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Product Standards, International Harmonization, and Export Diversification

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Abstract

A new database of EU product standards in the textiles, clothing, and footwear sectors provides consistent and robust evidence that international standards harmonization is associated with increased partner country export variety in developing countries. For an average low income country, a 1% reduction in the total number of EU standards is associated with a 0.6% increase in export variety, while a 1 percentage point increase in the proportion of EU standards that are internationally harmonized leads to a 0.8% increase in export variety. These effects are weaker, and even reversed, for high income countries.

Keywords: International trade; Textiles, clothing, and footwear; European Union; Product variety; Product standards.

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1 Introduction

By increasing the fixed product adaptation costs that firms must pay in order to access foreign markets, "regulatory protectionism" (Baldwin, 2000) has the potential to impact trade at the extensive, or new products, margin: higher fixed costs discourage export market entry, and reduce the range of product varieties exported. This effect could be particularly strong in poor countries, where lack of access to information, technology, managerial capacity, and finance can impede the ability of firms to adapt production processes quickly and adequately to meet product standards in rich country markets, or to obtain testing and certification services required to demonstrate conformity.

It has been suggested in the literature (Collier and Venables, 2007) that trade preferences might be one way of promoting export diversification in developing countries, i.e. an expansion in the range of product varieties exported. But such schemes focus almost exclusively on tariffs, and neglect the costs imposed by non-tariff measures (including product standards), not to mention the important role played by supply side constraints (see Hoekman, 2007, for a review). The costs imposed by NTMs are significant, however: Kee et al. (2006) estimate that they add 70% to the level of restrictiveness imposed by tariffs alone. Complementary policies to address these costs would therefore be an important part of any renewed focus on preferences as a possible means of promoting an increase in developing country export variety.

One complementary policy that deserves further attention is international harmonization of product standards. This paper provides empirical support for two important propositions: the negative impact of standards on foreign exporters is stronger for exporting countries with lower levels of per capita income; and those negative impacts can be attenuated through adoption by importing countries of internationally harmonized standards. The main novelty of this paper is its focus on the extensive margin of trade. Intuitively, harmonization of standards can affect the extensive margin through at least two channels. On the one hand, allowing access to multiple markets upon compliance with a single standard and payment of just one cost is suggestive of a scale effect that would tend to impact positively on the extensive margin. However, harmonization in practice often

results in adoption of a more costly standard in at least one of the harmonizing countries. This cost effect tends to work in the opposite direction, but will usually be dominated by the scale effect provided that the costs involved in "harmonizing up" are not too great. This paper formalizes these insights using a heterogeneous firms model of trade.

I find consistent support for a link between harmonization and the extensive margin using a new World Bank database of EU product standards in the textiles, clothing, and footwear sectors (Shepherd, 2006; Czubala et al., 2007). These standards are issued by the European Normalization Committee (CEN). Although compliance by firms is voluntary as a matter of law (as is the case for the standards considered by Swann et al., 1996, and Moenius, 2004), there is potential for these standards to have significant economic impacts: as at the end of 2006, CEN had issued 12,357 standards and approved documents and had another 3,510 in preparation. Results in this paper should therefore be seen as complementing previous work (see below) that focuses on EC Harmonization Directives.

EU standards data are related to export variety of partner countries using measures built up from highly detailed, 8-digit mirror data. Results show that the total number of standards in a given sector is generally negatively associated with the range of varieties exported by partner countries, but that the effect varies significantly with the exporting country's income level. For an average low income country (2003 GDP per capita = $352 in constant 2000 $US) the elasticity is -0.6, whereas for an average high income country (2003 GDP per capita = $26,410) the elasticity is 0.09. The exporting country's income level appears to be a crucial determinant of its firms' ability to adapt to foreign product standards, which is consistent with the existence of impediments to investment and technology upgrading in poor countries. This result is in line with the findings of Disdier et al. (2008) for the intensive margin: product standards in agriculture tend to impact negatively on exports from developing countries to the OECD, but have little discernible impact on trade within the OECD.

In addition, I find that the degree of international harmonization of EU standards–proxied by the proportion that are identical or equivalent to ISO standards–is generally positively associated with

partner country export variety, but that the effect again depends on the exporting country's income level. For an average low income country, a one percentage point increase in the proportion of harmonized standards is associated with an increase in export variety of 0.8%. For an average high income country, by contrast, the impact is a decrease in export variety of -0.7%. These results would be consistent with the dominance of the information transfer mechanism discussed by Moenius (2004) in the case of rich countries, but the dominance of the mechanisms discussed in this paper for many developing countries.

These results make two main contributions to the literature. First, they expand the scope of recent empirical work on trade growth at the extensive margin by examining the effects of standards and harmonization. Although the need to adapt products and production processes to meet foreign standards is often used as a motivation for including fixed market entry costs in models of international trade, this appears to be the first paper to make an empirical link between standards harmonization and extensive margin growth. Hummels and Klenow (2005) show that bigger, richer countries tend to export a wider range of products, as do those which face lower international transport costs. The positive extensive margin impacts of tariff liberalization and preferences are examined by Kehoe and Ruhl (2003), and Feenstra and Kee (2007).

This paper also expands the existing literature on the trade impacts of product standards both through a focus on extensive margin growth, and by an explicit examination of the partner country impacts of international harmonization. In an important early contribution on which this paper builds, Moenius (2004) uses a gravity model to show that bilaterally shared standards–and in some cases specific national standards–can promote trade. However, his results do not differentiate between standards which are internationally (not just bilaterally) harmonized and those which are not. Swann et al. (1996) do make such a distinction, finding evidence that UK national standards are associated with higher levels of both exports and imports, but that the corresponding effects are much weaker in the case of internationally harmonized standards. Their results are difficult to interpret, however, since their empirical model is not supported by a detailed theoretical framework.

Two recent empirical papers have carefully examined the third-country impacts of harmonization,

focusing on the intensive margin of trade. Chen and Mattoo (2008) use a sample selection gravity model to examine the impacts of EU Harmonization Directives and Mutual Recognition Agreements on intra- and extra-European trade. Baller (2007) adopts the same approach using data on both EU and ASEAN harmonization and mutual recognition agreements. Empirical results generally suggest that harmonization boosts trade among harmonizing countries, as well as imports from third countries. In particular, they suggest that some international standards agreements can increase the probability that the parties trade with each other, but can decrease that probability of trade with non-parties. The present paper builds on and extends these results by focusing on product variety, which is not the primary object of analysis in either of these two previous papers, and looking at CEN European standards rather than EC Harmonization Directives.[2]

The plan of the paper is as follows. The next section provides some theoretical motivation for the empirical hypotheses to be tested later on, using a heterogeneous firms model of trade. I provide an explicit definition of harmonization within this framework, and analyze its impacts on export product variety in harmonizing countries ("insiders") and non-harmonizing countries ("outsiders"). Section 3 describes the dataset, a new World Bank database of EU product standards, as well as measures of export variety covering up to 200 countries for the period 1995-2003. The empirical model is presented in section 4, along with estimation results, and robustness checks. Section 5 concludes, and offers some suggestions for further research in this area.

2 Theoretical Motivation

This section develops a simple theoretical framework that helps identify the expected effects of harmonization on insider and outsider countries, focusing exclusively on the extensive or "new products" margin of trade.[3] To do this, I use a slightly modified version of the Chaney (2008)

[2]Under the EU's "New Approach" to harmonization, EC Directives are accompanied by CEN standards. However, the approach taken by Chen and Mattoo (2008) and Baller (2007) relies on an indicator of the presence or absence of a Directive, and does not directly measure the density of CEN standards that accompany them. In any case, the sectors considered in the present paper are not subject to any EC Harmonization Directives.

[3]The model presented here could easily be adapted to show that another likely consequence of harmonization is to increase the "new markets" margin of imports in the harmonizing countries. However, the data used in the empirical

heterogeneous firms model.[4] There are two main reasons why firm heterogeneity is potentially important in this setting. First, it provides a rich framework for examining the trade impacts of fixed cost variables, such as product standards, and the way in which they can effect firm entry and exit decisions. Second, there is now a wealth of case study evidence suggesting that firms in the developing world respond to stricter foreign standards in very different ways. The discussion in World Bank (2005) and Diaz Rios and Jaffee (2008) is suggestive of a mechanism by which relatively low productivity firms contract, or even exit the market, as a result of more costly standards, whereas high productivity firms continue producing. There is also evidence of sector-wide technological progress over time in some countries following adoption of stricter standards abroad. Both dynamics are consistent with the intra-sectoral reallocation effects that lie at the core of models like Chaney (2008) and Melitz (2003).

The model considered here has three regions, and I compare two states. In the baseline state, all regions have different standards in place. Firms must pay one fixed cost per region in which they sell, which induces productivity-based sorting into markets. For each region dyad, there is a cutoff that determines the minimum level of productivity a firm must have in order to profitably ship from the producing market to the consuming market. Because the model assumes a fixed mass of potential entrants, this cutoff varies 1:1 with the mass of active firms and product varieties. As the cutoff moves downwards, and less productive firms enter the market, trade expands at the extensive margin. It is thus sufficient to analyze the effect of harmonization on the productivity cutoff in order to deduce its impact on trade growth at the new products margin.

In the harmonized state, one region adopts the standard prevailing in a second region. I show that the impact of harmonization on the productivity cutoffs depends on the interactions between a scale effect, a cost effect, and a remoteness effect. The scale effect impacts all productivity

part of this paper are ill-suited to investing that hypothesis because they only cover a very small number of sectors when aggregated over all countries, thus giving an insufficient number of data points for a rigorous empirical analysis. Preliminary results using this small sample (available on request) suggest that harmonization does indeed tend to increase the "new markets" margin of imports, but a detailed analysis must be left for future research.

[4]For a detailed discussion of the setup, solution, and equilibrium properties of this class of models, see Chaney (2008).

cutoffs negatively, reflecting the fact that harmonization effectively creates a single internal market comprising the two harmonizing regions. The cost effect always impacts the productivity cutoffs of the harmonizing regions ("insiders") negatively, since harmonization eliminates the differential that usually exists between the cost of accessing a market as a domestic producer and the cost of accessing it as a foreign exporter. However, the cost effect's impact on non-harmonizing countries ("outsiders") is strictly non-negative, since their firms must still pay at least one fixed cost in order to access both harmonized markets, in addition to the cost they need to pay to produce in their own domestic market. Finally, the remoteness effect, much like the multilateral resistance terms in Anderson and Van Wincoop (2003) picks up the fact that it is relative trade barriers that matter. In the small country case, this effect can be ignored. In the large country case, however, the remoteness effect impacts positively on the insiders' productivity cutoffs, because harmonization reduces their average level of trade barriers vis-à-vis all countries. The effect on the outsider's productivity cutoff is ambiguous, but will also be positive under plausible assumptions.

Assuming that the remoteness effect is not too strong, the model suggests that harmonization will always be associated with extensive margin trade growth for the insider regions. Under the same assumption, the outsider region will only experience extensive margin trade growth if the market size effect outweighs the cost effect. Thus, harmonization is beneficial for outsiders at the extensive margin provided that the harmonized standard is not too much more costly to comply with than the pre-existing national standards.

The theoretical framework set out in this section extends and complements existing work in two main ways. First, I gain considerable tractability in a three country setting, as well as sharper analytical results, by adopting a Chaney (2008) model. Baller (2007) and Felbermayr and Jung (2008) both use variations on the Melitz (2003) theme to analyze the trade effects of product standards. Second, I focus explicitly on the extensive margin effects of product standards and harmonization, and can derive analytical results for both. Felbermayr and Jung (2008), by contrast, focus on the productivity effects of mutual recognition and what they refer to as "deregulation", rather than harmonization as such. Given the prevalence of harmonization efforts, and in particular the importance

of unilateral adoption of foreign or international standards in the developing world, it is useful to complement Felbermayr and Jung (2008) with a more focused treatment of harmonization.

2.1 Model Setup

The world consists of three regions, Home (H), Foreign (F), and Rest of the World (R). One sector produces a single homogeneous good, while a second sector produces a continuum of differentiated goods. Utility is given by:

$$U = q_0^{\mu} \left(\int_{\Omega} q(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{(1-\mu)\frac{\sigma}{\sigma-1}} \tag{1}$$

where q_0 is the quantity consumed of the homogeneous good, $q(\omega)$ is consumption of each differentiated product variety $\omega \in \Omega$, μ and $(1-\mu)$ are the respective consumption weights of the two sectors, and σ is the elasticity of substitution among varieties within the differentiated goods sector.

Production in the homogeneous sector is subject to constant returns to scale, with one unit of labor input in region $i \in \{F,R\}$ producing $\bar{w}$ units of output, while one unit of labor in region H produces $\underline{w}$ units of output. I assume that H is a low productivity (developing) region, while F and R are high productivity (developed) regions. Thus, $\bar{w} > \underline{w}$. The price of the homogeneous good is normalized to unity and trade is costless, which means that the wage in H is $\underline{w}$ and in F and R it is $\bar{w}$.

In the differentiated goods sector, the cost c of producing q units in region i and selling them in region j is:

$$c_{ij}(q) = \frac{w_i}{\varphi} q + f_{ij} \tag{2}$$

where f_{ij} is the fixed cost of accessing the market in region j for firms in region i. I conceptualize f_{ij} as the design and retooling costs a firm in i must pay in order to satisfy product standards in j and thereby gain access to its market.[5] For expositional clarity, and in line with this paper's focus

[5] I treat product standards as exogenously imposed, and do not consider any role they might play on the consumption side (Ganslandt and Markusen, 2001) or any strategic interactions that may arise between regions (Gandal and Shy, 2001).

on the extensive margin, there are no variable (iceberg) trade costs. Firms are heterogeneous in productivity φ, which is drawn from a Pareto distribution with support $[1,+\infty)$, shape parameter $\gamma > \sigma - 1$, and CDF $G(\varphi) = P(\widetilde{\varphi} < \varphi) = 1 - \varphi^{-\gamma}$.

Labor is the only factor of production, and each region is endowed with L_i units. The model does not assume free entry as in Baller's (2007) two country model, but keeps the mass of potential entrants in each region fixed and proportional to $w_i L_i$. Total expenditure in each region Y_i is thus the sum of labor income $w_i L_i$ and redistributed profits $w_i L_i \pi$, where π is the dividend per share of a global mutual fund owned by labor (w_i shares per worker). Under standard assumptions, firm exports from region i to region j are equal to:

$$x_{ij}(\varphi) = (1-\mu) Y_j \left(\frac{p_{ij}(\varphi)}{P_j} \right)^{1-\sigma} \tag{3}$$

where $p_{ij}(\varphi) = \left(\frac{\sigma}{\sigma-1}\right)\left(\frac{w_i \tau_{ij}}{\varphi}\right)$ is the firm's optimal price, and P_j is the CES price index for region j. Net firm profits from producing in region i and selling in region j are:

$$\pi_{ij}(\varphi) = \left[p_{ij}(\varphi) - c_{ij}(\varphi)\right] q_{ij}(\varphi) - f_{ij} \tag{4}$$

2.2 Baseline Equilibrium

Chaney (2008) describes in full the solution of the above model, and its equilibrium properties. For present purposes, the most important result is that firms self-select into markets based on productivity. In equilibrium, zero profit conditions of the type $\pi_{ij}\left(\bar{\varphi}_{ij}\right) = 0$ implicitly define a productivity

cutoff condition of the following form for each market dyad:

$$\bar{\varphi}_{ij} = \lambda_4 \left(\frac{Y}{Y_j}\right)^{\frac{1}{\gamma}} \left(\frac{w_i}{\theta_j}\right) f_{ij}^{\frac{1}{\sigma-1}} \tag{5}$$

$$\lambda_4 = \left[\frac{\sigma}{\mu}\left(\frac{\gamma}{\gamma-(\sigma-1)}\right)\left(\frac{1}{1+\lambda_5}\right)\right]^{\frac{1}{\gamma}} \tag{6}$$

$$\lambda_5 = \frac{\left(\frac{\sigma-1}{\gamma}\right)\frac{(1-\mu)}{\sigma}}{1-\left(\frac{\sigma-1}{\gamma}\right)\frac{(1-\mu)}{\sigma}} \tag{7}$$

$$\theta_j^{-\gamma} = \sum_{k\in\{H,F,R\}} \frac{Y_k}{Y}(w_k)^{-\gamma} f_{kj}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]} \tag{8}$$

The equilibrium cutoff $\bar{\varphi}_{ij}$ represents the minimum level of firm productivity consistent with profitably exporting from i to j. Firms with $\varphi \leq \bar{\varphi}_{ij}$ become exporters, while those with $\varphi > \bar{\varphi}_{ij}$ do not. To be consistent with the observation that firms generally enter their domestic market first, and that only some domestic producers also export, I impose $f_{kk} < f_{lm}, \forall\{k,l \neq m\}$. One motivation for this condition is that foreign exporters need to obtain costly information on the nature of the importing country's standard before they can comply with it, meaning that there is always a differential between the compliance costs faced by domestic firms, and those faced by overseas competitors. As is clear from the form of the cutoff condition, stricter or more numerous standards in the importing country–i.e., an increase in the fixed cost of compliance–mean that relatively low productivity exporters are pushed out of the market, while high productivity firms can continue exporting ($\frac{d\bar{\varphi}_{ij}}{df_{ij}} > 0$, ignoring indirect effects).

The θ_j term can be interpreted as an index of region j's remoteness, similar to the inward multilateral resistance term of Anderson and Van Wincoop (2003). Intuitively, the more remote a region is from the world as a whole, the lower the productivity barrier that a potential exporter must break through for a given level of bilateral trade costs ($\frac{d\bar{\varphi}_{ij}}{d\theta_j} < 1$). This result simply reflects the fact that it is relative costs, and thus relative trade barriers, that matter.

2.3 Harmonization Equilibrium

Harmonization takes the form of the adoption by F of R's standard. Following harmonization, firms in F and R can access both regions upon compliance with the new harmonized standard, and payment of the fixed cost f_{RR}. Firms in H can now access F and R upon compliance with R's standard only, and thus payment of a single fixed cost, f_{HR}. Intuitively, it is obvious that the impact of harmonization depends on at least two forces that can act in different directions. On the one hand, accessing a larger market upon payment of a single fixed cost is suggestive of a scale effect that should make it easier to enter the export market, and thus increase trade at the extensive margin. However, the relative levels of fixed costs in F and R prior to harmonization also play a vital role in determining the outcome: the scale effect could be potentially undone if harmonization results, in effect, in the adoption by F of a much more costly standard.

It is straightforward to derive the equilibrium conditions under harmonization from equations (5) through (8) above. For the harmonizing regions F and R, the new productivity cutoffs are:

$$\bar{\varphi}'_{FF} = \bar{\varphi}'_{RR} = \bar{\varphi}'_{FR} = \bar{\varphi}'_{RF} = \lambda_4 \left(\frac{Y}{Y_F + Y_R} \right)^{\frac{1}{\gamma}} \left(\frac{\bar{w}}{\theta'_R} \right) f_{RR}^{\frac{1}{\sigma-1}} \tag{9}$$

$$\left(\theta'_R\right)^{-\gamma} = \left(\theta'_F\right)^{-\gamma} = \frac{Y_F + Y_R}{Y} \bar{w}^{-\gamma} f_{RR}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]} + \frac{Y_H}{Y} \underline{w}^{-\gamma} f_{HR}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]} \tag{10}$$

which reflects the fact that firms in either region can now access both regions upon payment of f_{RR} and without any additional costs. Similarly, the excluded region H's cutoffs for exports to the harmonizing regions are:

$$\bar{\varphi}'_{HF} = \bar{\varphi}'_{HR} = \lambda_4 \left(\frac{Y}{Y_F + Y_R} \right)^{\frac{1}{\gamma}} \left(\frac{\underline{w}}{\theta'_F} \right) f_{HR}^{\frac{1}{\sigma-1}} \tag{11}$$

with θ'_F defined as above. Thus, firms in H can access the combined F and R market upon payment of f_{HR}.

To identify the impact of harmonization on insiders and outsiders, I compare the export productivity cutoffs from F to R and from H to F prior to and following harmonization. The first comparison demonstrates the impact of harmonization on the harmonizing regions (insiders), while the second takes account of spillover effects to non-harmonizing regions (outsiders). Proceeding in this way makes it possible to identify three effects that act in different directions depending on the initial level of fixed costs, and the way in which harmonization is implemented. I refer to these as the scale effect, the cost effect, and the remoteness effect.

From above:

$$\frac{\bar{\varphi}'_{FR}}{\bar{\varphi}_{FR}} = \left(\frac{Y_R}{Y_F+Y_R}\right)^{\frac{1}{\gamma}} \times \left(\frac{f_{RR}}{f_{FR}}\right)^{\frac{1}{\sigma-1}} \times \left(\frac{\theta_R}{\theta'_R}\right) \tag{12}$$

$$\frac{\bar{\varphi}'_{HF}}{\bar{\varphi}_{HF}} = \underbrace{\left(\frac{Y_F}{Y_F+Y_R}\right)^{\frac{1}{\gamma}}}_{Scale\,Effect} \times \underbrace{\left(\frac{f_{HR}}{f_{HF}}\right)^{\frac{1}{\sigma-1}}}_{Cost\,Effect} \times \underbrace{\left(\frac{\theta_F}{\theta'_F}\right)}_{Remoteness\,Effect} \tag{13}$$

In both cases, it is obvious that the scale effect must always lie between zero and unity, regardless of the initial values of the fixed cost parameters or the way in which harmonization is implemented. Since the comparison is in terms of productivity cutoffs, this means that the scale effect tends to produce a lower productivity cutoff in all countries following harmonization. This result makes obvious intuitive sense: harmonization effectively expands the market available to firms in all regions.

For the insiders F and R, the cost effect acts in the same direction as the scale effect: it must lie between zero and unity since $f_{RR} < f_{FR}$ by assumption. Intuitively, this result reflects an effective cost reduction for producers in F: instead of having to treat R as a foreign market, and thus pay a relatively high entry cost, they can now effectively treat it as a domestic market.

The cost effect for the outsider H, on the other hand, depends on initial conditions. One possibility is that F and R initially have different but equally burdensome (costly) standards, i.e. $f_{HR} = f_{HF}$. I refer to this scenario as "harmonization across", since it represents a horizontal move to an equally restrictive standard, rather than a vertical move to a more or less restrictive one. In this case, the

cost effect simply cancels out, because the cost of accessing R or F does not change for H.

A more interesting case is "harmonization up": F's standard is initially less burdensome (costly) than R's, so harmonization implies an increase in restrictiveness. In this scenario, $f_{HR} > f_{HF}$. As a result, the cost effect is greater than unity: harmonization brings about an increase in the cost for firms in H of accessing the market in F, and so the minimum productivity cutoff moves up.

In the absence of indirect effects via the remoteness terms,[6] harmonization always results in a lower productivity cutoff for insiders. The effect on outsiders, however, is ambiguous: the stronger the scale effect (i.e., the larger the combined market of F and R) and the weaker the cost effect (i.e., the smaller the cost increase when F harmonizes up to R's standard), the more likely it is that the overall effect will be to lower the productivity cutoff for outsiders too.

Analysis of the indirect impacts of harmonization through the remoteness terms makes the situation somewhat more complex. For the case of trade between the insiders F and R, the remoteness effect can be written as:

$$\frac{\theta_R}{\theta_R'} = \left[\frac{\frac{Y_H}{Y}\underline{w}^{-\gamma} f_{HR}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]} + \frac{Y_F}{Y}\overline{w}^{-\gamma} f_{FR}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]} + \frac{Y_R}{Y}\overline{w}^{-\gamma} f_{RR}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]}}{\frac{Y_H}{Y}\underline{w}^{-\gamma} f_{HR}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]} + \frac{Y_F}{Y}\overline{w}^{-\gamma} f_{RR}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]} + \frac{Y_R}{Y}\overline{w}^{-\gamma} f_{RR}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]}} \right]^{-\frac{1}{\gamma}} \tag{14}$$

The remoteness effect tends to increase the productivity cutoff if harmonization leads to an overall decrease in remoteness, i.e. if $\theta_R > \theta_R'$. In fact, this will always be the case for the two insiders because $f_{RR} < f_{FR}$ by assumption, which means that $f_{RR}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]} > f_{FR}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]}$. It follows that the denominator of the expression in brackets must be greater than the numerator, and thus $\frac{\theta_R}{\theta_R'} > 1$. Intuitively, harmonization between large regions decreases the weighted average level of their trade barriers with respect to all potential exporters. By bringing them, in effect, closer to the world as a whole, harmonization makes it more difficult for firms in F to export to R for a given level of absolute bilateral costs due to the change this brings about in the level of relative trade costs.

[6] More formally, the remoteness effect can be ignored in a more general model with a large number of countries and H, F, and R all small, since $\frac{\theta_R}{\theta_R'} \approx 1$ and $\frac{\theta_F}{\theta_F'} \approx 1$.

For the outsider H, the corresponding effect is:

$$\frac{\theta_F}{\theta_F'} = \left[\frac{\frac{Y_H}{Y}\underline{w}^{-\gamma} f_{HF}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]} + \frac{Y_F}{Y}\overline{w}^{-\gamma} f_{FF}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]} + \frac{Y_R}{Y}\overline{w}^{-\gamma} f_{RF}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]}}{\frac{Y_H}{Y}\underline{w}^{-\gamma} f_{HF}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]} + \frac{Y_F}{Y}\overline{w}^{-\gamma} f_{RR}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]} + \frac{Y_R}{Y}\overline{w}^{-\gamma} f_{RR}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]}} \right]^{-\frac{1}{\gamma}} \tag{15}$$

which varies in terms of its substantive effect according to whether the situation is one of harmonization across or harmonization up. In the former case, $f_{FF} = f_{RR}$ and $f_{RF} > f_{RR}$ by assumption. Thus the denominator of the expression in parentheses is greater than the numerator, as above, and it must be the case that $\frac{\theta_F}{\theta_F'} > 1$. So in the harmonization across case, the remoteness effect tends to raise the productivity cutoff. Again, the intuition is that harmonization decreases the overall level of trade barriers affecting imports into F, and thus for a given level of fixed costs between H and F, it becomes relatively more difficult for H's exporters to access F's market.

In the case of harmonization up, the impact of the remoteness effect on the outsider H is ambiguous because $f_{RR}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]} < f_{FF}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]}$ but $f_{RR}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]} > f_{RF}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]}$. For the symmetric case $Y_R = Y_F$, the impact of the remoteness effect depends on the relative differences between f_{RR} and f_{FF} versus f_{RR} and f_{RF}. For a sufficiently small initial difference in domestic market entry costs between F and R, and a sufficiently large initial difference in the cost of domestic entry in R versus the cost of exporting from R to F, the condition $\frac{\theta_F}{\theta_F'} > 1$ holds, and the remoteness effect tends to raise the productivity cutoff.

More generally, though, the impact of the remoteness effect for H must be regarded as ambiguous. The cost differences discussed in the symmetric case still operate even when the regions are asymmetric, but the difference between Y_R and Y_F is also now crucial. From the form of the cutoff conditions, it is clear, however, that for a given level of cost differences, Y_R sufficiently large relative to Y_F ensures that the $f_{RR}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]} > f_{RF}^{-\left[\frac{\gamma}{(\sigma-1)-1}\right]}$ inequality dominates and that the remoteness effect tends to raise the productivity cutoff. For this paper, the $Y_R >> Y_F$ context is particularly relevant, because it is international harmonization–i.e., adoption by one country of a standard prevailing internationally–that is examined empirically.

2.4 Consolidation

This section has presented a simple theoretical framework for analyzing the impacts of product standards and harmonization on the extensive margin of trade. The model shows that the impact of harmonization on the extensive margin of trade depends on the interactions between three different effects: a scale effect, since harmonization creates a larger internal market between the harmonizing regions; a cost effect, since the harmonized standard can in some cases be more burdensome than the initial unharmonized standards; and a remoteness effect, which takes account of relative price effects.

The model highlights the fundamental distinction between insiders–the harmonizing regions–and outsiders. Abstracting from indirect (remoteness) effects, harmonization is always beneficial at the extensive margin for the insiders. However, its impact is ambiguous for outsiders, and depends on the relative strength of the market size and cost effects. (See Table 1 for a recapitulation.)

3 Data and Stylized Facts

The remainder of the paper conducts empirical tests of some important predictions from the model in section 2. As a preliminary, this section presents two new data sources that will be used in that work: the World Bank's EU Standards Database, and measures of export variety covering up to 200 countries based on highly-detailed, 8-digit mirror (import) data from Eurostat.

3.1 The EU Standards Database

Measuring the extent of standardization in EU product markets is not an easy business.[7] Each member state sets both voluntary and mandatory standards on a national level, while centralized EU bodies also have the power to set standards with transnational application. Swann et al. (1996) and Moenius (2004) examine the trade impacts of voluntary national standards, while Chen and Mattoo

[7] For a general review of these mechanisms, see EC (2000).

(2008) and Baller (2007) focus on EC Directives. Only Czubala et al. (2007) look directly at the role played by transnational voluntary standards, such as those issued by the European Committee for Standardization (CEN).

CEN is a transnational association established in 1961 by national standards bodies from across Europe. Its standards must be adopted by all EU countries, and override any conflicting or inconsistent national standards. However, compliance with these standards is voluntary for firms. In addition to its work complementing EU Harmonization Directives, CEN is also active in independently developing standards in consultation with industry and national bodies. As noted above, CEN's output to date is substantial: 12,357 standards and approved documents, with 3,510 more in preparation. By contrast, the European Commission has issued less than two dozen Harmonization Directives under its "New Approach". (See Pelkmans, 1987, for a review of the New Approach.) While some CEN standards effectively provide for detailed implementation of EC Directives, many of them–including the ones that I analyze here–are in sectors not covered by a Directive.

The World Bank's EU Standards Database (EUSDB) provides the first catalogue of CEN European standards in the agriculture, textiles, clothing, and footwear sectors, with mapping to a standard trade classification (HS 2000). This paper focuses exclusively on the three manufactured goods sectors.[8] From a development point of view, these sectors are particularly important since they are associated with the early stages of industrialization in many countries.

For a full overview of EUSDB's methodology, see Shepherd (2006) and Czubala et al. (2007). The general approach is similar to that of Swann et al. (1996) and Moenius (2000, 2004), although those authors both consider national standards in EU member states rather than CEN's EU-wide standards.[9] The primary information source for EUSDB is Perinorm (www.perinorm.com), a bibliographic database maintained jointly by the British, French, and German national standards bodies.

[8] I exclude agriculture because the measure of international harmonization recorded by EUSDB (equivalence with an ISO standard) is arguably less relevant to that sector. Standards promulgated by organizations such as the Codex Alimentarius are likely to be of greater importance.

[9] An alternative approach is taken in recent papers by Fontagné et al. (2005) and Disdier et al. (2008). They use TRAINS data and country notifications to build databases of mandatory national standards. This is a promising approach, but one which currently suffers from the inconsistent reporting behavior of national authorities.

It contains over 1.1 million records from 22 (mostly OECD) countries. Each record corresponds to a single national, regional, or international standard. For each standard, EUSDB contains data including the dates of entry into force and withdrawal, and a 1-0 dummy variable indicating whether or not it is identical or equivalent to an ISO standard. This variable is used as a proxy for de facto international harmonization. All information is cross-checked against CEN's own on-line standards catalogue, before being manually mapped to the Harmonized System product classification (http://www.cen.eu/catweb/cwsen.htm).

For each 2- and 4-digit HS code, EUSDB provides a count of the number of CEN standards in force in a given year over the sample period (1995-2003).[10] It also counts the number of those standards that are treated as internationally harmonized using the above definition. Simple counts are used as proxies for the standards burden because Perinorm does not provide information on which to base an assessment of the relative restrictiveness of individual standards. Constructing such measures would require highly specialized technical and commercial information that is not currently available, and in any event would pose substantial problems of comparability across countries and sectors. Counts are therefore used as the best available proxy at the current time.

Table 2 presents basic descriptive statistics, which disclose a number of notable features (see Shepherd, 2006; and Czubala et al., 2007, for a complete discussion). All three sectors have undergone rapid growth in terms of the total number of standards in force. However, the bulk of standards remain concentrated in the textiles sector (84%). Although the proportion of internationally harmonized standards has generally risen, the pattern across sectors is by no means uniform.

3.2 Measuring Export Variety

To examine the impact of standards and international harmonization on the extensive margin of trade, I construct new measures of export variety covering up to 200 countries. I follow the recent

[10] Counts include standards that entered into force prior to 1995 provided they were still in force at some point during the sample period. A standard is considered to be in force for a given year if it came into force before or during that year. If it is withdrawn at some point during the year, it is still assumed to be in force for the entire year. Amendments to existing standards are counted as additional standards.

empirical literature on product variety in trade (e.g., Hummels and Klenow, 2005; and Broda and Weinstein, 2006), in building on the theory-consistent measure of variety developed by Feenstra (1994). I use the version of his measure set out by Feenstra and Kee (2008):

$$\Lambda_{xst} = \frac{\sum_{l \in V_{s,t}^{x}} \overline{p_l^w q_l^w}}{\sum_{l \in V_s^w} \overline{p_l^w q_l^w}} \tag{16}$$

The denominator is the total value of world exports in a particular sector, summing across all product varieties within that sector. Thus, V_s^w is the full set of varieties exported in sector s, taking account of all exporting countries and all time periods. Average world trade values by product variety across all years ($\overline{p_l^w q_l^w}$) are used to create the sum. While the denominator is invariant by exporter and time, the numerator is not. It consists of the sum of world average trade values in product varieties shipped by exporter x at time t. The use of world average trade values ensures that variation in the numerator–and in Λ_{xst} itself–is due only to changes in x's variety set. This measure therefore has the important advantage of allowing consistent comparisons of product variety to be made across years and countries.

To implement this approach empirically, I use 8-digit import data from the European Union for the years 1995-2003.[11] In line with availability of standards data, I calculate Λ for three sectors: textiles (HS chapters 50-60), clothing (chapters 61-63), and footwear (chapter 64). Prior to calculation, I exclude from the dataset all observations relating to internal trade amongst EU-15 members, as well as product codes without verbal description which correspond to residual categories covering confidential or otherwise unclassified flows. For the world average trade value $\overline{p_l^w q_l^w}$, I take the average over the sample period of import values for the EU-15 (treated as a single entity).

The median variety measure in the clothing and footwear sectors ($\Lambda_{med} = 0.2$ to 0.3) is noticeably higher than in textiles ($\Lambda_{med} \leq 0.1$). However, the range in each case is very wide, running from zero to 0.8 or 0.9. The fact that the median is so low within this range suggests that most countries

[11] These data are freely available through the Eurostat website (http://fd.comext.eurostat.cec.eu.int/xtweb/).

export a relatively modest range of varieties in these three sectors, but that a few countries export a very wide range.

In terms of the rank ordering of countries by variety, results are broadly sensible: China, Turkey, India, and a number of countries in Central and Eastern Europe appear at the top of the list for clothing and footwear, while highly industrialized countries like Switzerland and the United States arrive in the lead for the more capital intensive textiles sector. The presence of the United States and Switzerland amongst the leading countries in clothing and footwear suggests that the trade data from Eurostat may be picking up some amount of re-exports or processing trade. This is not problematic for the paper's results, however, since they are robust to the inclusion or exclusion of developed countries in the estimation sample (results available on request).

3.3 Standards, Harmonization, and Extensive Margin Growth: Preliminary Evidence

Before moving to a formal empirical model in the next section, it is useful to first investigate the data graphically. I use EUSDB to calculate the total number of EU standards ($stds_{st}$) and the proportion of internationally harmonized EU standards ($\frac{iso_{st}}{stds_{st}}$) for each sector-year. The first of these variables is a proxy for the overall cost burden imposed by EU standards: the more standards a firm must comply with it, the more costly compliance is assumed to be. The second variable is a proxy for the degree to which EU standards are harmonized with international norms, namely the proportion of them that are equivalent or identical to an ISO standard. Figure 2 uses non-parametric Lowess regressions to provide some preliminary evidence as to the relationships between standardization, harmonization, and partner country export variety measured as Λ_{xst}.[12] As expected, the total number of standards is generally associated with a decline in partner country export variety, while the reverse is true for the proportion of internationally harmonized EU standards. Of course,

[12] To obtain the graphs, I average export variety across all partner countries for each sector-year. I then run a multivariate version of the Lowess smoother (Royston and Cox, 2005). The dependent variable is $\overline{\Lambda}_{xst}$, and the independent variables are $stds_{st}$ and $\frac{iso_{st}}{stds_{st}}$.

there are many potential confounding factors that this preliminary analysis does not account for, and averaging these effects across exporters results in a considerable loss of information.

4 Empirical Model and Estimation Results

In the remainder of the paper, I conduct empirical tests of the following three propositions:

1. The total number of EU standards, as a proxy for the overall costs of compliance facing foreign exporters, is negatively associated with the export variety of countries outside the EU;

2. The proportion of EU standards that are harmonized with ISO standards, as a proxy for the degree of international harmonization, is positively associated with the export variety of countries outside the EU; and

3. The elasticity of export variety with respect to the total number of EU standards is increasing in the exporting country's income level, and the partial elasticity of export variety with respect to the proportion of harmonized standards is decreasing in the exporting country's income level.

The first of these propositions follows directly from the form of the export cutoff condition in the model set out in section 2. The second follows from the analysis of harmonization's impacts on "outsiders" in section 2, assuming that remoteness effects can be ignored, and that the scale effect dominates the cost effect in the case of harmonization up. The third proposition is not directly addressed in the model, but reflects the possibility that the cost of meeting a given standard might be greater in developing than in developed countries. The model treats such costs as exogenous, but in practice they would be a function of the local availability of skilled technical labor, and design sector capital (computers, high technology machine tools, etc.). It is plausible that such costs might be relatively high in developing countries because of the scarcity of these factors. Indeed, in an

extreme case they might be totally absent, and would need to be imported–thus adding considerably to the costs of compliance, relative to a developed country benchmark. Firm level data collected by Maskus et al. (2005) suggest that compliance costs do in fact differ substantially across countries.

To test these hypotheses, I estimate two equations:

$$\ln(\Lambda_{xst}) = \beta_1 \ln(stds_{st}) + \beta_2 \frac{iso_{st}}{stds_{st}} + \beta_5 \ln\left(imp_{st}^{EU}\right) + \beta_6 atc2_{st} + \beta_7 atc3_{st} + \delta_{xs} + \delta_{xt} + \varepsilon_{xst} \quad (17)$$

$$\ln(\Lambda_{xst}) = \beta_1 \ln(stds_{st}) + \beta_2 \frac{iso_{st}}{stds_{st}} + \beta_3 \ln(stds_{st}) * \ln(gdppc_{xt}) + \beta_4 \frac{iso_{st}}{stds_{st}} * \ln(gdppc_{xt}) + ...$$
$$... + \beta_5 \ln\left(imp_{st}^{EU}\right) + \beta_6 atc2_{st} + \beta_7 atc3_{st} + \delta_{xs} + \delta_{xt} + \varepsilon_{xst} \quad (18)$$

Both equations are reduced forms suggested by the theoretical model developed in section 2.[13] The first equation expresses partner country export variety as a function of the total cost burden of EU standards, the degree of harmonization, and a number of additional controls. I use the total value of EU imports in each sector (imp_{st}) as a proxy for sectoral expenditures ($(1-\mu)Y_j$ in section 2). Two dummies ($atc2$ and $atc3$) are equal to unity for years 1998 onwards and 2002 onwards, in order to capture the effects of quota liberalization under phases two and three of ATC implementation.[14] The panel structure of the data makes it possible to control for a wide range of additional factors using fixed effects. Exporter-sector fixed effects take care of factors that are largely invariant over the time horizon considered here. Examples include comparative advantage in each of the three sectors, and long term connections with EU importers through contractual arrangements or FDI, as well as sector-specific technology parameters. Exporter-year fixed effects control for changes in the level of industrial or institutional development, country-specific macroeconomic or policy shocks, as well as technological change affecting all three sectors but specific to each exporting

[13] Structural estimation of the model is not feasible, as it would require detailed data on the distribution of firm productivity across a large number of countries. However, to the extent that parameters such as σ and γ vary by sector-year or country-sector, they are absorbed by fixed effects in equations (17) and (18).

[14] I assume that ATC quotas apply only to the textiles and clothing sectors as defined here, and not to footwear. This is basically consistent with the product list in the Annex to the ATC, which has extensive coverage in HS chapters 50-63, but lists only three 6-digit product lines in Chapter 64.

country (such changes being highly likely due to the interlinkages that exist among the sectors).

4.1 Baseline Estimation Results

Table 3 presents baseline estimation results using OLS.[15] In column 1, the total count of EU standards enters with a negative coefficient, and is statistically significant at the 1% level. By contrast, the proportion of standards that are internationally harmonized carries a positive coefficient that is statistically significant at the 10% level. In terms of magnitude, column 1 suggests that a 1% increase in the total number of standards is associated with a -0.4% decrease in partner country export variety, while a one percentage point increase in the proportion of internationally harmonized standards is associated with a 0.7% increase in export variety. Both results are in line with expectations based on the theoretical model developed in section 2. Similarly, the coefficient on total EU imports is also positive and statistically significant at the 1% level, and suggests a reasonable (0.6) elasticity of the extensive margin with respect to market size in the importing region.

Column 2 of Table 3 shows that inclusion of per capita income interaction terms captures an important dimension of the data. The coefficient on $stds_{st}$ remains negative and 1% significant, while its interaction term is positive and 1% significant. The impact of importer product standards on partner country export variety thus depends crucially on the development level of the exporting country: for an average low income country (2003 GDP per capita = $352) the elasticity is -0.6, whereas for an average high income country (2003 GDP per capita = $26,410) the elasticity is 0.09. So while standards have only a very weak, and possibly positive, impact on the export variety of developed countries, they have a strongly negative impact on the export variety of poor countries.

The opposite dynamic is apparent in the case of harmonization. Including the interaction terms in fact leads to stronger results in terms of statistical significance. In column 2, the coefficient on

[15] Export variety Λ_{xst} has 7 zero entries and 1108 missing entries, which should be treated as zero. All regressions use $\ln(\Lambda_{xst})$ as the dependent variable, but results only differ marginally if $\ln(0.001+\Lambda_{xst})$ is used instead. In part, this is due to other data being missing for countries with a substantial number of zero entries, which has the effect of restricting the sample. Also, results are robust to estimation using Tobit instead of OLS.

$\frac{iso_{st}}{stds_{st}}$ is positive and 5% significant, while the interaction term is negative and 5% significant. As for standards, the impact of harmonization on partner country export variety also depends crucially on the exporter's development level: for an average low income country, a one percentage point increase in the proportion of internationally harmonized standards is associated with an increase in export variety of 0.8%, while for an average high income country the impact is a decrease in export variety of 0.7%. The result for developing countries is consistent with the predictions made in section 2, but the negative impact on developed countries appears, on its face, more difficult to explain. In fact, the previous literature contains a number of similar results. Using a developed country sample Swann et al. (1996) find results that are generally consistent with a trade restricting impact of internationally harmonized standards relative to national standards. Moenius (2004) finds that in some sectors, bilaterally harmonized standards are trade restricting. Both papers suggest an explanation for these findings in terms of information effects: harmonized standards by their nature cannot inform foreign producers as to the state of demand or consumer preferences in the importing country. Although the data do not at this stage permit a definitive conclusion, it is possible that this mechanism tends to dominate other effects for developed countries that are relatively unconstrained in terms of the financial and technological requirements of adaptation to product standards, and which may export high quality products where information on consumer preferences is particularly important.

4.2 Robustness Checks

To ensure the robustness of the baseline results, I conduct additional checks in three dimensions: accounting for the potential endogeneity of product standards; controlling for additional confounding factors related to trade policy in textiles, clothing, and footwear; and comparing results across alternative country samples.

4.2.1 Endogeneity

Previous work has eluded to the possibility that product standards could be endogenous to trade, for instance through a political economy process. In an environment where tariffs are bound through the WTO system, local producers might use unduly costly standards as a means of "raising rivals' costs" (Fischer and Serra, 2000; Ganslandt and Markusen, 2001). There are suggestions in the literature that such an effect may be relevant empirically (Essaji, 2005; Kono, 2006), but the evidence presented at this stage is relatively weak. Intuitively, it seems less likely that such a dynamic exists in relation to partner country export variety than for total trade flows. Nonetheless, I re-estimate the baseline model with and without interaction terms using first and second lags of the standards variables, since they should be exogenous with respect to current export variety.

Columns 3-6 of Table 3 present results. Interestingly, the regressions with income per capita interaction terms perform much better than those without. In the model with first lags, the coefficients on $stds_{st}$, $\frac{iso_{st}}{stds_{st}}$, and the two interaction terms have the same signs as in the baseline regression, and are 1% significant. Since all coefficients increase markedly in absolute value terms, it can be said that using first lags leads to results that are stronger in terms of both statistical and economic significance. In the case of second lags, results remain consistent with the baseline, but are somewhat weaker. The coefficient on $stds_{st}$ is negative and its interaction term is positive, while the reverse is true for $\frac{iso_{st}}{stds_{st}}$. However, only the standards coefficients are statistically significant at conventional levels (1%).[16] For the models without interaction terms, no coefficients are statistically significant, and all but one carry unexpected signs.

Overall, the results using lagged standards terms are very similar to those obtained in the baseline model, at least in the case of the model with per capita income interactions. I interpret them as indicating that endogeneity is unlikely to be a major issue in this case. This result accords with the findings of Moenius (2004) using five year lags of standards, and of Chen and Mattoo (2008) using harmonization in similar sectors as an instrument for harmonization. In addition, the results with

[16]The coefficient on the $\frac{iso_{st}}{stds_{st}}$ interaction term is significant at the 20% level, prob. = 0.192.

lagged standards terms again highlight the importance of allowing for standards to have different effects according to the development level of the exporting country.

4.2.2 Accounting for the Impacts of Trade Policy

The baseline models already account in part for the potential impacts of EU trade policy by including dummies for the second and third phases of ATC liberalization, which occurred during the sample period. However, there are two additional dimensions that need to be explored. First, I include WITS-TRAINS data on applied bilateral tariffs.[17] Results in columns 1-2 of Table 4 are very close to the baseline, although there is a slight loss of statistical significance in some cases: $\frac{iso_{st}}{stds_{st}}$ is not significant in the model without interaction terms, and in the model with interactions both terms are 10% significant compared with 5% in the baseline. The coefficient on tariffs is not statistically significant in either regression, and only has the expected negative sign in column 1 (no interactions). This contrasts with other work on export variety, which tends to suggest that tariffs can have a significant negative impact (e.g., Feenstra and Kee, 2007). There are two likely reasons for the difference in this case. First, during the sample period the main trade distortions in the sectors under consideration here came from non-tariff barriers, particularly quotas. Second, TRAINS has only partial coverage of preferential tariff rates over the sample period analyzed here, which is potentially important given the role of regional agreements and development-related preferences in these sectors.

As an additional check, I exclude from the estimation sample those countries that were subject to quotas under the ATC regime (columns 3-4 of Table 4). The response of firms in those countries to changes in the number and type of EU standards would have potentially been constrained by these quotas, and this mechanism could conceivably impact results from the baseline models. However, estimation results suggest that this is in fact not a major problem in these data. Results in terms of sign are identical to the baseline, although the coefficients on $\frac{iso_{st}}{stds_{st}}$ and its interaction term

[17] These data are not included in the baseline model because they significantly restrain the estimation sample. This is due to lack of data availability.

change from 5% significance in the baseline to 10% significance in the model without ATC quota countries. Interestingly, all coefficients are slightly larger in absolute value than under the baseline, suggesting that the existence of quotas might indeed have acted to constrain somewhat the export variety response of some of the EU's trading partners.

4.2.3 Alternative Country Samples

It is also important to ensure that results are robust to the use of different country samples. In particular, this method can be used to exclude the influence that regional or preferential trade agreements might have on export variety, other than through channels such as tariffs. For instance, favorable rules of origin might be an additional factor influencing trade growth at the extensive margin in this sector (De Melo and Portugal Perez, 2009). I therefore rerun the baseline models excluding all countries that are party to a regional trade agreement with the EU,[18] and then all countries in the African Caribbean and Pacific group of countries.[19]

Results are in Table 4 columns 5-8. Excluding the EU's RTA partners (columns 5-6) makes very little difference to the results: the coefficients on standards, harmonization, and both sets of interaction terms carry the same signs, have similar magnitudes, and remain statistically significant at the 10% level or better. Exclusion of the ACP countries, on the other hand, causes the coefficients on standards and harmonization to become significant at the 15% and 20% levels respectively (probs. = 0.133 and 0.164), although their signs remain in line with expectations, and their magnitudes are similar to the baseline. However, exclusion of the ACP countries from the model with interaction terms results in a loss of statistical significance for all coefficients, even though they retain the expected signs. They are much smaller in absolute value than under the baseline. The likely reason for these results is that the ACP classification covers the vast majority of the poorer developing countries. As a result, the variance in per capita GDP for the sub-sample without the ACPs is much smaller than for the full sample. The unique variation in the interaction terms is correspondingly

[18] Data on regional agreements come from http://www.worldtradelaw.net/fta/ftadatabase/ftas.asp, supplemented by information from http://trade.ec.europa.eu/doclib/docs/2006/december/tradoc_111588.pdf.

[19] The list of ACP countries comes from http://ec.europa.eu/development/Geographical/RegionsCountries_en.cfm.

less, which makes it difficult to identify independent effects in levels and interactions. However, the results from the model without interaction terms suggest that the main insights from the baseline model continue to apply even when the ACP countries are excluded from the estimation sample.

5 Conclusions, Policy Implications, and Future Research

This paper has provided the first direct empirical evidence that while product standards overall impact negatively on partner country export variety, harmonization to international standards can act as an important mitigating factor. It has also shown that the strength of these effects depends crucially on the exporting country's development level. For an average low income country the elasticity of export variety with respect to the total number of EU standards is -0.6, whereas for an average high income country it is 0.09. The effect of a one percentage point increase in the proportion of EU standards that are harmonized with international standards is associated with an increase in export variety of 0.8% in an average low income country, but a decrease of -0.7% in an average high income country. These results have proved highly robust to the use of lagged standards data as a check against endogeneity bias, the inclusion of additional trade policy variables, and estimation using sub-samples excluding countries that were bound by quotas under the ATC, are parties to an RTA with the EU, as well as the ACP countries.

These are significant findings given the importance of the textiles, clothing, and footwear sectors to economies in the early stages of industrialization. Based on a heterogeneous firms framework, these results would tend to suggest that harmonization can be an effective way of promoting foreign market access for firms with lower productivity than incumbent exporters, since it induces a downwards shift in the export productivity cutoff. International harmonization could therefore be expected to encourage exports by small and medium enterprises in developing countries–a prediction that future work using firm level data could test. Importing countries looking to provide an impulsion to non-traditional exports from developing countries could perhaps use international standards harmonization as a complement to more generous tariff preferences and more open rules

of origin.

An alternative way of interpreting the results presented here is in terms of export diversification, an important policy issue for many developing countries. By equating variety growth and diversification, a case can be made that international standards harmonization could be one way in which the large, rich country import markets could help support export diversification in developing countries. These results therefore complement recent work on diversification, which has highlighted the importance of policies such as trade facilitation (Dennis and Shepherd, 2007).

The main obstacle to future empirical work in the area of product standards and their trade effects remains limited data availability. While the World Bank's EU Standards Database provides information on the textiles, clothing, and footwear sectors, there is clearly a need to expand on this both in terms of geographical and sectoral scope. Future work with an expanded dataset could usefully investigate the possibility that international harmonization might also impact geographical export diversification, an important dimension of extensive margin growth that could not be examined here.

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Tables and Figures

Table 1: Theoretical predictions of the effects of harmonization.

	Harmonization Across	Harmonization Up
Initial Conditions	$f_{FF} = f_{RR}$	$f_{FF} < f_{RR}$
	$f_{HF} = f_{HR}$	$f_{HF} < f_{HR}$
Insider Productivity Cutoff	Scale Effect < 0	Scale Effect < 0
	Cost Effect < 0	Cost Effect < 0
	Remoteness Effect > 0	Remoteness Effect > 0
Outsider Productivity Cutoff	Scale Effect < 0	Scale Effect < 0
	Cost Effect = 0	Cost Effect > 0
	Remoteness Effect > 0	Remoteness Effect <> 0

1. See section 2 for a full description of the model, parameters, and harmonization effects.

2. Harmonization in all cases is defined as adoption by region F of region R's standard. Following harmonization, producers in F and R can access the combined market upon payment of the fixed cost f_{RR}, while producers in H must pay f_{HR}.

Table 2: Data, descriptive statistics, and sources.

Variable	Definition	Obs.	Mean	Std. Dev.	Min.	Max.	Source
Λ_{xst}	Export variety; see formula in text.	4544	0.333	0.340	0	0.987	Eurostat; own calculations.
$stds_{st}$	Total number of EU standards.	5652	91.799	95.037	5	303	EUSDB.
$\frac{iso_{st}}{stds_{st}}$	Proportion of ISO-harmonized EU standards.	5652	0.386	0.214	0	0.649	EUSDB; own calculations.
$gdppc_{xt}$	Per capita income in constant 2000 $US.	4319	4351.35	7242.615	56.52	38403.78	WDI.
τ_{xst}	Simple average EU tariffs (applied).	4158	4.268	4.564	0	17	WITS-TRAINS.
imp_{st}^{EU}	Total EU import value.	5652	2.36E10	1.68E10	5.24E9	5.54E10	Eurostat.

1. Subscripts are used as follows: x = exporter; s = sector; t = year.

2. Λ_{xst} has 7 zero entries and 1108 missing entries. All regressions use $\ln(\Lambda_{xst})$ as the dependent variable, but results are not substantially different if $\ln(0.001+\Lambda_{xst})$ is used instead.

Table 3: Regression results.

	Baseline		First Lags		Second Lags	
$\ln(stds_{st})$	-0.415***	-1.574***	-0.1	-2.228***	0.05	-1.415***
	[0.143]	[0.473]	[0.169]	[0.462]	[0.162]	[0.529]
$\frac{iso_{st}}{stds_{st}}$	0.665*	2.903**	-0.08	5.059***	-0.15	1.28
	[0.376]	[1.452]	[0.346]	[1.348]	[0.336]	[1.471]
$\ln(stds_{st}) * \ln(gdppc_{xt})$		0.163***		0.256***		0.172***
		[0.057]		[0.055]		[0.065]
$\frac{iso_{st}}{stds_{st}} * \ln(gdppc_{xt})$		-0.355**		-0.619***		-0.24
		[0.176]		[0.164]		[0.182]
$\ln(imp_{st}^{EU})$	0.608***	0.982***	0.997***	0.848***	0.772***	0.996***
	[0.224]	[0.229]	[0.232]	[0.227]	[0.217]	[0.210]
No. observations	4537	3792	4038	3380	3531	2967
No. countries	187	167	187	166	187	166
R^2	0.71	0.71	0.73	0.74	0.75	0.76

1. All regressions use $\ln(\Lambda_{xst})$ as the dependent variable. Regressions in columns 1 and 2 use current values of $stds_{st}$ and $\frac{iso_{st}}{stds_{st}}$, columns 3-4 use $L.stds_{st}$ and $L.\frac{iso_{st}}{stds_{st}}$, and columns 5-6 use $L^2.stds_{st}$ and $L^2.\frac{iso_{st}}{stds_{st}}$.

2. All models include fixed effects by exporter-sector, and exporter-year. All models include dummy variables for the second and third phases of ATC liberalization (not reported). Robust standard errors appear in square brackets under the coefficient estimates. Statistical significance is indicated using * (10%), ** (5%), and *** (1%).

Table 4: Robustness checks.

	Tariffs		No Quota		No RTA		No ACP	
$\ln(stds_{st})$	-0.368**	-1.442***	-0.481***	-1.687***	-0.441***	-1.587***	-0.22	-0.45
	[0.146]	[0.473]	[0.167]	[0.543]	[0.159]	[0.512]	[0.143]	[0.400]
$\frac{iso_{st}}{stds_{st}}$	0.45	2.656*	0.773*	3.048*	0.721*	2.872*	0.54	0.64
	[0.370]	[1.466]	[0.438]	[1.643]	[0.411]	[1.586]	[0.385]	[1.323]
$\ln(stds_{st}) * \ln(gdppc_{xt})$		0.146**		0.170***		0.159**		0.05
		[0.057]		[0.065]		[0.063]		[0.045]
$\frac{iso_{st}}{stds_{st}} * \ln(gdppc_{xt})$		-0.320*		-0.372*		-0.342*		-0.09
		[0.178]		[0.198]		[0.196]		[0.154]
$\ln(imp_{st}^{EU})$	0.725***	1.014***	0.718***	1.147***	0.712***	1.059***	0.32	0.641***
	[0.239]	[0.244]	[0.256]	[0.263]	[0.247]	[0.257]	[0.211]	[0.190]
$\ln(1+\tau_{xst})$	-0.06	0.05						
	[0.116]	[0.105]						
No. observations	4023	3607	4159	3450	4116	3421	3093	2407
No. countries	182	166	187	167	175	157	113	96
R^2	0.71	0.72	0.71	0.71	0.71	0.71	0.77	0.81

1. All regressions use $\ln(\Lambda_{xst})$ as the dependent variable. Regressions in columns 1-2 use the full sample, columns 3-4 exclude countries subject to ATC quotas, columns 5-6 exclude countries having a regional trade agreement with the EU, and columns 7-8 exclude the African Caribbean and Pacific group of countries.

2. All models include fixed effects by exporter-sector, and exporter-year. All models include dummy variables for the second and third phases of ATC liberalization (not reported). Robust standard errors appear in square brackets under the coefficient estimates. Statistical significance is indicated using * (10%), ** (5%), and *** (1%).

Figure 1: Non-parametric (Lowess) regression of $\overline{\Lambda}_{xst}$ on $stds_{st}$ and iso_{st}.