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Regionalism in Standards: Good or Bad for Trade?*

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Abstract

Regional agreements on standards have been largely ignored by economists and blessed by multilateral trade rules. Using a constructed panel data that identifies the different types of agreements at the industry level, we find that such agreements increase the trade between participating countries but not necessarily with the rest of the world. Harmonization of standards may reduce the exports of excluded countries, especially in markets that have raised the stringency of standards. Mutual Recognition Agreements are more uniformly trade promoting unless they contain restrictive rules of origin, in which case intra-regional trade increases at the expense of imports from other countries.

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1 Introduction

In launching their trade talks, the European Union and the Association of Southeast Asian Nations (ASEAN) agreed to focus not only on tariffs and quotas but also on what Pascal Lamy, the WTO Director-General and then EU trade commissioner, called "the real 21st century trade issues": harmonizing standards.[1] This initiative is an example of the process of "deep integration" which is most advanced within the European Union but also underway in many other regions. The shift in regional negotiating emphasis away from conventional barriers and towards standards is explained by two factors. First, multilateral negotiations have achieved remarkable reductions in tariffs and quotas but done relatively little to reduce the trade restrictive impact of technical barriers. Second, while multilateral trade rules governing regional agreements on tariffs seek at least in principle to balance the interests of integrating countries and the rights of excluded countries,[2] the rules treat regional agreements on standards as always benign and worthy of encouragement.[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 traditional trade barriers provides no adequate answer. This paper undertakes a systematic empirical analysis to examine how regional initiatives on standards affect trade patterns. First, on the basis of a review of the initiatives, the paper identifies the elements of regional agreements on standards that are relevant to predicting their impact on patterns of trade. Then, employing a specially constructed panel dataset that directly identifies the country pairs, industries and time period in which different types of policy initiatives are in effect, the paper addresses three empirical questions: Do regional agreements on standards lead to a significant increase in trade between participating countries? What happens to trade with countries that are left out? And how does the impact differ across participating and excluded countries?

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 arguably the enhancement of welfare by remedying market failure—arising, for example, from invisible risks of product use, neg-

ative environmental externalities, or product incompatibility due to the producers' failure to coordinate. Agreements on standards, therefore, often aim to secure the gains from integrated markets without unduly compromising the role of standards as remedies for market failure.

There are in effect two types of agreements on standards: harmonization and mutual recognition. In the case of harmonization, the participating countries adopt one common standard to replace their initially different standards. While the resulting integration of markets implies that all firms selling to the harmonizing region can enjoy improved economies of scale, the harmonized standard could be more stringent than some of the initial standards and therefore dampen firms' incentive to sell in the region. Countries in which firms are better equipped to comply with the new harmonized standard are more likely to increase exports to the region. In mutual recognition, countries recognize one another's standards or technical regulations, granting firms the opportunity of complying with the least stringent regulation in the participating region. Hence, the positive effect of economies of scale is reinforced by a fall in the compliance cost. These benefits may, however, be available only to firms in the participating countries if mutual recognition agreements include restrictive rules of origin.[4] If restrictive rules of origin are imposed, then intra-regional trade can be expected to increase at the expense of imports from third countries.

We test these hypotheses by estimating the effect of standards agreements on both the probability and volume of trade between two countries using a modified Heckman two-stage estimator with the control of multiple fixed effects. We find that the evidence broadly confirms the main predictions. Regional harmonization significantly increases intra-regional trade, raising both the likelihood and volume of trade between participating countries in affected industries. Exports of excluded countries to the region, however, decline on average. Mutual Recognition Agreements (MRAs) promote trade both within the region and with the rest of the world, unless they contain restrictive rules of origin in which case intra-regional trade increases at the expense of imports from other countries.

We also explore how the effects of standards agreements can vary across participating and excluded countries. Among participating countries, we find countries that initially had

more stringent standards are more likely to experience an increase in imports than those that raise standards during harmonization. Among excluded countries, we find countries in which firms are better equipped to comply with stricter standards are more likely to increase their exports to the harmonizing region, and their exports are less adversely affected by MRAs containing restrictive rules of origin.

Finally, we consider the possibility that the initiatives on standards are endogenous, either because of correlation between the initiative and omitted variables or because of reverse causality between the initiative and trade. To deal with this issue, we employ an instrumental variable approach, adopting the harmonization status of adjacent industries (i.e., those classified in the same SITC 2-digit sector) as the instrument for harmonization. This variable serves as a plausible instrument because it is significantly correlated with the endogenous regressor and does not exert a direct impact on trade in the considered industry. Estimates obtained from the three-stage IV model indicate that correcting for endogeneity does not significantly change the estimated effect on trade of harmonization.

The rest of this paper is organized as follows. In Section 2, we provide an overview of the policy initiatives that deal with standards. In Section 3, we discuss the related literature and present our hypotheses on the trade implications of these initiatives. We describe the data and construction of the key variables in Section 4. In Section 5, we test the hypotheses and present the empirical evidence. Section 6 deals with the potential endogeneity of harmonization. Section 7 concludes the paper and draws out the implications for the design of international trade rules.

2 An overview of regional initiatives on standards

Differences in standards across countries reflect differences in consumer preference, income, firm productivity or history. The differences in standards could be "horizontal" (such as the voltage requirement in electrical products) or "vertical" (such as the level of pesticide tolerated in food products). In either case, they could cause a fragmentation of the market, impede trade and inhibit the realization of economies of scale.

The simplest, and potentially most powerful, approach to deal with different national

standards 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 judgment of the European Court of Justice in 1979.[5] 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.[6]

Hence, to address the trade inhibitive aspect of standards, two types of regional initiatives have been taken: harmonization of standards and mutual recognition agreement of conformity assessment (an important aspect of standards compliance).

2.1 Harmonization of standards

When there exist significant differences in countries' initial standards, 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 standards 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.[7] The harmonization directives cover every aspect of the relevant standards, including the substantive content, the labeling requirement, and the conformity assessment procedures.

Available evidence suggests that harmonization within the EU tended towards the high range of initial standards. For example, Vogel (1995) points out that the role of the Union's richest and most powerful members, which imposed 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.[8]

By mapping each of the harmonization directives on to the SITC 3-digit level industries, we find that, in practice, harmonizing directives have been applied to most of the manufacturing product categories in which technical regulations are important, particularly to those in which the mutual recognition approach was seen to be failing. Figure 1 illustrates the coverage of harmonization over time in terms of the percentage of EU's harmonized

(intra-regional or total) imports. As harmonization was gradually implemented in more industries, the percentage of intra-EU imports under the effect of harmonization rose from 7 percent to 53 percent over the period of 1986-2001, while the percentage of harmonized total EU imports rose from 9 percent to 47 percent over the same period.

[Figures 1 and 2 about here]

Figure 2 compares the volume of intra-EU imports between industries that were harmonized either during or before the sample period and the rest of the manufacturing industries. It appears that, while intra-EU trade grew in the entire manufacturing sector, it grew more rapidly in the harmonizing industries. In fact, before 1990 industries that were eventually harmonized had a smaller volume of intra-EU trade than the other industries. But as harmonization took effect, intra-EU trade in these industries began to increase more rapidly and, after 1995, significantly exceeded the level of intra-EU trade in the other industries.[9]

2.2 Mutual Recognition Agreement (MRA) of conformity assessment

In many cases, harmonization of substantive standards may be deemed neither feasible nor desirable. Countries may nevertheless choose at least to mutually recognize each other's conformity assessment requirements, i.e. country A trusts country B to test whether a product meets country A's standards. Such initiatives remove duplicated testing and certification procedures and lower the excess costs that firms face in demonstrating compliance of their goods to the standards. Examples of these initiatives include the intra-EU MRAs on some unharmonized industries and the EU's agreements with a number of other countries.

A key element of the MRAs is the rule of origin. The MRAs between the EU and USA and the EU and Canada, for example, do not impose any restriction on the manufacturing origin of the products as a qualification for the treatment. In other words, products can be tested in any participating country and sold in the entire region, regardless of whether they are manufactured in the region or imported from elsewhere. For example, as a result of the MRA between the EU and Canada in the telecommunication equipment industry, the EU recognizes the conformity assessment performed in Canada and vice versa. Moreover, this

mutual recognition applies to all the telecommunication equipment sold in the agreement region, irrespective of where they are manufactured. In contrast, the MRAs the EU has concluded with Australia and New Zealand impose restrictive rules of origin and so the benefit of mutual recognition in conformity assessment is only available to products manufactured in the participating countries. In other words, products imported from third countries, for example, China, have to continue to meet the conformity assessment requirements in each participating country.[10]

3 Related literature and hypotheses

The literature on regionalism has almost exclusively focused on tariffs and quotas with a few notable exceptions.[11] In this section, we discuss the few studies on standards and identify the hypotheses we examine in the empirical section.

3.1 Related literature

Two theoretical studies, Baldwin (2000) and Ganslandt and Markusen (2001), are relevant to our analysis. In particular, Baldwin (2000) provides a systematic overview of regulatory protectionism. He also develops a model to examine the effect of mutual recognition and anticipates some of the results of this paper on MRAs. But the implications of harmonization and the asymmetric effects on participating and excluded countries, a central aspect of the present paper, are beyond the scope of that model.

As far as we know, only two previous studies have empirically explored the impact of *shared* standards on trade. Swann *et al.* (1996) regress British net exports, exports and imports over the period 1985-1991 on counts of voluntary national and international standards recognized by the United Kingdom and Germany. They discover that the international standards to which Britain is a party have little impact on imports but a significantly positive effect on exports, while British national standards tend to raise both imports and exports. Moenius (2005) regresses bilateral trade volumes in 4-digit SITC industries on counts of shared standards in a sample of 14 countries over 11 years, and finds a highly significant positive relationship.

Our paper differs from these empirical contributions in a number of aspects. First, instead of relying on approximate measures of shared standards, we directly identify harmonization directives and mutual recognition initiatives taken by countries in specific industries, and also distinguish between the impact of these two types of measures. Second, we examine not only the effect on trade between participating countries, but also on trade with excluded countries, a dimension which has been largely ignored in the empirical literature. Third, we allow for differing impacts of harmonization across destination markets, depending on factors such as whether they previously had more or less stringent standards, and across source countries, depending on characteristics that reflect their ability to meet standards. Finally, we take a first step in addressing the potential endogeneity of the harmonization decision in order to ensure that the parameter estimates are consistent.

3.2 Testable hypotheses on the implications of alternative initiatives

As a prelude to our empirical investigation of the effects of standards agreements on trade patterns, we present certain testable hypothesis. As in Baldwin (2000) and Ganslandt and Markusen (2001), it is helpful to assume that a firm must incur fixed costs to meet each distinct standard in the destination markets to which it sells, and that the variable costs of production increase with the stringency of the standard.[12] Any policy initiative on standards that affects one or both of these factors has a direct impact on the decision to sell as well as on the quantity sold in any country.

The key analytical insights can be explained by drawing a partial analogy between 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 a customs union, the economic impact of standards harmonization depends on the level at which the harmonized standard is set. Unlike the case of a customs union, standards harmonization has a market integration effect that creates scale economy benefits (fixed cost savings) for the firms of not just participating but also 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. When the harmonized standard is set in the high range of initial standards, as seems to have happened in the EU (Section 2.1),

firms in some countries may find that the positive effect of fixed cost savings is offset by the negative effect of variable cost increases, resulting in a decline in overall exports.

As in the case of a free trade area, the economic impact of an MRA depends critically on the choice of rules of origin. For the participating countries, an MRA is in effect a downward harmonization of technical requirements since firms are now free to meet the least costly of the initial set: trade is stimulated not only by market integration but also by the reduced stringency of the requirement. The implications for imports from third countries, however, differ drastically with the rules of origin. If firms of third countries are denied the benefits of the MRA and must continue to meet the original requirement 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 requirement, then they too could increase their exports to the region.

4 Data and empirical methodology

4.1 Data

The central variables in this paper are the regional initiatives on standards. To construct our regressors, we examine the official documents associated with each harmonization and MRA directive and identify the countries, industries, and time periods affected by each directive. We identify the industries that are influenced by the harmonization directives at the SITC (rev. 2) 3-digit level, which in most cases is the level of disaggregation considered in the directives. For example, in Directive 89/106/EEC (Construction Products), the products listed as subject to harmonization include aluminium and aluminium alloys (SITC industry 684), copper and copper alloys (662), glass (664), paints (533) and so on.

The harmonization directives are not always related to specific products but also in several cases to product attributes. Thus, a single industry (e.g., television receivers and electric power machinery) may be affected by multiple harmonization 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 to assume that the impact is linearly related to the number of directives applied to each industry, i.e., each additional directive in an industry has an identical incremental effect on trade, and to count the number of directives in place. Alternative approaches include considering a dummy variable to represent the presence of any harmonization directive or assigning a dummy variable to each directive. We established that the results are not sensitive to the choice of approach.[13]

We use the following baseline equation:

$$trade_{ijkt} = \alpha + \beta X + \delta_{ikt} + \eta_{jkt} + \gamma_{ijk} + \mu_{ijt} + \varepsilon_{ijkt}, \tag{1}$$

where $trade_{ijkt}$, the dependent variable, is the natural log of imports of country j from country i in industry k and year t.[14] 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).[15]

In equation (1), X denotes a vector of six explanatory variables, which represent (i) the case when the exporter and importer share an agreement (harmonization, MRA with rules of origin, or MRA without rules of origin), and (ii) the case when the importer has an agreement with a country other than the exporter. While variables from set (i) estimate the effect of regional initiatives on the trade between participating countries, variables from set (ii) capture their effect on the imports from third countries. Formally,

$$\begin{aligned} \beta X \;=\; & \beta_1 HAR_{ijkt} + \beta_2 HAR\_M_{ijkt} + \beta_3 MRA\_RO_{ijkt} + \beta_4 MRA\_RO\_M_{ijkt} \\ & + \beta_5 MRA\_NRO_{ijkt} + \beta_6 MRA\_NRO\_M_{ijkt}. \end{aligned} \tag{2}$$

In the equation above, HAR_{ijkt} represents the number of directives applicable to industry k between exporter i and importer j in year t. Since harmonization is only implemented

in the EU (and EFTA after 1994), HAR_{ijkt} is only positive if, as of time t, both the exporter and importer are members of the EU/EFTA and the relevant industry has been harmonized. For all other cases, HAR_{ijkt} is equal to zero. HAR_M_{ijkt} represents the number of directives applicable to industry k between importer j and any country other than exporter i in year t, unless i is also subject to the same directives. Since harmonization is only in effect in EU and EFTA countries, HAR_M_{ijkt} is positive if, as of time t, the importer is a member of the EU/EFTA, the exporter is not, and the relevant industry has been harmonized. For all other cases, HAR_M_{ijkt} is equal to zero.[16] For instance, since the EU had implemented two directives in the agricultural machinery industry by 1993, $HAR_{ijkt} = 2$ for UK's imports of agricultural machinery from Germany (or any other EU/EFTA country) since 1993, and $HAR\_M_{ijkt} = 2$ for UK's imports of agricultural machinery from China since 1993.

MRA_RO_{ijkt} and MRA_NRO_{ijkt} are dummy variables reflecting the existence of an MRA of conformity assessment, respectively, with or without rules of origin between exporter i and importer j in industry k in year t.[17] For instance, MRA_RO_{ijkt} is equal to 1 since 1999 for Canada's imports of telecommunication equipment from any EU member and vice versa. The cases where an MRA with or without rules of origin is reached between importer j and any country other than exporter i (without the participation of exporter i) are respectively represented by $MRA\_RO\_M_{ijkt}$ and $MRA\_NRO\_M_{ijkt}$. For example, $MRA\_RO\_M_{ijkt}$ is equal to 1 since 1999 for Canada's imports of telecommunication equipment from Japan.

Apart from the explanatory variables, we employ four types of fixed effects. First, we include a nested exporter-industry-year fixed effect, i.e., δ_{ikt}, to capture factors such as sectoral output in the exporting country at a particular time. We also include a nested importer-industry-year fixed effect, i.e., η_{jkt}, to control for variables such as sectoral demand and domestic competition in the importing country at a particular time. In addition, an importer-exporter-industry fixed effect, i.e., γ_{ijk}, is used to reflect any time-invariant bilateral sectoral elements such as the distance between countries as relevant to a particular industry. Last, we consider an exporter-importer-year fixed effect, i.e., μ_{ijt}, to capture all time-variant bilateral factors, such as the existence of a Free Trade Agreement (FTA) and

the political relationship between the countries. Table 1 summarizes the above notations.

[Table 1 about here]

The use of these extensive fixed effects serves to isolate the effect of standards agreements on the pattern of trade. We are not, however, able to exclude the possibility of omitted variables that exist in the same dimension as our key explanatory variables, such as the time-varying tariffs that the importing country sets on the exporter from a particular country in a given industry. Tariffs are not included because there are a large number of missing values in the tariff data, especially in the earlier period of our sample. We thus rely on the fixed effects to mitigate the potential bias. For example, the importer-industry-year fixed effect captures the effect of the importer's time-varying sectoral MFN tariff rates, and if the importer and exporter have implemented a preferential trade agreement, then the exporter-importer-year fixed effect captures its effect. Furthermore, in Section 6 we specifically address the potential endogeneity of our estimates that could arise from omitted variables.

4.2 Empirical methodology

The methodology employed in this paper builds on a traditional strand of trade literature, the estimation of international trade flows using the gravity equation, which dates back to Tinbergen (1962). Over time, this approach has been furnished with theoretical underpinnings and strengthened by improved estimation techniques. Representative studies include—but are not confined to—Anderson (1979), Helpman and Krugman (1985), Helpman (1987), Feenstra (2002), and Anderson and Van Wincoop (2003).[18] However, as argued by Helpman, Melitz, and Rubinstein (forthcoming), the majority of the previous studies, by only considering positive trade flows, give up important information about non-trading countries.

To see this, consider the expectation of equation (1) if only positive trade flows were included in estimation:

$$E\left[trade_{ijkt}|\, X,\ \delta_{ikt},\ \eta_{jkt},\ \gamma_{ijk},\ \mu_{ijt},\ trade_{ijkt}>0\right] = \alpha+\beta X+\delta_{ikt}+\eta_{jkt}+\gamma_{ijk}+\mu_{ijt} +E\left[\varepsilon_{ijkt}|\, trade_{ijkt}>0\right]. \quad (3)$$

As indicated in the above equation, omitting the last argument could potentially lead to selection bias. This issue is particularly important when exploiting bilateral trade flows at industry level, where a greater percentage of country pairs have zero trade. Hence, as in Helpman, Melitz, and Rubinstein (forthcoming), we adopt a two-stage estimation procedure to address the potential selection bias.

The conventional two-stage Heckman (1979) selection model is often employed for this type of analysis. However, including fixed effects in the first-stage probit model would give rise to the incidental parameter problem. Thus, we adopt a modified two-step estimation procedure which is largely similar to the Heckman (1979) model and originally introduced in Olsen (1980).

In the first stage, we estimate country i's decision to export to country j, i.e.,

$$\Pr\left[trade_{ijkt}>0\right]=\alpha_1+\varphi_1 Z+\delta_{1ikt}+\eta_{1jkt}+\gamma_{1ijk}+\mu_{1ijt}+\varepsilon_{1ijkt}, \quad (4)$$

where Z represents the explanatory variables including the instrument. When market entry costs are significant, a pre-existing market presence will influence a country's decision to export to a market but not the actual quantity of exports. We therefore consider, for each industry, the prior presence of the exporting country in the import market as our instrument in the first stage.[19] To be specific, we use an indicator variable that takes the value of 1 if the exporter sold the product to the importer at time $t-5$.[20] A Linear Probability model is employed in this stage to avoid the incidental parameter problem noted above. A general drawback of the Linear Probability model is the possibility that predicted probabilities may be negative or higher than one. However, Wooldridge (2001) points out that the Linear Probability model is completely general when most of the explanatory variables are discrete and contain mutually exclusive and exhaustive categories (see Chapter 15), which is the

case in this paper.

Then in the second stage, we estimate the volume of exports, i.e.,

$$\begin{aligned} trade_{ijkt} &= \alpha_2 + \varphi_2 X + \delta_{2ikt} + \eta_{2jkt} + \gamma_{2ijk} + \mu_{2ijt} + \varepsilon_{2ijkt} \\ &\quad + \sigma\lambda(\hat{\alpha}_1 + \hat{\varphi}_1 Z + \hat{\delta}_{1ikt} + \hat{\eta}_{1jkt} + \hat{\gamma}_{1ijk} + \hat{\mu}_{1ijt}), \end{aligned} \tag{5}$$

using OLS for all $trade_{ijkt} > 0$, where $\sigma\lambda(.)$ represents the control for the selection bias:

$$\begin{aligned} & \sigma\lambda(\hat{\alpha}_1 + \hat{\varphi}_1 Z + \hat{\delta}_{1ikt} + \hat{\eta}_{1jkt} + \hat{\gamma}_{1ijk} + \hat{\mu}_{1ijt}) \\ = \; & E\left[\varepsilon_{ijkt} | \, trade_{ijkt} > 0\right] \\ = \; & E\left[\varepsilon_{ijkt} | \, \varepsilon_{1ijkt} < \hat{\alpha}_1 + \hat{\varphi}_1 Z + \hat{\delta}_{1ikt} + \hat{\eta}_{1jkt} + \hat{\gamma}_{1ijk} + \hat{\mu}_{1ijt}\right]. \end{aligned} \tag{6}$$

In the Heckman selection model, $\lambda(.)$ is the inverse Mills ratio, and because ε_{1ijkt} and ε_{ijkt} are assumed to have a joint normal distribution $\lambda(.)$ is equal to $\phi(.)/\Phi(.)$, where $\phi(.)$ denotes the standard normal probability density function and $\Phi(.)$ the standard normal cumulative distribution function.[21] In our modified selection model, ε_{1ijkt} is uniformly distributed because of the adoption of a Linear Probability model in the first stage, and as shown in Olsen (1980) $\lambda(c) = c - 1$ in this case.[22]

5 Empirical Evidence

The estimated effects of initiatives

Table 2 presents the estimates obtained from the above two-stage model. The first-stage results show that the explanatory variables have a significant impact on a country's decision to export to another market. First, the prior presence of an exporting country in the import market significantly influences its decision to export to that market in a subsequent period. Regional initiatives on standards also matter. In particular, each harmonization directive raises the probability of trade between two harmonizing countries by 1 percentage point. However, it decreases the probability that a third country exports to the region by 0.7 percentage points, suggesting that the increased strictness of the harmonized

standard has on average a greater adverse effect on exporters of excluded countries than on exporters of participating countries. Mutual recognition agreements, especially those without restrictive rules of origin, also increase the likelihood of trade between participating countries. However, when mutual recognition agreements impose restrictive rules of origin, the probability that an excluded country will export to the participating region is 5 percentage points lower.

[Table 2 about here]

In stage 2, we control for the selection bias and find that the initiatives still exert a significant impact on the volume of trade along expected lines. The harmonization directives unambiguously stimulate the volume of intra-regional trade but on average reduce harmonizing countries' imports from the rest of the world. As we shall see later, the effect on third countries is not uniformly negative, and can be explained by the heterogeneity among third countries in the ability of their firms to meet standards.

The impact of an MRA again depends on whether it includes restrictive rules of origin. MRAs with rules of origin provide a powerful stimulus to the volume of intra-regional trade but at the expense of imports from countries outside the region. The negative coefficient on MRA_RO_M, -0.14, implies that imports from an excluded country suffer a 13% $(= 1 - \exp(-0.14))$ decline in affected industries. However, when an MRA does not include restrictive rules of origin, imports from both member countries and third countries increase, indicated by the positive coefficients on both MRA_NRO and MRA_NRO_M.[23]

We next explore how the effects of standards agreements can vary across participating and excluded countries.

The asymmetric effect of initiatives on participating countries

In Section 3.2, we suggested that the effect of harmonization on the imports of participating countries depends on how the costs of meeting the new harmonized standard compare with the benefits from economies of scale in integrated markets—an increase in the stringency of the standard may partially or completely offset the positive effect of market integration. As noted in Section 2.1, the EU members which initially imposed the

most stringent standards have used their influence to ensure that the EU's harmonized standards were set close to their own levels. These countries are expected to experience a greater increase in imports than countries that raise their standards during harmonization.[24] While both groups of countries experience an increase in imports because firms selling to them achieve greater economies of scale, this effect is reinforced in the former group by the reduced costs of meeting a lower standard and (partially) offset in the latter group by the increased costs of meeting a higher standard. In order to distinguish between harmonizing countries according to the stringency of their initial standards, we rely on two sources of information.

First, we generate an indicator variable, based on Vogel (1995), to represent the harmonizing countries which are considered to have stricter initial standards, i.e. Germany, Denmark and the Netherlands. We interact this variable with the harmonization measures of importing countries and test our prediction. Table 3 reports the two-stage estimation results with the additional interaction terms. As shown, the parameters of the interaction terms are mostly significant and positive. In particular, third countries are more likely to export to harmonized countries that had stricter initial standards than to those with lower initial standards. This is because an increase in the strictness of the standard in the latter countries after harmonization dampens, to some extent, the positive effect of market integration on third countries' incentive to export. Moreover, the effect of harmonization on the volume of trade is also different between these two groups of countries. Countries that were likely to have raised their standards during harmonization not only experience a smaller increase in intra-regional imports but also a greater decline in imports from third countries.[25]

[Table 3 about here]

The effect of harmonization on the imports of participating countries could also vary across industries because the cost of meeting standards is different in each industry. For example, industries in which firms must incur a larger fixed cost to meet each country's distinct standard are expected to reap larger economies of scale in integrated markets. To directly measure such costs would require richer data than is currently available, but we

can use regulatory intensity, i.e., the average number of standards countries impose in an industry, as a proxy. If each standard is concerned with one attribute of the product, then products subject to multiple standards are particularly likely to face diseconomies of scale in the absence of uniform standards across countries. For example, consider automobiles, a conventionally heavily regulated industry. Automobile producers are required to satisfy numerous environmental and safety standards in each destination market which raises firms' costs of selling in multiple markets that do not share common standards. Harmonization plays an especially important role in these industries in helping firms achieve economies of scale and expand export destinations.

Several studies, such as Swann *et al.* (1996), Moenius (2005), Essaji (2006), and Fontagné *et al.* (2005), have used the count of the standards as a proxy for the regulatory intensity at an industry in a particular country. We follow Essaji (2006) and Fontagné *et al.* (2005) in drawing from the UNCTAD's TRAINS database, which records product standards, testing and certification procedures, and labeling requirements set by a number of countries at the HS 8-digit industry level.[26] Even though the number and content of regulations varies across countries, the more heavily regulated industries tend to be the same. To construct the sectoral regulatory intensity, we compute the average number of technical regulations set by the industrial countries in each HS 8-digit industry and then calculate the industry sum at the SITC 3-digit level.[27] The 10 sectors that have the highest regulatory intensity by our measure are apparel and clothing industry, organic chemicals, vegetables and fruits, textile products, inorganic chemicals, road vehicles, machinery specialized for particular industries, fish products, cereals products, and medicinal and pharmaceutical products.

In Table 4, we interact sectoral regulatory intensity with the harmonization variables and report the estimation results. The effect of harmonization on the decision to export is indeed dependent on the regulatory intensity of the industries. Industries with heavy regulations experience a greater increase in the likelihood of trade after harmonization than the industries with fewer regulations. There is, however, no significant correlation between the effect of harmonization on the export volume of third countries and the regulatory intensity of the industry.

[Table 4 about here]

The asymmetric effect of initiatives on third countries

Do regional agreements on standards have a uniform effect on exporters in the rest of the world? Our discussion in Section 3.2 suggests that the effects can be asymmetric if countries differ in their firms' ability to meet standards. To test this hypothesis, we use two alternative variables to proxy for the ability of firms in a country to meet more stringent standards.

First, we examine whether the effects are dependent on a country's GDP per capita. The presumption is that firms in industrial countries are on average better equipped to meet more stringent standards than firms in developing countries. We, therefore, interact GDP per capita with each type of regional initiative. The parameters of the interaction terms are reported in Table 5. We find that third countries with a higher GDP per capita are not only more likely to export to harmonized countries but also more likely to see an increase in the volume of their exports. Furthermore, the exports of these countries are less adversely affected by MRAs that impose restrictive rules of origin. MRAs without restrictive rules of origin also affect the exports of third countries to different extents. However, in this case, exports of countries with a lower GDP per capita appear to receive a greater boost from MRAs. This finding is not surprising because MRAs without restrictive rules of origin amount to a reduction in the stringency of conformity assessment requirements which evidently helps firms with a limited ability to meet standards.

[Table 5 about here]

We also consider a country's R&D expenditure (as a proportion of GDP) as another possible proxy for the ability to meet more stringent technical regulations.[28] By interacting this variable with each type of regional initiative, we find the parameters of the interaction terms in Table 6 are mostly similar to those in Table 5. Third countries with a greater R&D expenditure are more likely to experience an increase in their exports to harmonized countries. Similarly, the exports of these countries are less adversely affected by MRAs that impose restrictive rules of origin while the positive effect of MRAs that do not restrict rules of origin is smaller.[29]

[Table 6 about here]

The view that the ability to meet standards differs across countries admittedly does not take into account the role of multinational enterprises (MNEs) in international production and trade. For example, the ability of a firm in China to meet U.S. standards for electronic products could depend on the extent of foreign ownership, and hence the extent of technology transfer. However, despite the globalization of production, there can remain differences across countries in firms' ability to meet standards due to national differences in areas such as research and development, technology capacity, and skill availability.

6 The endogeneity of harmonization

Our estimation results have been obtained with a range of controls designed to eliminate correlation between the explanatory variables and the error term. We cannot, however, rule out the potential endogeneity of the two types of regional initiatives on standards, harmonization and mutual recognition of conformity assessment. Here, we focus on harmonization, the more comprehensive of the two initiatives, because it influences a larger set of industries over a longer period of time.

The harmonization decision — including the selection of industries and timing of implementation — may be endogenous for two main reasons: it could be correlated with some exogenous factors that are omitted in our estimation equation or it could be, at least in part, the result rather than the cause of trade, the dependent variable. A similar concern also arises in the estimation of the effect of free trade agreements. To address this issue, Baier and Bergstrand (2004, 2007a) and Magee (2003) have formally estimated the economic determinants of FTAs. These papers find that country pairs that are similar in market size, sufficiently different in factor endowment, and geographically proximate are more likely to have an FTA in place. In this section, we deal with the potential endogeneity bias in the estimated effect of harmonization using the Instrumental Variable (IV) approach.[30]

Since we have already included multiple fixed effects in our estimation, the choice of instruments is rather limited. We adopt a binary variable, i.e., $HAR\_dummy_{ij\tilde{k}t}$, which takes the value of 1 if an adjacent industry (i.e., in the same SITC two-digit sector) $\tilde{k}$

is harmonized and 0 otherwise. For example, consider the SITC industry 682 (copper), which was harmonized in 1992. To construct our instrument, we examine if any industry in the sector of 68 (non-ferrous metals) was harmonized before or in 1992. Since one of the adjacent industries, i.e., industry 684 (aluminium), was harmonized by 1992, the instrument takes the value of 1. This variable is a plausible IV for two reasons. First, industries classified in the same two-digit sector (e.g., copper and aluminium, television receivers and radio broadcast receivers, etc.) are likely to have similar characteristics, such as labor intensity and scale economies, some of which may influence the harmonization decision. Second, the harmonization of an adjacent industry should not be directly correlated with the trade volume in a particular industry.[31]

The IV approach builds on the two-stage model we estimated in Section 5 and now consists of three stages. First of all, we estimate an equation of the harmonization status using the instrument, $HAR\_dummy_{ij\tilde{k}t}$ and the fixed effects, in a Linear Probability model:[32]

$$\Pr\left[HAR_{ijkt} > 0\right] = \alpha_0 + \varphi_0 HAR\_dummy_{ij\tilde{k}t} + \delta_{0ikt} + \eta_{0jkt} + \gamma_{0ijk} + \mu_{0ijt} + \varepsilon_{0ijkt}. \quad (7)$$

Then, we estimate equations (4) and (5) sequentially, including in both equations the predicted probability of harmonization (obtained from the first stage). The results are summarized in Table 7.

[Table 7 about here]

As shown in the first-stage estimation results, the harmonization status is highly correlated between adjacent industries. In fact, the likelihood of harmonization in an industry rises by 0.5 when standards in an adjacent industry are already harmonized. After including the predicted probability of harmonization in the second and third stages, we find its effects on both the decision to trade and volume of trade remain significant. The rest of the results also remain essentially unchanged. The Hausman (1978) tests lend further support to the 3-Stage estimates.

7 Conclusion

This paper analyzes the implications for trade of various regional initiatives that deal with technical barriers. It is evident that harmonization and mutual recognition can have a positive impact on both the likelihood and volume of 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 positive impact on trade of market integration due to enhanced economies of scale can be offset by the increased production cost due to a stricter standard. Thus, countries with stricter initial standards witness a larger increase in imports relative to those with less strict initial standards. Moreover, the impact of harmonization on a third country's exports is positively correlated with the country's ability to meet the standards, proxied by its GDP per capita and R&D expenditure.

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

We also address the potential endogeneity of standards harmonization by employing an IV approach in a three-stage model. The instrumental variable used is the harmonization status of adjacent industries (classified in the same SITC 2-digit sector), which is significantly correlated with an industry's probability of being selected for harmonization. The estimated effects of regional initiatives are robust to the correction for endogeneity,

As noted in the introduction, multilateral rules on goods trade have taken a permissive approach to regional agreement on standards. While it is neither feasible nor desirable to restrict the freedom of countries to harmonize or mutually recognize their standards, more could be done to strike a better balance between the interests of integrating and excluded countries. 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 few developing countries are likely to be party to such agreements with industrial countries in the foreseeable future. A better balance

of interests could be achieved if multilateral rules ensured that agreements did not impose an unnecessarily high cost on excluded countries. For example, the rules could require countries that seek to harmonize their standards upward to demonstrate why the less strict of the original standards is not adequate to meet their regulatory objective. The rules could also discourage the imposition of restrictive rules of origin in mutual recognition agreements, which deny the benefits of the agreements to exporters in third countries.

This paper should be seen as the beginning of a research program, and there remains much scope for deepening the analysis. Two types of industry-level data would be particularly helpful: first, on how the level of harmonized standards compares with the level of the standards that countries originally imposed in a particular industry; second, the implications of complying with standards for the costs of firms, across industries and countries. Such data would make it feasible to carry out an analysis that generates rich insights at the industry level. Furthermore, as indicated in Section 5, the availability of firm level data could help improve our understanding of how the impact of standards agreements depends on factors such as firm location and ownership.

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Lead Footnote

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Notes

[1]"EU and Asean to pave way for trade pact talks", Financial Times, 7 September 2004.

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

[3]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."

[4]"Rules of origin" are defined by the WTO as "the criteria used to define where a product was made." In the case of MRAs, rules of origin are deemed to be restrictive if the benefits of the agreement are not extended to products manufactured outside the region.

[5]The judgment was given by the European Court of Justice on 20 February 1979 in case 120/78.

[6]A key 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 stringency.

[7]Table A.1 lists the harmonization directives implemented before 2001.

[8]The EC (1998) Single Market Review also 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).

[9]This figure, however, does not exclude the possibility that the extent of intra-regional trade may be both the cause and effect of harmonization. Thus, it emphasizes the importance of disentangling the causality between harmonization and trade which is addressed in Section 6.

[10]Table A.2 lists the implemented Mutual Recognition Agreements of conformity assessment and their rules of origin.

[11]See Maskus and Wilson (2001) for a detailed review of the literature.

[12]Sometimes the additional fixed cost can be avoided by complying with the most stringent standard in the destination markets. However, in other cases, incurring additional fixed costs is inevitable because the standard does not concern vertical differentiation of products on some quality dimension, but the incompatibility of products (e.g. two-prong versus three-prong plugs).

[13]These results are available from the authors.

[14]We added 1 to the import value before taking the natural log so that $trade_{ijkt}$ is equal

to 0 when the import value is zero.

[15]Table A.3 lists all the countries in the sample. Czech Republic and Slovak Republic are excluded because of the lack of sectoral trade data in 1993. Belgium and Luxembourg are considered as one unit throughout the period.

[16]The value of HAR_{ijkt} and HAR_M_{ijkt} ranges from 0 to 7 as the max number of directives that have been applied to an industry is 7 (in the metalworking machinery industry).

[17]The MRA variables are all dummies because no industries in the data are subject to more than one MRA directive.

[18]This equation has also been expanded to include more factors that may explain trade flows, such as international borders (e.g., McCallum, 1995; Wei, 1996; Evans, 2003), preferential trading blocs (see Frankel, 1997; Baier and Bergstrand, 2007a), currency unions (see Rose, 2000; Tenreyro and Barro, 2002), membership in the WTO (see Rose, 2004), as well as the home market effects (see Davis and Weinstein, 2003).

[19]We are grateful to one of the referees for suggesting this instrumental variable.

[20]We also considered as an alternative instrument the exporter's presence in the importing market at other points in the past, such as t-10, and obtained results similar to those presented in the paper.

[21]In fact, Olsen (1980) points out that the Heckman model does not require bivariate normality, only the normality of the residual in the selection equation, i.e., ε_{1ijkt}, and the linearity of the conditional expectation of the residual in the main equation , i.e., ε_{ijkt} given ε_{1ijkt}. Bivariate normality is a sufficient condition for his results to hold, but not necessary.

[22]Olsen (1980) points out that given the assumptions that ε_{1ijkt} is uniformly distributed and ε_{2ijkt} normally distributed, the distribution of ε_{ijkt} is the convolution of a uniform and a normal density which is symmetric but with a broader peak and narrower tails. Only when the absolute vaule of the correlation between ε_{ijkt} and ε_{1ijkt} exceeds 0.5 does this hybrid density function differ noticeably from the normal.

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

[24]One could in principle also compare the effect of MRAs across participating countries. However, because the MRAs implemented so far are only concerned with conformity assessment and do not affect the stringency of standards, we focus here on harmonization.

[25]We also considered the Global Competitiveness Report (1998) (henceforth, GCR) as an alternative source of information on the stringency of countries' standards. Based on responses to its executive opinion survey, GCR constructs a variable to measure a country's stringency of standards. According to this variable, Germany, Denmark, and Norway imposed the strictest standards - a definition similar to Vogel's except that Netherlands is replaced with Norway. We directly interacted the variable reported in GCR with the harmonization variables, and found qualitatively similar results to those presented in Table 3.

[26]This dataset is however mostly only available for 1999. Since relative regulatory intensity of industries is unlikely to have changed much over time, the dataset serves our purpose.

[27]We also considered the industry average (instead of total) number of technical regulations and using all (instead of just developed) countries in the calculation. The results are not sensitive to the choice of the measure.

[28]This data is taken from the World Bank's World Development Indicators (WDI).

[29]We also allowed the effect of regional initatives on third countries to vary by the countries' education level, measured by the average years of schooling, and did not find a systematic and significant pattern.

[30]We also considered the Propensity Score Matching method to correct for the endogeneity of harmonization, and found the estimated effect of harmonization on the intra-regional trade remains robust. We used this technique to create the missing counterfactual of a harmonized industry had its standards remained different across countries. We matched each

harmonized industry with an unharmonized industry which exhibits very similar characteristics. Then, the causal effect of harmonization was derived from the average difference in the growth of trade between each harmonized industry and its matched control industry. We found that trade in harmonized industries grows significantly faster after harmonization than unharmonized industries that share similar characteristics. Baier and Bergstrand (2007b) also adopt this method to analyze the effect of Free Trade Agreements on trade and effectively control for both observable and unobservable differences between the country pairs that formed an FTA and those that did not.

[31]We demonstrated the latter justification by including the harmonization status of adjacent industries as an additional regressor in our two-stage model and found the estimate of its parameter statistically insignificant.

[32]As discussed earlier, a Linear Probability model instead of a probit model is adopted to avoid the incidental parameter problem which arises with the use of fixed effects.

Table 1: Notations in estimations

Dependent variable	
trade_{ijkt}	the natural logarithm of the imports of country j from country i in industry k and year t plus 1
Fixed effects	
δ_{ikt}	exporter-industry-year
η_{jkt}	importer-industry-year
γ_{ijk}	exporter-importer-industry
μ_{ijt}	exporter-importer-year
Explanatory variables	
HAR_{ijkt}	the number of harmonization directives between i and j in industry k and year t
HAR_M_{ijkt}	the number of harmonization directives (that do not cover i) between j and any country other than i in industry k and year t
MRA_RO_{ijkt}	1 if an MRA with rules of origin exists between i and j in industry k and year t, and 0 otherwise
MRA_RO_M_{ijkt}	1 if an MRA with rules of origin (that does not cover i) exists between j and any country other than i in industry k and year t, and 0 otherwise
MRA_NRO_{ijkt}	1 if an MRA without rules of origin exists between i and j in industry k and year t, and 0 otherwise
MRA_NRO_M_{ijkt}	1 if an MRA without rules of origin (that does not cover i) exists between j and any country other than i in industry k and year t, and 0 otherwise

Table 2: The estimated effects of harmonization and MRAs

Explanatory variables	Stage 1 decision to trade	Stage 2 trade volume
Presence at the export market at t-5 (IV)	0.76***	—
	(0.001)	
Harmonization on intra-regional trade	0.01***	0.19***
(HAR)	(0.001)	(0.013)
Harmonization on imports from the ROW	-0.007***	-0.44***
(HAR_M)	(0.001)	(0.009)
MRAs with rules of origin on intra-regional trade	0.06***	0.35***
(MRA_RO)	(0.004)	(0.066)
MRAs with rules of origin on imports from the ROW	-0.05***	-0.14***
(MRA_RO_M)	(0.002)	(0.028)
MRAs without rules of origin on intra-regional trade	0.20***	3.09***
(MRA_NRO)	(0.008)	(0.125)
MRAs without rules of origin on imports from the ROW	0.02***	0.84***
(MRA_NRO_M)	(0.004)	(0.056)
λ	—	5.89***
Number of observations	4,160,352	2,796,489
R square	0.67	0.39
Root MSE	0.38	3.17

Notes: (i) Exporter/Importer-industry-year, country pair-industry, and country pair-year fixed effects are controlled; (ii) standard errors, clustered at the country pair-industry level, are reported in parentheses; (iv) ***, **, and * represent 1%, 5%, and 10% significance levels, respectively.

Table 3: The asymmetric effects of harmonization across harmonized countries

Explanatory variables	Stage 1 decision to trade	Stage 2 trade volume
Presence at the export market at t-5 (IV)	0.76***	—
	(0.001)	
Harmonization on intra-regional trade	0.01***	0.06***
(HAR)	(0.001)	(0.015)
× harmonized countries with stricter *initial* standards$^{(i)}$	-0.001	0.72***
	(0.002)	(0.037)
Harmonization on imports from the ROW	-0.01***	-0.53***
(HAR_M)	(0.001)	(0.011)
× harmonized countries with stricter *initial* standards$^{(i)}$	0.01***	0.41***
	(0.001)	(0.024)
MRAs with rules of origin on intra-regional trade	0.06***	0.29***
(MRA_RO)	(0.004)	(0.066)
MRAs with rules of origin on imports from the ROW	-0.05***	-0.12***
(MRA_RO_M)	(0.002)	(0.028)
MRAs without rules of origin on intra-regional trade	0.20***	3.16***
(MRA_NRO)	(0.008)	(0.124)
MRAs without rules of origin on imports from the ROW	0.02***	0.79***
(MRA_NRO_M)	(0.004)	(0.056)
λ	—	5.88***
Number of observations	4,160,352	2,796,489
R square	0.67	0.39
Root MSE	0.38	3.16

Notes: (i) this group includes Germany, Denmark, and Netherlands, which are considered by Vogel (1995) as the countries with the strictest standards in EU and EFTA prior to harmonization.

Table 4: The asymmetric effects of harmonization across industries

Explanatory variables	Stage 1 decision to trade	Stage 2 trade volume
Presence at the export market at t-5 (IV)	0.76***	—
	(0.001)	
Harmonization on intra-regional trade	-0.01***	0.09
(HAR)	(0.002)	(0.109)
× intensity of regulations	0.01***	0.04***
	(0.001)	(0.010)
Harmonization on imports from the ROW	-0.05***	-0.34***
(HAR_M)	(0.001)	(0.071)
× intensity of regulations	0.02***	-0.04
	(0.001)	(0.028)
MRAs with rules of origin on intra-regional trade	0.06***	0.35***
(MRA_RO)	(0.004)	(0.221)
MRAs with rules of origin on imports from the ROW	-0.05***	-0.14***
(MRA_RO_M)	(0.002)	(0.064)
MRAs without rules of origin on intra-regional trade	0.20***	3.11***
(MRA_NRO)	(0.008)	(0.727)
MRAs without rules of origin on imports from the ROW	0.02***	0.85***
(MRA_NRO_M)	(0.004)	(0.167)
λ	—	5.90***
Number of observations	4,160,352	2,796,489
R square	0.67	0.39
Root MSE	0.38	3.17

Notes: (i) Exporter/Importer-industry-year, country pair-industry, and country pair-year fixed effects are controlled; (ii) standard errors, clustered at the country pair-industry level, are reported in parentheses; (iv) ***, **, and * represent 1%, 5%, and 10% significance levels, respectively.

Table 5: The asymmetric effects of harmonization and MRAs across third countries by GDP per capita

Explanatory variables	Stage 1 decision to trade	Stage 2 trade volume
Presence at the export market at t-5 (IV)	0.76***	—
	(0.001)	
Harmonization on intra-regional trade	0.01***	0.20***
(HAR)	(0.001)	(0.013)
Harmonization on imports from the ROW	-0.06***	-0.66***
(HAR_M)	(0.005)	(0.072)
× GDP per capita	0.007***	0.02***
	(0.001)	(0.008)
MRAs with rules of origin on intra-regional trade	0.05***	0.36***
(MRA_RO)	(0.003)	(0.066)
MRAs with rules of origin on imports from the ROW	-0.11***	-0.49***
(MRA_RO_M)	(0.018)	(0.220)
× GDP per capita	0.007***	0.04*
	(0.002)	(0.02)
MRAs without rules of origin on intra-regional trade	0.18***	3.22***
(MRA_NRO)	(0.008)	(0.125)
MRAs without rules of origin on imports from the ROW	0.02	4.07***
(MRA_NRO_M)	(0.02)	(0.339)
× GDP per capita	0.0004	-0.35***
	(0.003)	(0.036)
λ	—	5.89***
Number of observations	4,135,588	2,784,952
R square	0.67	0.39
Root MSE	0.38	3.17

Notes: (i) Exporter/Importer-industry-year, country pair-industry, and country pair-year fixed effects are controlled; (ii) standard errors, clustered at the country pair-industry level, are reported in parentheses; (iv) ***, **, and * represent 1%, 5%, and 10% significance levels, respectively.

Table 6: The asymmetric effects of harmonization and MRAs across third countries by RD expenditure

Explanatory variables	Stage 1 decision to trade	Stage 2 trade volume
Presence at the export market at t-5 (IV)	0.73***	—
	(0.001)	
Harmonization on intra-regional trade	0.03***	0.28***
(HAR)	(0.001)	(0.015)
Harmonization on imports from the ROW	-0.05***	-0.73***
(HAR_M)	(0.001)	(0.018)
× R&D expenditure (relative to GDP)	0.04***	0.22***
	(0.001)	(0.014)
MRAs with rules of origin on intra-regional trade	0.05***	0.43***
(MRA_RO)	(0.005)	(0.077)
MRAs with rules of origin on imports from the ROW	-0.08***	-1.06***
(MRA_RO_M)	(0.005)	(0.061)
× R&D expenditure (relative to GDP)	0.03***	0.70***
	(0.003)	(0.040)
MRAs without rules of origin on intra-regional trade	0.13***	2.24***
(MRA_NRO)	(0.008)	(0.131)
MRAs without rules of origin on imports from the ROW	0.07***	1.21***
(MRA_NRO_M)	(0.008)	(0.099)
× R&D expenditure (relative to GDP)	-0.03***	-0.26***
	(0.005)	(0.061)
λ	—	5.98***
Number of observations	3,070,736	2,207,031
R square	0.66	0.38
Root MSE	0.37	3.16

Notes: (i) Exporter/Importer-industry-year, country pair-industry, and country pair-year fixed effects are controlled; (ii) standard errors, clustered at the country pair-industry level, are reported in parentheses; (iv) ***, **, and * represent 1%, 5%, and 10% significance levels, respectively.

Table 7: Correcting for the endogeneity of harmonization

Explanatory variables	Stage 1 harmonization	Stage 2 dec. to trade	Stage 3 trade volume
Harmonization of the adjacent industry (IV in stage 1)	0.50***	—	—
	(0.01)		
Presence at the export market at $t-5$ (IV in stage 2)		0.76***	—
		(0.001)	
Harmonization on intra-regional trade		0.01***	0.90***
(HAR_*dummy*)		(0.001)	(0.028)
Harmonization on imports from the ROW		-0.005***	-0.45***
(HAR_M)		(0.001)	(0.009)
MRAs with rules of origin on intra-regional trade		0.06***	0.06***
(MRA_RO)		(0.004)	(0.067)
MRAs with rules of origin on imports from the ROW		-0.05***	-0.24***
(MRA_RO_M)		(0.002)	(0.028)
MRAs without rules of origin on intra-regional trade		0.19***	3.25***
(MRA_NRO)		(0.008)	(0.124)
MRAs without rules of origin on imports from the ROW		0.03***	0.82***
(MRA_NRO_M)		(0.004)	(0.056)
λ	—	—	5.82***
Number of observations	4,160,352	4,160,352	2,796,489
R square	0.57	0.67	0.39
Root MSE	0.14	0.38	3.17

Notes: (i) Exporter/Importer-industry-year, country pair-industry, and country pair-year fixed effects are controlled; (ii) standard errors, clustered at the country pair-industry level, are reported in parentheses; (iv) ***, **, and * represent 1%, 5%, and 10% significance levels, respectively.

Table A.1: The "New Approach" Harmonization 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
Canada and Swiss	No

Table A.3: List of countries in the sample

Argentina	Hungary	Pakistan
Australia	Iceland	Philippines
Austria	India	Poland
Belgium and Luxembourg	Indonesia	Portugal
Canada	Ireland	Saudi Arabia
Chile	Israel	Singapore
China	Italy	Spain
Colombia	Japan	Sweden
Denmark	Korea	Switzerland
Finland	Malaysia	Taiwan
France	Mexico	Thailand
Germany	Netherlands	Turkey
Greece	New Zealand	United Kingdom
Hong Kong	Norway	United States

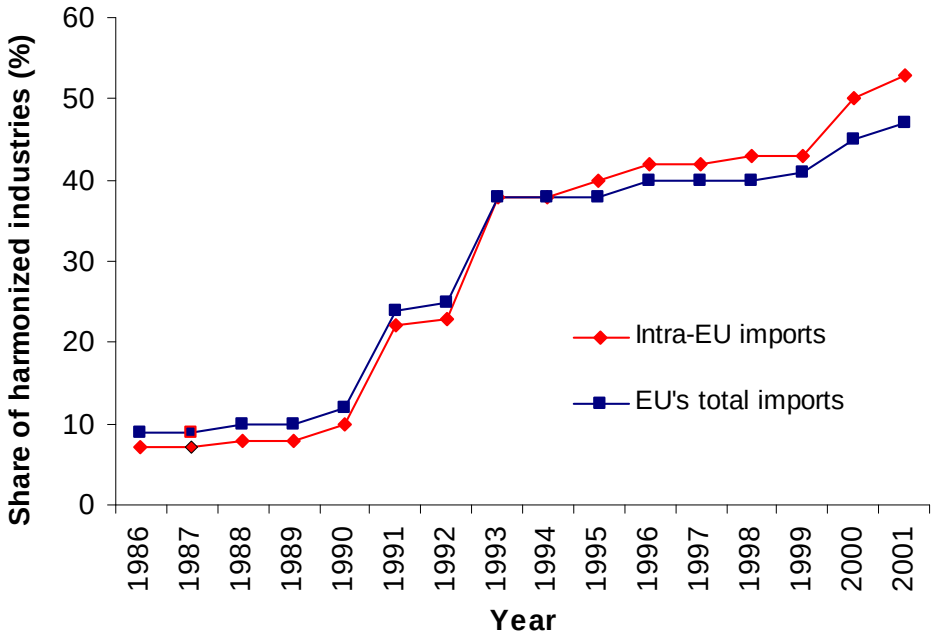

Figure 1: The coverage of harmonization in EU's imports

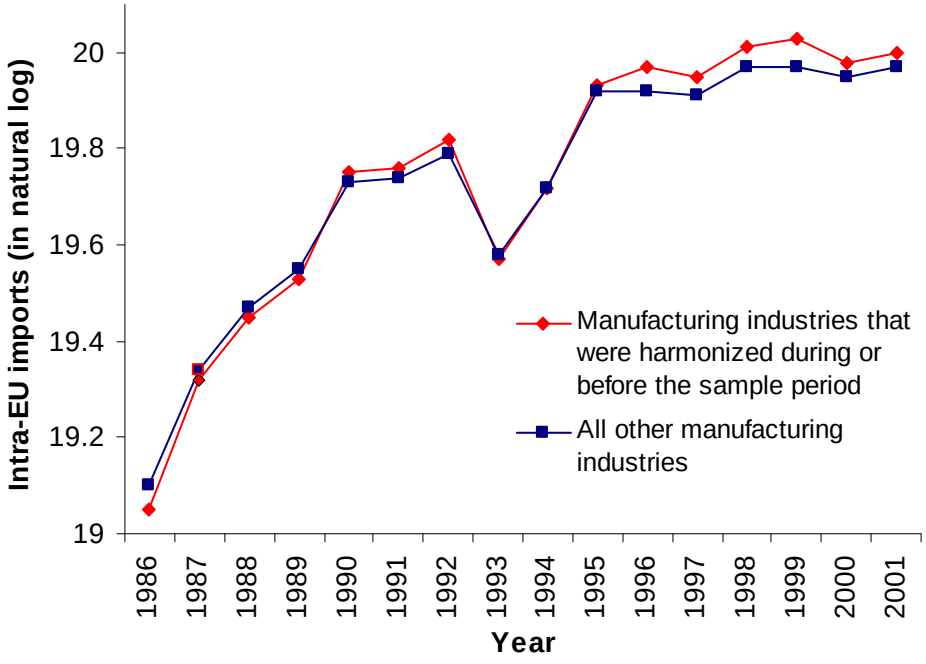

Figure 2: A comparison of intra-EU imports between harmonizing and other manufacturing industries