$" confirms that the increase in imports of these two groups of countries differs significantly in magnitude. Intra-regional imports of countries that were likely to have raised their standards during harmonization increase by 29%, considerably less than the 43% increase for countries with initially stricter standards. This sharp difference is also evident in imports from outside the harmonizing area. Imports of countries with less strict initial standards from a third country increase by 3%, while imports of countries with stricter initial standards increase by 32%.[26] The rest of the coefficients are similar to those in the column I.

[25] The literature on the impact of RTA on extra-bloc trade is mixed. Frankel, Stein, and Wei (1997) examine intra- and extra-bloc trade for eight RTAs-EC, EFTA, NAFTA, MERCOSUR, and the Andean Pact, AFTA, the CER, and the East Asian Economic Caucus for the period 1970-1992. Their study suggests that RTAs had positive impacts on all trade flows except for the EC's intra-bloc trade and EFTA's and NAFTA's trade with nonmembers. The authors conclude that there is little trade diversion. Soloaga and Winters (2001) find that RTAs between developing countries increase extra-bloc trade. In particular, ASEAN since 1980 increases intra-bloc trade, extra-bloc imports, and extra-bloc exports. Our estimates suggest that the average effect of these agreements is positive.

[26] In our alternative definitions of countries with stricter initial standards, as we gradually include more countries along the rank of GDP per capita, the magnitude of the coefficients on the interacting terms becomes moderated. This tendency seems to indicate the three countries considered here are a better

Table 3: Estimated effects of harmonization and MRAs

Regressand: ln(import)	I	II
Harmonization on intra-regional trade	0.2749***	0.2562***
(HAR)	(0.010)	(0.011)
importers with stricter initial standards		0.0989***
(HAR×strictness)		(0.022)
Harmonization on imports from the ROW	0.0950***	0.0310***
(HAR_M)	(0.005)	(0.005)
importers with stricter initial standards		0.2477***
(HAR_M×strictness)		(0.011)
Harmonization on exports to the ROW	0.6438***	0.6393***
(HAR_E)	(0.005)	(0.005)
MRAs with rules of origin on intra-regional trade	2.3540***	2.3589***
(MRA_RO)	(0.031)	(0.031)
MRAs with rules of origin on imports from the ROW	-0.4768***	-0.4799***
(MRA_RO_M)	(0.037)	(0.037)
MRAs with rules of origin on exports to the ROW	0.3956***	0.3963***
(MRA_RO_E)	(0.036)	(0.036)
MRAs without rules of origin on intra-regional trade	0.6362***	0.6390***
(MRA_NRO)	(0.074)	(0.074)
MRAs without rules of origin on imports from the ROW	0.7794***	0.7950***
(MRA_NRO_M)	(0.037)	(0.037)
MRAs without rules of origin on exports to the ROW	1.6235***	1.6154***
(MRA_NRO_E)	(0.037)	(0.037)
RTA on intra-regional trade	1.7225***	1.7266***
(RTA)	(0.011)	(0.011)
RTA on imports from the ROW	0.0458***	0.0404***
(RTA_M)	(0.005)	(0.005)
RTA on exports to the ROW	0.0309**	0.0292***
(RTA_E)	(0.005)	(0.005)
Number of observations	4160352	4160352
Log likelihood	-7840111	-7839841

Standard errors are reported in parentheses.

Exporter/Importer-industry-year, pair-industry fixed effects are controlled.

***, **, and * represent 1%, 5%, and 10% significance levels, respectively.

4.2 The divergent impact on imports from third countries

Do regional agreements in standards have a similar impact on exporters everywhere in the rest of world? As discussed in section 2, firms that incur a larger fixed cost of complying with country-specific standards reap larger benefits from scale economies, while firms that incur a higher variable cost of compliance will suffer (benefit) more from any increase (decline) in the stringency of the standard. Any asymmetry in costs can thus be expected to lead to rather distinctive effects on exporters in different origins.

Of considerable interest is the possible disparity in the effect of regional agreements on exporters from developing countries and exporters from developed countries. We generate a dummy variable, i.e., *developing*, which is equal to 1 for a developing country exporter and 0 for a developed country exporter. We consider all OECD countries as developed and the rest of the sample countries as developing. This dummy variable is used to interact with the three variables which capture the impact on imports from third countries: HAR_M, MRA_RO_M, and MRA_NRO_M. The regression results are reported in the column I of Table 4.

While regional harmonization promotes imports from developed third countries by 34%, there is actually a 16% reduction in imports from the excluded developing world (the coefficient on HAR_M for developing country exporters is -0.1675 and $e^{-0.1675} = 0.84$). These results are consistent with the assumption, which drives the predictions in Proposition 1 in section 2, that developing countries tend to find it more costly to meet stricter standards, and reap smaller benefits from the economies of scale generated by integrated markets (i.e., $c_k < c_l$ and $F_k > F_l$).

The impact of MRAs on developing and developed countries turns out to depend on whether they include rules of origin. If they do, they hurt developing country exports (39% decline) more than they hurt developed country exports (28% decline). But MRAs without rules of origin enhance developing country exports even more than they enhance developed country exports, revealed by the positive coefficient on the interacting term $MRA\_NRO\_M \times developing$. A possible explanation is offered by the intuition behind

definition of the subset with most stringent standards.

Table 4: The divergent impact on imports from third countries

Regressand: ln(import)	I	II
Harmonization on intra-regional trade	0.3002***	0.2825***
(HAR)	(0.010)	(0.011)
importers with stricter initial standards		0.0951***
(HAR×strictness)		(0.023)
Harmonization on imports from the ROW	0.2912***	
(HAR_M)	(0.007)	
from developing countries	-0.4587***	
(HAR_M×developing)	(0.012)	
from developed countries to importers with stricter initial		0.4491***
standards (HAR_M where developing=0 & strictness=1)		(0.014)
from developing countries to importers with stricter initial		0.0458***
standards (HAR_M where developing=1 & strictness=1)		(0.017)
from developed countries to importers with less strict initial		0.2369***
standards (HAR_M where developing=0 & strictness=0)		(0.008)
from developing countries to importers with less strict initial		-0.2421***
standards (HAR_M where developing=1 & strictness=0)		(0.010)
Harmonization on exports to the ROW	0.6357***	0.6315***
(HAR_E)	(0.005)	(0.005)
MRAs with rules of origin on intra-regional trade	2.3185***	2.3233***
(MRA_RO)	(0.031)	(0.031)
MRAs with rules of origin on imports from the ROW	-0.3294***	-0.3334***
(MRA_RO_M)	(0.041)	(0.041)
from developing countries	-0.1792***	-0.1763***
(MRA_RO_M×Developing)	(0.044)	(0.044)
MRAs with rules of origin on exports to the ROW	0.3204***	0.3213***
(MRA_RO_E)	(0.036)	(0.036)
MRAs without rules of origin on intra-regional trade	0.6612***	0.6641***
(MRA_NRO)	(0.075)	(0.075)
MRAs without rules of origin on imports from the ROW	0.8237***	0.8379***
(MRA_NRO_M)	(0.040)	(0.040)
from developing countries	0.2267***	0.2296***
(MRA_NRO_M×Developing)	(0.041)	(0.041)
MRAs without rules of origin on exports to the ROW	1.5031***	1.4952***
(MRA_NRO_E)	(0.037)	(0.037)
RTA on intra-regional trade	1.7331***	1.7371***
RTA on imports from the ROW	0.0347***	0.0295***
RTA on exports to the ROW	0.004	0.0027

Proposition 3 in section 2: the greater reduction in compliance costs for developing country firms may offset the smaller benefits they derive from economies of scale.

Finally, we test for the hypotheses in Proposition 1 by comparing respectively the four cases: the importer had more/less stringent initial standards while the exporter is a developed/developing country. Column II of Table 4 shows that with harmonization, exports to countries with stricter initial standards of both developed and developing countries increase, but the increase in the former (57%) is much greater than the increase in the latter (5%). Developed third countries' exports to countries with less strict initial standards also rise (by 27%), but developing countries' exports decline by 22%. These results are consistent with the predictions in Proposition 1, and the assumption that developing countries benefit less from economies of scale, and so see a smaller increase in exports to the market that does not increase the stringency of its standard) and are hurt more by an increase in the stringency of the standards in other markets to which their exports decline.[27]

These findings suggest that harmonization of standards is generally advantageous to participating and excluded developed countries that have similar cost structures, but could hurt the exports of developing countries. In the case of mutual recognition agreements, excluded developed and developing countries have greater commonness of cause: absent rules of origin both gain, with rules of origin both lose, with a larger impact on developing countries in each case.

5 Empirical issues

Our econometric results have been obtained with a range of controls designed to eliminate any correlation between the endogenous variables and the error term. However, we cannot rule out econometric problems arising for two reasons: omission of unobserved effects and self selection. First of all, initiatives on standards are not the only measures that have drawn the countries of the European Union closer together. For example, it could be that liberalization of transport inside the EU has reduced the costs of transport inside the

[27] The estimation results presented in this section are aligned with our predictions presented in section 2 based on an asymmetry of the form $c_x < c_y$ and $F_x > F_y$ (case (i)).

Union faster than the costs outside the Union. Secondly, it may be that the initiatives on standards have been taken in precisely those industries in which trade between members was growing, so the initiatives are at least in part the results rather than the cause of trade growth. In this section we test the robustness of our results.

5.1 Endogenous effects

We first consider the possible omission of unobserved effects, which are not already embodied in the multiple nested fixed effects included in section 4. Such effects must therefore consist of time-variant bilateral factors such as the preferential political or economic relations between two countries that might be correlated with the explanatory variables of interest.

Following the approach suggested in Baltagi (2001) and originally due to Mundlak (1978) on endogenous individual effects, we attempt to test and capture this time-variant bilateral effect, denoted by μ_{ijt}, by assuming μ_{ijt} is a linear function of the averages of all the existing explanatory variables (measures of regional initiatives) across industries:

$$\mu_{ijt} = \bar{X}_{ijt.}\pi + v_{ijt}, \tag{8}$$

where $\bar{X}_{ijt.}$ is a $1 \times R$ vector of observations on the explanatory variables averaged across industries. This effect is uncorrelated with the explanatory variables if and only if $\pi = 0$. As Mundlak (1978) assumed, without loss of generality, the X are deviations from their sample mean. The main equation to be estimated becomes:

$$y = X\beta + PX\pi + \epsilon, \tag{9}$$

where $P = I_N \otimes I_N \otimes I_T \otimes \bar{J}_R$, and the new error term has zero mean and variance-covariance matrix.

The estimation results with the control of unobserved time-variant bilateral effect are reported in column I of Table 5. The coefficient on μ_{ijt} is statistically significant and positive, rejecting the null of zero correlation between the unobserved effect and explanatory variables. It suggests that over time a stronger bilateral relationship leads

to a larger amount of sectoral trade. Furthermore, note that the magnitude of most estimates has fallen except for the coefficients on HAR and MRA_RO, compared to column I in Table 3. This result shows that consideration of the unobserved effect reduces the explanatory power of most of the regressors but not of intra-EU harmonization and MRA with rules of origin.[28] While this test cannot be regarded as conclusive,at least the inclusion of a measure of unobserved effects does not alter our qualitative conclusions.

5.2 Self selection

The problem of self section would lead to an overestimation of the trade-enhancing effect of initiatives on standards if the industries were selected based on observed rapid growth of trade - that is, initiatives were taken precisely in the sectors in which trade could ex ante be predicted to grow rapidly. [29] Formally, this concern can be expressed as

$$\begin{aligned} \hat{x} &= 1 \text{ if } \hat{x}^* > 0 \\ \hat{x} &= 0 \text{ otherwise,} \end{aligned} \tag{10}$$

where $\hat{x}$ refers to dummy variables: MRA_RO and MRA_NRO; and $\hat{x}^* = \hat{\gamma}'Z + v$ with Z representing a vector of exogenous/predetermined variables, in our case the lagged growth rate of trade;

$$\begin{aligned} \tilde{x} &= J \text{ if } \mu_{J-1} \leqslant \tilde{x}^* \\ &\ldots \\ \tilde{x} &= 1 \text{ if } 0 < \tilde{x}^* \leqslant \mu_1 \\ \tilde{x} &= 0 \text{ if } \tilde{x}^* \leqslant 0, \end{aligned} \tag{11}$$

[28] The considerable decrease in the coefficients of RTA variables with the inclusion of $\mu_{ijt}$is not surprising, since RTA variables also measure time-variant bilateral relations.

[29] Since we have included as a control nested bilateral industry fixed effects, we have not reached any conclusions based on cross-sectional variations, i.e. by comparing the level of trade across country pairs (or industries) with or without the initiatives. Instead, we predict the rate of growth in trade resulting from harmonization/mutual recognition, for a given pair of countries in a particular industry. Hence, any potential self-selection problem arising from differences in the level of bilateral trade do not undermine our estimates.

Table 5: Robustness analysis

Regressand: ln(import)	I	II
Stage 1:		
Harmonization (HAR)	–	-0.1113***
MRA with rules of origin (MRA_RO)	–	-0.0449***
MRA without rules of origin (MRA_NRO)	–	-0.0961***
Stage 2:		
Harmonization on intra-regional trade	0.4561***	0.3050***
(HAR)	(0.010)	(0.012)
Harmonization on imports from the ROW	0.0515***	0.1374***
(HAR_M)	(0.005)	(0.006)
Harmonization on exports to the ROW	0.6046***	0.5166***
(HAR_E)	(0.005)	(0.006)
MRAs with rules of origin on intra-regional trade	2.4154***	3.4057***
(MRA_RO)	(0.031)	(0.037)
MRAs with rules of origin on imports from the ROW	-0.7087***	-0.5511***
(MRA_RO_M)	(0.037)	(0.045)
MRAs with rules of origin on exports to the ROW	0.3197***	0.4641***
(MRA_RO_E)	(0.073)	(0.045)
MRAs without rules of origin on intra-regional trade	0.3197***	0.6703***
(MRA_NRO)	(0.074)	(0.073)
MRAs without rules of origin on imports from the ROW	0.2512***	0.6686***
(MRA_NRO_M)	(0.037)	(0.045)
MRAs without rules of origin on exports to the ROW	1.1430***	1.2522***
(MRA_NRO_E)	(0.037)	(0.045)
RTA on intra-regional trade	0.0539***	1.4927***
(RTA)	(0.019)	(0.014)
RTA on imports from the ROW	-1.2349***	-0.2614***
(RTA_M)	(0.012)	(0.006)
RTA on exports to the ROW	-1.2540**	-0.1752***
(RTA_E)	(0.012)	(0.006)
μ	11.2570***	–
Inverse Mills Ratios	–	***

where $\tilde{x}$ refers to the discrete choice variable: HAR, and $\tilde{x}^* = \tilde{\gamma}'Z + v$.

To correct the selectivity, we follow Vella (1993) and conduct our analysis over two stages. First, we estimate the determining effect of the lagged three-year average trade growth in $\ln import_{ijrt}$, i.e. $growth_{ijr(t-1)}(\equiv Z)$, on harmonization in an ordered probit model and mutual recognitions in a bi-variate probit model. Second, following Dubin and McFadden (1984), we compute generalized residuals (inverse mills ratio) from the first stage, i.e. $E(\hat{v}|\hat{x})$, to be included as additional regressors in our original estimating equation in section 4, which can be rewritten in terms of its conditional expectation as follows:[30]

$$E\left(y|\hat{X}\right) = X\beta + E\left(\hat{v}|\hat{X}\right)\lambda. \tag{12}$$

Least squares on the regression form of the above equation produces consistent estimates of β.

The two-step estimators are reported in column II of Table 5.[31] In the first stage, the ordered probit estimate of the coefficient on HAR is significantly negative, suggesting a relatively low rate of trade growth is associated with a decision to harmonize.[32] Likewise, in the bi-variate probit model, the coefficients on both MRA_RO and MRA_NRO are significantly negative, implying that two countries are more prone to reach an MRA in an industry, with or without rules of origin, in situations o relatively slow growth of bilateral trade. Furthermore, the effect of trade growth rate on the probability of adopting an MRA without rules of origin is stronger than the effect on the probability of adopting an MRA with rules of origin. The estimates obtained in the second stage confirm that when initiatives are associated with poor growth of trade (as revealed by the first-stage estimates), selectivity implies that the results reported in Table 3 underestimate the impact of the initiatives. In conclusion, our attempts to correct for self selection amplify

[30] Recall that HAR is a discrete choice variable with 7 possible outcomes, while there are three potential outcomes in the biprobit model of MRA_RO and MRA_NRO because ($P[MRA\_RO = 1, MRA\_NRO = 1] = 0$). Thus, we obtain totally 8 generalized residuals as additional regressors in the second step of estimation.

[31] Modeling the two types of MRAs in two seperate probit models, as an alternative to the bi-probit model in the first stage, is also conducted and yields very similar estimates.

[32] The interpretation of the coefficients in an ordered probit model has to be careful. Although the marginal effects on the middle outcomes are ambiguous without extra calculations, the probability of harmonization is unambiguously higher (because the probability associated with the leftmost outcome, i.e., $P(\tilde{x} = 0)$, is reduced) when the trade growth rate is lower.

the estimated impact of harmonization and mutual recognition.

6 Conclusion

This paper analyzes the implications of various regional initiatives that deal with technical barriers for trade. Both analytically and empirically we find that both harmonization and mutual recognition can have a significant positive impact on trade within the region and with third countries. But there is a qualification in each case. If the harmonized standard is stricter than the initial standard in some countries, then the benefits from market integration in terms of economies of scale can be offset by the increased production cost due to a stricter standard. It is evident that a larger trade increase in countries that imposed stricter initial standards relative to those with less strict initial standards. Exports of developing countries to the harmonizing region differ sharply across destinations: their exports to countries that raise their standards fall, whereas exports to the harmonizing countries that had stricter standards before rise moderately.

When mutual recognition agreements contain restrictive rules of origin, then their benefits will be confined to countries within the region at the expense of imports from the rest of the world, in particular, developing countries. When MRAs are open to firms regardless of origins, both intra-regional trade and trade with the rest of the world, especially with developing countries, rise substantially.

We noted that multilateral rules on goods trade have taken a permissive approach to regional agreement on standards. It is neither feasible nor desirable to restrict the freedom of countries to harmonize or mutually recognize their standards. However, more could be done to protect the rights of countries that are excluded from such agreements. This is particularly important because few of the agreements on standards include developing countries, and the big differences in social preferences over issues such as safety and the environment suggest that developing countries are unlikely to be party to many such agreements with industrial countries in the foreseeable future. Multilateral rules should ideally make it more difficult to conclude agreements of the type that impose an unnecessarily high price of exclusion, especially on developing countries. Thus, the imposition

of restrictive rules of origin, which deny the benefits of mutual recognition agreements to third countries for no legitimate reason, should be outlawed. It is harder to prevent the upward harmonization of standards. But it may be possible to build on the presumption that international trade law already creates in favor of the use of international standards by individual countries (in Articles 2.4 and 2.5 of the WTO's Agreement on Technical Barriers to Trade) and oblige countries that harmonize their standards to demonstrate why international standards or the less strict of the original standards are not adequate to meet their regulatory goals.

This paper should be seen as the beginning of a research program, and there remains much scope for deepening the analysis. In particular, two types of industry-level data would help: first, on how the level of harmonized standards compare with the standards that countries originally imposed; second, the precise cost implications for firms of complying with standards, across industries and countries.

Appendix A

[Table A.1 and Table A.2]

Appendix B.1: Proof for Proposition 1.

Proof. (i) In markets with strictest initial standards, $ds_j = 0$ and $dN_j > 0$, and thus equation (7) becomes

$$dQ_{ij} = \frac{1}{\gamma_{ij}} \sum_z \left[\phi_{ij} \sum_m \left(\frac{\partial n_{zj}}{\partial n_{mj}} V^*_{mj} \right) + \varphi_{ij} V^*_{zj} \right] dN_j, \tag{a.1}$$

where $\phi_{ij} \equiv n_{ij} \partial q^*_{ij} / \partial n_{iz}$ and $\varphi_{ij} \equiv q^*_{ij} \partial n_{ij} / \partial n_{iz}$. Equation (a.1) can be further simplified as

$$dQ_{ij} = \frac{dQ_{ij}}{dn_{ij}} \sum_z \frac{\partial n_{ij}}{\partial n_{zj}} \frac{V^*_{zj}}{\gamma_{ij}} dN_j, \tag{a.2}$$

where $dQ_{ij}/dn_{ij} = \partial Q_{ij}/\partial n_{ij} + \sum_z \left(\partial Q_{ij}/\partial n_{zj} \right) \left(\partial n_{zj}/\partial n_{ij} \right)$. Provided that $\partial P^*_j / \partial Q_{ij} > SOC_{ij}/n_{ij}$ ($SOC_{ij} \equiv 2(\partial P_j/\partial Q_{ij}) n_{ij}$ denotes the second-order condition to maximize Π_{ij}), $-q^*_{ij}/n_{ij} < \partial q^*_{ij}/\partial n_{ij} = -q^*_{ij} \left(\partial P_j / \partial Q_{ij} \right) / SOC < 0$ and thus $\partial Q_{ij}/\partial n_{ij} = q^*_{ij} + n_{ij} \partial q^*_{ij} / \partial n_{ij} > 0$. Furthermore, we find

$$\begin{aligned} \partial V^*_{zj} / \partial n_{ij} &= \frac{\partial \left(P^*_j Q_{zj} \right)}{\partial n_{ij}} - c_z s_j \frac{\partial q^*_{zj}}{\partial n_{ij}} \\ &= \frac{\partial P^*_j}{\partial Q_{ij}} \frac{\partial Q_{ij}}{\partial n_{ij}} + \left[\left(Q_{zj} \frac{\partial P^*_j}{\partial Q_{zj}} + P^*_j \right) n_{zj} - c_z s_j \right] \frac{\partial q_{zj}}{\partial n_{ij}} \\ &< 0, \end{aligned} \tag{a.3}$$

because $\partial P^*_j / \partial Q_{mj} < 0 \ \forall m$ (the negative slope of the demand function),

$$\frac{\partial Q_{ij}}{\partial n_{ij}} = q^*_{ij} + n_{ij} \frac{\partial q_{ij}}{\partial n_{ij}} = q^*_{ij} \left[1 - \frac{\partial P_j}{\partial Q_{ij}} \frac{n_{ij}}{SOC_{ij}} \right] = \frac{1}{2} q^*_{ij} > 0, \tag{a.4}$$

$(\partial P^*_j / \partial Q_{zj}) Q_{zj} + P^*_j = c_z s_j$ at profit maximization, and $\partial q_{zj} / \partial n_{ij} < 0$. Thus,

$$\partial n_{zj} / \partial n_{ij} = - \frac{\left(\bar{n} N_j / \Delta F \right) \left(\partial V^*_{zj} / \partial n_{ij} \right)}{\left(\bar{n} N_j / \Delta F \right) \left(\partial V^*_{zj} / \partial n_{zj} \right) - 1} < 0. \tag{a.5}$$

In addition, we know $\partial Q_{ij}/\partial n_{zj} = q_{ij}^{*}\partial n_{ij}/\partial n_{zj} + n_{ij}\partial q_{ij}^{*}/\partial n_{zj} < 0$. Hence, $dQ_{ij}/dn_{ij} > 0$.

Moreover, because $\partial P_j^{*}/\partial Q_{kj} = \partial P_j^{*}/\partial Q_{lj}$ (products that meet the same standard are identical to consumers regardless of the production location) and $q_{kj}^{*} > q_{lj}^{*}$, we find $\partial q_{zj}/\partial n_{kj} < \partial q_{zj}/\partial n_{lj}$ (where $\partial q_{zj}/\partial n_{ij} = -q_{ij}^{*}\left(\partial P_j/\partial Q_{ij}\right)/SOC_{zj}$), as well as $\left(\partial P_j^{*}/\partial Q_{kj}\right)\left(\partial Q_{kj}/\partial n_{kj}\right) < \left(\partial P_j^{*}/\partial Q_{lj}\right)\left(\partial Q_{lj}/\partial n_{lj}\right)$ (where $\partial Q_{ij}/\partial n_{ij}$ is defined in (a.5)). Therefore, $\partial V_{zj}^{*}/\partial n_{kj} < \partial V_{zj}^{*}/\partial n_{lj} < 0$, which unambiguously leads to $\partial n_{kj}/\partial n_{lj} > -1$.

Because the profit-maximizing reaction function, i.e., $q_{ij}^{*} = f\left(q_{zj}|_{z\neq i}\right)$, is a strictly decreasing function of c_i, given by

$$\frac{\partial f\left(q_{zj}|_{z\neq i}\right)}{\partial c_i} = \frac{s_j}{\partial^2 R_{ij}/\partial q_{ij}^2} < 0 \tag{a.6}$$

where $\partial^2 R_{ij}/\partial q_{ij}^2 < 0$. At equilibrium, $\partial q_{ij}^{*}/\partial c_i < 0$. We find that V_{ij}^{*} is also strictly decreasing when c_i rises, because

$$\frac{\partial V_{ij}^{*}}{\partial c_i} = \frac{\partial R_{ij}}{\partial q_{ij}}\frac{\partial q_{ij}^{*}}{\partial c_i} - s_j\left(q_{ij}^{*} - c_i\frac{\partial q_{ij}^{*}}{\partial c_i}\right) < 0 \tag{a.7}$$

given $\partial R_{ij}/\partial q_{ij} > 0$ and $\partial q_{ij}^{*}/\partial c_i < 0$. Thus, $V_{kj}^{*} > V_{lj}^{*}$. As a result, $dQ_{kj} > 0$, because $V_{kj}^{*} > V_{lj}^{*} > -\left(\partial n_{kj}/\partial n_{lj}\right)V_{lj}^{*}$.

By contrast, in markets with less strict initial standards, $ds_j > 0$ and $dN_j > 0$. Equation (7) becomes

$$dQ_{ij} = \frac{dQ_{ij}}{dn_{ij}}\sum_z \frac{\partial n_{ij}}{\partial n_{zj}}\frac{V_{zj}^{*}}{\gamma_{ij}}dN_j + \left[n_{ij}^{*}\frac{\partial q_{ij}^{*}}{\partial s_j} + \frac{N_j}{\gamma_{ij}}\frac{dQ_{ij}}{dn_{ij}}\sum_z\left(\frac{dn_{ij}}{dn_{zj}}\frac{\partial V_{zj}}{\partial s_j}\right)\right]ds_j. \tag{a.8}$$

Because

$$\frac{\partial n_{ij}(n_{zj}|_{z\neq i})}{\partial c_i} = \gamma_{ij}N_j\frac{\partial V_{ij}^{*}}{\partial c_i} < 0, \tag{a.9}$$

we find $n_{kj} < n_{lj}$. Furthermore,

$$\frac{\partial q_{ij}^{*}}{\partial s_j} = \frac{\frac{\partial P_j}{\partial s_j} - c_i}{-SOC} < 0, \tag{a.10}$$

because $c_i > \partial P_j/\partial s_j$, and $SOC < 0$. Given $c_k < c_l$, we obtain $\partial q_{lj}^{*}/\partial s_j < \partial q_{kj}^{*}/\partial s_j < 0$.

Thus $n^*_{lj}\partial q^*_{lj}/\partial s_j < n^*_{kj}\partial q^*_{kj}/\partial s_j < 0$, where $n^*_{ij}\partial q^*_{ij}/\partial s_j$ denotes the direct effect of an increase in s_j that appears in equation (a.8). The second multiplier of ds_j in equation (a.8) denotes the indirect effect of an increase in s_j. We consider $c_i > \tilde{c} \equiv \partial P^*_j/\partial s_j + (N_j/\gamma_{ij})(dQ_{ij}/dn_{ij})\sum_z [(\partial n_{ij}/\partial n_{zj})(\partial V_{zj}/\partial s_j)]\, SOC/n^*_{ij}$, which indicates the negative net effect of an increase in s_j. Denote the solution of ds_j that sets (a.7) to zero as $\Delta\underline{s}$ for $i = k$, and we conclude $dQ_{kj} > 0$ when $ds_j < \Delta\underline{s}$ while $dQ_{kj} < 0$ otherwise.

(ii) As for dQ_{lj}, when $ds_j = 0$, $dQ_{lj} > 0$ if and only if $V^*_{lj}/V^*_{kj} > -\partial n_{lj}/\partial n_{kj}$, where $V^*_{ij} \equiv (P^*_j - c_i s_j q^*_{ij})$ for $i = k, l$. The above condition holds when $((P^*_j - c_l s_j)q^*_{lj}/(P^*_j - c_k s_j)q^*_{kj} =)(P^*_j - c_l s_j)^2/(P^*_j - c_k s_j)^2 > -\partial n_{kj}/\partial n_{lj}$, where $P^*_j > c_i s_j$, $\partial n_{kj}/\partial n_{lj}$ is defined in (a.3) with $i = k$, and the first equality follows, at profit maximum, $P^*_j - \partial P_j/\partial q_{ij} - c_i s_j = 0$. When $c_l < \underline{g}(c_k) \equiv 1/s_j[P_j + \underline{b}(P_j - c_k s_j)]$ where $\underline{b} \equiv [-\left(N_j/\gamma_{lj}\right)(\partial V^*_{lj}/\partial n_{kj})]^{1/2}$, $(P^*_j - c_l s_j)^2/(P^*_j - c_k s_j)^2 > -\partial n_{kj}/\partial n_{lj}$, and thus $dQ_{lj} > 0$; when $c_l > \underline{g}(c_k)$, $dQ_{lj} < 0$. When $ds_j > 0$, given another additional negative impact on dQ_{lj} arising from $ds_j > 0$, we conclude $dQ_{lj} < 0$ when $c_l > \underline{g}(c_k)$. ■

Appendix B.2: Proof for Proposition 2.

Proof. As suggested in Appendix B.1, when $c_i > \tilde{c}$, the net effect of an increase in s_j is negative. Comparing the harmonizing markets of $ds_j = 0$ with those of $ds_j > 0$, we find that, in the latter markets, the positive market integration effect may be partially or even completely offset by the negative effect of $ds_j > 0$. Thus, the increase in imports of harmonizing market j, i.e., dQ_{ij}, from any exporter i is a strictly decreasing function of ds_j. ■

Appendix B.3: Proof for Proposition 3.

Proof. (i) In the case of mutual recognition with restrictive rules of origin, $dn_{ij}(n_{zj}|_{z\neq i}) > 0$ for $i, j \in H$ because $dN_j > 0$ and $ds_j \leqslant 0$, and $dn_{zj}(n_{mj}|_{m\neq z}) = 0$ for $z \notin H$ in equation (4). Thus $dn^*_{ij} > 0$ and $dn^*_{zj} < 0$ in equation (5). As a result, for $i, j \in H$, given $ds_j \leqslant 0$, $dn^*_{ij} > 0$, $dn^*_{zj} < 0$, and $\partial n_{ij}/\partial n_{zj} < 0$, $dQ_{ij} > 0$ in equation (6). For $i \in H, z \notin H$, and $j \in H$,

$$\frac{dQ_{zj}}{dn_{ij}} = \frac{\partial Q_{zj}}{\partial n_{ij}} + \frac{dQ_{zj}}{dn_{zj}}\frac{\partial n_{zj}}{\partial n_{ij}} < 0, \tag{a.11}$$

and thus given $ds_j = 0$ and $dn^*_{ij} > 0$, $dQ_{zj} < 0$.

(ii) For $k, l \notin H$, $j \in H$,

$$\begin{aligned} \frac{d(Q_{lj} - Q_{kj})}{dn_{ij}} &= \frac{d(n_{lj}q_{lj} - n_{kj}q_{kj})}{dn_{ij}} \\ &= n_{lj}\frac{dq_{lj}}{dn_{ij}} - n_{kj}\frac{dq_{kj}}{dn_{ij}} + q_{lj}\frac{\partial n_{lj}}{\partial n_{ij}} - q_{kj}\frac{\partial n_{kj}}{\partial n_{ij}}. \end{aligned} \tag{a.12}$$

Note $n_{lj}/n_{kj} > dq_{kj}/dq_{lj}$, because

$$\begin{aligned} dq_{kj}/dq_{lj} &= \frac{\left(\partial P^*_j/\partial Q_j\right)(\partial Q_j/\partial q_{lj})}{\left(\partial P^*_j/\partial Q_j\right)(\partial Q_j/\partial q_{kj}) + 1} \\ &= \frac{\left(\partial P^*_j/\partial Q_j\right) n_{lj}}{\left(\partial P^*_j/\partial Q_j\right) n_{kj} + 1} < \frac{n_{lj}}{n_{kj}}. \end{aligned} \tag{a.13}$$

Therefore, $n_{lj}dq_{lj}/dn_{ij} < n_{kj}dq_{kj}/dn_{ij}$. When $c_l > \underline{g}'(c_k) \equiv 1/s_j[P_j + \underline{b}'(P_j - c_k s_j)]$ where $\underline{b}' \equiv -\gamma_{lj}/(N_j \partial V^*_{lj}/\partial n_{kj})$, $\partial n_{lj}/\partial n_{kj} < -q_{kj}/q_{lj}$, and $q_{lj}\partial n_{lj}/\partial n_{ij} < q_{kj}\partial n_{kj}/\partial n_{ij}$ given $\partial n_{kj}/\partial n_{ij} = -1$ with $i \in H, k \notin H$. Therefore, $d(Q_{lj} - Q_{kj})/dn_{ij}$ defined in equation (a.12) is negative. Given $dn^*_{ij} > 0$, $d(Q_{lj} - Q_{kj}) < 0$ and thus $dQ_{lj} < dQ_{kj} < 0$. ■

Appendix B.4: Proof for Proposition 4.

Proof. (i) In the case of mutual recognition without rules of origin, $dN_j > 0$ and $ds_j \leqslant 0$ for exporters of all origins. When the exporter countries are type K (either within the region or in the rest of the world) or type L with $c_l < \underline{g}(c_k)$, the effects of both $dN_j > 0$ and $ds_j \leqslant 0$ are positive as shown in Appendix B.1. Thus, imports of any harmonizing market from type K countries – both within the region and in the rest of the world – and type L countries with $c_l < \underline{g}(c_k)$ increase, i.e., $dQ_{ij} > 0$, $dQ_{kj} > 0$, $dQ_{lj} > 0$ for $i, j \in H$, $k, l \notin H$.

(ii) When harmonizing markets have stricter initial standards, $ds_j < 0$. As pointed out in Appendix B.1, the net effect of $ds_j > 0$ is negative, which in turn implies a positive net effect of $ds_j < 0$. When $c_l > \underline{g}(c_k)$, $dQ_{lj} > 0$ only when the positive net effect of $ds_j < 0$ is sufficiently large to compensate the negative net effect of $dN_j > 0$. Setting equation

(a.8) equal to zero, we solve for ds_j and denote the solution as $-\Delta\bar{s}$. For any $ds_j < -\Delta\bar{s}$, $dQ_{lj} > 0$.

(iii) As mentioned in Appendix B.1, the negative direct effect of $ds_j > 0$, i.e., $n^*_{ij}\partial q^*_{ij}/\partial s_j$, is stronger for $i = l$. Next we consider and compare the indirect effect of ds_j, i.e., $\left(N_j/\gamma_{ij}\right)(dQ_{ij}/dn_{ij})\sum_z(\partial n_{ij}/\partial n_{zj})(\partial V^*_{zj}/\partial s_j)$, where $\partial n_{ij}/\partial n_{zj}$ is defined in equation (a.5) for $i = k, l$ and

$$\begin{aligned}\frac{\partial V^*_{zj}}{\partial s_j} &= \left(\frac{\partial P^*_j}{\partial s_j} - c_z\right) q^*_{zj} + (P^*_j - c_i s_j)\frac{\partial q^*_{zj}}{\partial s_j} \\ &= q^*_{zj}\left[\frac{\partial P^*_j}{\partial s_j} - c_z + \frac{\partial P^*_j}{\partial q^*_{zj}}\frac{\partial q^*_{zj}}{\partial s_j}\right].\end{aligned} \tag{a.14}$$

When $c_l > \bar{g}(F_k) \equiv \partial P^*_j/\partial s_j + \theta_{lj} - \bar{b}\left[(\partial P^*_j/\partial s_j) - c_k + \theta_{kj}\right]$ with $\theta_{zj} \equiv (\partial P^*_j/\partial q^*_{zj})(\partial q^*_{zj}/\partial s_j)$ and $\bar{b} \equiv (q_{kj}/q_{lj})\max\{\gamma_{kj}/(N_j\partial V^*_{kj}/\partial n_{lj}), \left(N_j/\gamma_{lj}\right)(\partial V^*_{lj}/\partial n_{kj})\}$, we then obtain that $\sum_z(\partial n_{kj}/\partial n_{zj})(\partial V_{zj}/\partial s_j) > 0$ as well as $\sum_z(\partial n_{lj}/\partial n_{zj})(\partial V_{zj}/\partial s_j) < 0$. Overall, the negative net effect of $ds_j > 0$ is stronger for $i = l$, which in turn suggests the positive impact of $ds_j < 0$ is larger for $i = l$. Setting equation (a.8) to be equivalent between k and l, we are able to solve for ds_j and denote the solution as $-\Delta\bar{s}'$. For $ds_j < -\Delta\bar{s}'$, $dQ_{lj} > dQ_{kj} > 0$. ■

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Table A.1: The New Approach Directives

Directives	Reference
Low voltage equipment	73/23/EEC
Simple pressure vessels	97/23/EC
Toys	88/378/EEC
Construction products	89/106/EEC
Electromagnetic compatibility	89/336/EEC
Machinery	98/37/EC
Personal protective equipment	89/686/EEC
Non-automatic weighing instruments	90/384/EEC
Active implantable medical devices	90/385/EEC
Gas appliances	90/396/EEC
Hot water boilers	92/42/EEC
Civil explosives	93/15/EEC
Medical devices	93/42/EEC
Potentially explosive atmospheres	94/9/EEC
Recreational craft	94/25/EC
Lifts	95/16/EC
Refrigeration appliances	96/57/EC
Pressure equipment	97/23/EC
In vitro diagnostic medical devices	98/79/EC
Radio and telecommunications terminal equipment	99/5/EC
Cable installation designed to carry person	00/9/EC
Packaging and packaging waste	94/62/EC
High speed rail systems	96/48/EC
Marine equipment	96/98/EC

Table A.2: The MRAs of Conformity Assessment

MRA of Conformity Assessment	Rules of Origin
EU and Australia	Yes
EU and New Zealand	Yes
EFTA and Australia	Yes
EFTA and New Zealand	Yes
INTRA EU	Yes
EU and USA	No
EU and Canada	No
Australia and New Zealand	No
Canada and Korea	No
Canada and Swiss	No