POLICY RESEARCH WORKING PAPER 4390

Product Standards, Harmonization, and Trade:

Evidence from the Extensive Margin

Ben Shepherd

The World Bank
Development Research Group
Trade Team
November 2007

Abstract

The author uses a new database of EU product standards in the textiles, clothing, and footwear sectors to present the first empirical evidence that international standards harmonization is associated with increased partner country export variety. A 10 percentage point increase in the proportion of internationally harmonized standards is associated with a 0.2 percent increase in partner country export variety, whereas a 10 percent increase in the total number of standards is associated with a nearly 6 percent decrease in product variety. Although small, the harmonization elasticity is statistically significant, and proves highly robust to sample changes and instrumental variables estimation using instruments motivated by political economy considerations. Moreover, it is found to be around 50 percent higher for low income countries, which suggests that they may be particularly constrained in adapting products to meet multiple standards. Numerical simulations show that these findings are consistent with a heterogeneous firms model of trade in which harmonization is beneficial at the extensive margin provided that any increases in compliance costs are not too large.

This paper—a product of the Trade Team, Development Research Group—is part of a larger project on trade costs, trade facilitation, and economic development, supported through a Trust Fund of the U.K. Department for International Development (http://econ.worldbank.org/projects/trade_costs). Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at bshepherd@worldbank.org.

Product Standards, Harmonization, and Trade: Evidence from the Extensive Margin

Ben Shepherd

Development Research Group–Trade

The World Bank, Washington, D.C.

bshepherd@worldbank.org

I am grateful to Bernard Hoekman, John S. Wilson, and an anonymous referee for comments on a previous draft. This work is part of a project on trade facilitation and development supported through a Trust Fund of the U.K. Department for International Development (http://econ.worldbank.org/projects/trade_costs). The findings, interpretations, and conclusions expressed in this paper are entirely those of the author. They do not necessarily represent the view of the World Bank, its Executive Directors, or the countries they represent.

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 product") 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.

It has been suggested in the literature (Collier and Venables, 2007) that trade preferences might be one way of promoting export diversification, 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 the view that international harmonization can limit the scope for regulatory protectionism, and thereby attenuate the possible negative impacts of product standards on developing country exporters. Its main novelty is its focus on the extensive margin of trade. The intuition behind this positive impact of harmonization on the extensive margin is simple: by providing access to all harmonizing markets upon compliance with a single standard–and payment of a single fixed market entry cost–harmonization not only reduces compliance costs for harmonizing countries, but also eliminates the multiple costs that would otherwise face exporters in non-harmonizing countries. Numerical simulations using a three-country heterogeneous firms model show that the extensive margin impacts of harmonization should be positive for both harmonizing and non-harmonizing countries, even if the harmonized standard results in a moderate increase in compliance costs.

I find strong support for these predictions using a new World Bank database of EU product standards in the textiles, clothing, and footwear sectors (Czubala et al., 2007). These standards are issued by the European Normalization Committee (CEN). Although compliance 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 EU-wide harmonization of mandatory standards, through EC Directives.

Standards data are related to export variety of non-EU countries using measures built up from highly detailed, 8-digit mirror (import) data. Results show that the total count of standards in a given sector is negatively associated with the range of varieties exported by partner countries: the elasticity of product variety with respect to the number of standards is 0.6 in the preferred specification. A higher proportion of internationally harmonized standards in the total–proxied by the number of standards which are identical or equivalent to ISO standards–is found to be positively associated with export variety. Moreover, I find evidence that the impact of international harmonization is stronger for low income exporters: the elasticity of export variety with respect to the proportion of harmonized standards is 0.03, compared with 0.02 for the full sample. Although quantitatively small, these elasticities are statistically significant at the 1% level.

To be sure that I am identifying genuinely exogenous variation in the standards measures, I adopt a novel instrumental variables strategy based on the two-tier political economy framework within which trade policy and standards function in the EU. The argument is that the EU-wide size of each sector (proxied by total value added and number of employees) is an indicator of the industry's resources with which to lobby governments. Since harmonization can reduce the costs faced by overseas competitors, incumbents have an incentive to lobby against it, as a way of raising their rivals' costs (see e.g., Salop and Scheffman, 1983). In addition, Herfindahl indices of employment and value added are used as indicators of the propensity of individual EU member states to overcome their collective action problem, and lobby jointly against harmonization in order to protect "their" industry. These measures have explanatory power for the potentially endogenous variables, and standard statistical tests show that they are exogenous to partner country export variety. Results prove to be highly robust when the model is re-estimated by two stage least squares using these data as instruments.

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 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. Moenius (2004) uses a gravity model to show that bilaterally shared standards–and in some cases specific national standards–can promote trade. However, he does 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 does not include factors such as market size (GDP) and trade barriers (tariffs).

To my knowledge, the only recent empirical papers to deal with third-country impacts of harmonization are Chen and Mattoo (2004) and Baller (2007). Chen and Mattoo (2004) use a sample selection gravity model (cf. Helpman et al., 2007) to examine the impacts of EU Harmonization Directives and Mutual Recognition Agreements on intra- and extra-European trade. These effects are captured using dummy variables. 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. The present paper builds on and extends these results by focusing on product variety, which is not the object of analysis in either of these two previous papers.

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 use simulations to examine its impacts on export product variety in harmonizing and non-harmonizing countries. 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, robustness checks, and details of instrumental variables estimates. Section 5 concludes, and offers some suggestions for further research in this area.

2 Theoretical Motivation

This section develops a simple theoretical framework that is used to produce predictions which the remainder of the paper tests empirically. Since the model is essentially a three-country version of Melitz (2003), it is presented in outline only.[1] The key feature of this model is the inclusion of fixed market entry costs that are allowed to vary bilaterally. I motivate the existence of such costs by relating them to the need to modify products and production processes in order to meet foreign standards.[2] The available firm-level evidence suggests that foreign standards can indeed impose

[1] The presentation here is closest to the version of Melitz (2003) that appears in Helpman et al. (2004) or Baldwin and Harrigan (2007). Baller (2007) also applies a heterogeneous firms framework to the analysis of product standards.

[2] The model does not directly address the distinction drawn in the policy literature between mandatory and voluntary standards. The fixed costs modeled here can be seen as related to standards that are either a commercial or legal

substantial fixed costs of compliance: Maskus et al. (2005) report an average of $425,000 per firm, or 4.7% of value added, based on a survey of over 600 firms in 16 developing countries. For firms in the textiles and clothing sectors, the mean investment cost required to comply with technical requirements is 2.7% of firm sales. The range is very wide, however, running from 0.01% to 44.1%. This suggests that the firm-level impacts of standards can vary drastically, thereby making a heterogeneous firms approach particularly attractive.[3]

After setting out a baseline scenario without harmonization, I modify the model to take account of product standard harmonization covering two of the three countries only. Harmonization lowers the fixed costs of exporting from one harmonizing country to another such that they are at the same level as the costs of domestic market entry. This reflects the fact that under harmonization, domestic producers in both harmonizing countries produce goods satisfying the same standard, and they can therefore export them inside the harmonization zone without paying any further adaptation costs. From the perspective of the third (non-harmonizing) country, harmonization means that it is only necessary to pay one fixed cost (not two) in order to access both foreign markets.

Using numerical simulations, I show that harmonization thus defined raises the export marginal cost cutoff in the two harmonizing countries vis-à-vis each other, and also in the non-harmonizing country. Foreign harmonization therefore makes it easier for producers in the third country to overcome the cost hurdles associated with exporting, which in turn results in increased export variety due to the association of each firm with a distinct product variety. Although the level of compliance costs imposed by the harmonized standard as compared with pre-existing national standards has the potential to limit or even reverse this outcome, simulations show that the third-country impact is positive even when compliance with the harmonized standard is moderately more burdensome.

---

necessity for export sales. Note that I do not consider the role that standards can play on the consumption side (Fischer and Serra, 2000; Ganslandt and Markusen, 2001), nor reductions in information costs for exporters (Moenius, 2004).

[3] There is also an emerging body of case study evidence on this point. World Bank (2005) shows that management capacity and strategic decisions are an important determinant of how developing country firms react to changes in foreign product standards. The logic of the Melitz (2003) model presented here suggests that the cost increases associated with such changes will be felt most acutely by relatively unproductive firms, which may drop out of markets as a result.

2.1 Consumption Block

The world consists of three regions: Home (H), Foreign (F), and the Rest of the World (R). Labor is the only factor of production, and the regions are endowed with L units each. Each region has two productive sectors. One produces a freely traded homogeneous good under constant returns to scale with one unit of labor required for one unit of output. Wages are therefore equal to unity in equilibrium. The other sector produces a continuum of differentiated goods under increasing returns to scale and costly trade. Absolute specialization in any sector is excluded.

Identical consumers in all markets maximize the two-tier utility function (1). Their expenditure shares are β for the differentiated sector and $(1-\beta)$ for the homogeneous sector. The elasticity of substitution in the differentiated sector is σ, across the set of varieties V.

$$U = q^{(1-\beta)} \left(\int\limits_{v \in V} x(v)^{1-\frac{1}{\sigma}} dv \right)^{\beta\left(\frac{\sigma}{\sigma-1}\right)} \tag{1}$$

As is well known, a typical demand function x is:

$$x\left[p\left(v\right)\right] = \frac{\beta E \left[p\left(v\right)\right]^{-\sigma}}{\int\limits_{v \in V^i} p\left(v\right)^{1-\sigma} dv} \equiv d^i \left[p\left(v\right)\right]^{-\sigma} \tag{2}$$

where V^i is the set of varieties available in country $i \in \{H, F, R\}$, $E = L$ is total expenditure by that country's consumers, and the summary parameter d^i is a demand shifter.

2.2 Production Block

As usual in Dixit-Stiglitz models, producers in the differentiated goods sector engage in constant markup pricing such that $p\left(v\right) = \frac{\sigma}{\sigma-1}c$. Firms in each country face a fixed startup cost f_d^i that must be paid in order to enter the domestic market. This cost reflects the investment required to establish a production process that manufactures goods which accord with local product standards.

A typical firm's domestic market profit function is therefore:

$$\pi_d^i = \underbrace{d^i \left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma}}_{\text{revenue}} - \underbrace{d^i \left(\frac{\sigma}{\sigma-1}c\right)^{-\sigma} c}_{\text{variable costs}} - \underbrace{f_d^i}_{\text{fixed costs}} \equiv \frac{d^i}{\sigma}\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma} - f_d^i \tag{3}$$

Setting this expression equal to zero and solving for c establishes three maximum marginal costs c_d^i above which it is not possible to profitably supply the domestic market in each country.

$$c_d^i = \left(\frac{\sigma f_d^i}{d^i}\right)^{\frac{1}{1-\sigma}} \left(\frac{\sigma-1}{\sigma}\right), \ (i \in \{H, F, R\}) \tag{4}$$

Firms wishing to export face an additional layer of costs over and above the cost of domestic market entry: they must pay a fixed cost to adapt their production process so as to produce goods that comply with foreign product standards.[4] Product standards are unique to each country, so fixed product adaptation costs must be paid cumulatively (i.e. one fixed cost per market entered). I use f_x^{ij} to indicate the fixed market entry costs that must be paid when exporting from i to j, and assume that compliance with foreign standards is in all cases more costly than compliance with domestic ones (i.e., $f_x^{ij} > f_d^i, f_d^j$). Thus, the additional profits from exporting are:

$$\pi_x^{ij} = \underbrace{d^j \left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma}}_{\text{revenue}} - \underbrace{d^j \left(\frac{\sigma}{\sigma-1}c\right)^{-\sigma} c}_{\text{variable costs}} - \underbrace{f_x^{ij}}_{\text{fixed costs}} \equiv \frac{d^j}{\sigma}\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma} - f_x^{ij} \tag{5}$$

and the maximum marginal cost c_x^{ij} above which it is not possible to profitably export is:

$$c_x^{ij} = \left(\frac{\sigma f_x^{ij}}{d^j}\right)^{\frac{1}{1-\sigma}} \left(\frac{\sigma-1}{\sigma}\right), \ (i \in \{H, F, R\}, i \neq j) \tag{6}$$

I introduce marginal cost heterogeneity by assuming that c follows an identical Pareto distribution with support $[0, \overline{c}]$ in all three countries. This setup implies a cumulative distribution function

[4] To sharpen the focus on the role of fixed adaptation or retooling costs, variable (iceberg) trade costs are set equal to unity. This assumption could be relaxed, for instance to study the impact of per unit conformity assessment and certification costs. However, the basic insights of the model would not change.

$G(c) = \left(\frac{c}{\bar{c}}\right)^k$ and probability density function $g(c) \equiv \frac{dG(c)}{dc} = \frac{kc^{k-1}}{\bar{c}^k}$, where $k > \sigma - 1$ is a "shape" parameter that indexes firm heterogeneity.[5]

A free entry condition closes the production block of the model. The expected profits from domestic and export market sales are equated with the fixed cost of entering the marginal cost "lottery" f_e (identical in all countries):

$$\underbrace{\int_0^{c_d^i} \left(\frac{d^i}{\sigma} \left(\frac{\sigma}{\sigma - 1} c \right)^{1-\sigma} - f_d^i \right) dG(c)}_{\text{Expected profits from domestic sales}} + \underbrace{\int_0^{c_x^{ij}} \left(\frac{d^j}{\sigma} \left(\frac{\sigma}{\sigma - 1} c \right)^{1-\sigma} - f_x^{ij} \right) dG(c)}_{\text{Expected profits from export sales to } j} +$$
$$\underbrace{\int_0^{c_x^{ik}} \left(\frac{d^k}{\sigma} \left(\frac{\sigma}{\sigma - 1} c \right)^{1-\sigma} - f_x^{ik} \right) dG(c)}_{\text{Expected profits from export sales to } k} = f_e, \quad (i \in \{H, F, R\}; i \neq j \neq k) \quad (7)$$

The above framework gives three free entry conditions (7), three cutoff expressions for domestic market entry (4), and six additional cutoff expressions for export market entry (6). The model has the same number of unknowns, namely three demand shifters d^i, three domestic market cost cutoffs c_d^i, and six export cost cutoffs c_x^{ij}. Equilibrium will see firms in each country self-selecting into four groups based on their marginal cost draws: high cost firms will exit immediately without producing for any of the three markets, those with slightly lower costs will produce for the domestic market only, and those with relatively low costs will in addition export to one or both other markets. The higher the export marginal cost cutoff for each bilateral trading relationship, the greater the proportion of active domestic firms that will be able to enter that export market. So for a given mass of firms, a higher threshold is associated with greater export variety since each firm produces a distinct variety of the differentiated good.

2.3 Modeling Product Standard Harmonization

International harmonization of F's product standards–i.e., bringing them into line with those prevailing in the rest of the world (R)–means that all firms now have access to two markets upon

[5] Assuming $k > \sigma - 1$ ensures convergence of the integrals in the free entry conditions below.

payment of a single fixed cost.[6] With the same standard in place in both markets, goods manufactured in F or R can be sold freely in the other country without any need for further adaptation. The fixed costs of exporting are eliminated between these two markets, leaving only the fixed costs of domestic market entry (identical in the two countries). The profit function for sales within the harmonization zone is therefore

$$\pi^i = \underbrace{\frac{d^i}{\sigma}\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma}}_{\text{net domestic sales}} + \underbrace{\frac{d^j}{\sigma}\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma}}_{\text{net foreign (within zone) sales}} - \underbrace{f_d^i}_{\text{fixed costs}}, \ (i,j \in \{F,R\}, i \neq j) \tag{8}$$

which gives a combined domestic and export market cutoff for each harmonizing country:

$$c_d^i = \left[\frac{f_d^i}{\frac{1}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}\left[d^i + d^j\right]}\right]^{\frac{1}{1-\sigma}}, \ (i,j \in \{F,R\}, i \neq j) \tag{9}$$

The export conditions from F and R to H remain unchanged from the pre-harmonization model, but those in the opposite direction require modification. After harmonization, producers in H still face a fixed cost of exporting to F or R due to the need to adapt their product to the harmonized standard (originally R's standard). However, there is now only one additional standard they need meet in order to sell in both F and R, as opposed to the two separate standards that initially prevailed. H's two export market profit expressions therefore collapse into a single one:

$$\pi_x^H = \underbrace{\frac{d^F}{\sigma}\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma}}_{\text{net sales in } F} + \underbrace{\frac{d^R}{\sigma}\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma}}_{\text{net sales in } R} - \underbrace{f_x^H}_{\text{fixed costs}} \tag{10}$$

which leads to a new cutoff for H covering exports to both F and R:

$$c_x^H = \left[\frac{f_x^H}{\frac{1}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}\left[d^F + d^R\right]}\right]^{\frac{1}{1-\sigma}} \tag{11}$$

These changes to the profit conditions require corresponding changes to the free entry condi-

[6] The model treats harmonization as a discrete, exogenous policy shock. For an examination of harmonization in a political economy setting, see Gandal and Shy (2001).

tions for all countries. For H, the condition is now

$$\underbrace{\int_0^{c_d^H}\left(\frac{d^H}{\sigma}\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma}-f_d^H\right)dG\left(c\right)+}_{\text{Expected profits from domestic sales}}$$

$$\underbrace{\int_0^{c_x^H}\left(\frac{d^F}{\sigma}\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma}+\frac{d^R}{\sigma}\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma}-f_x^H\right)dG\left(c\right)}_{\text{Expected profits from export sales in } F \text{ and } R}=f_e \quad (12)$$

while for F and R the condition takes the following form:

$$\underbrace{\int_0^{c_d^i}\left(\frac{d^i}{\sigma}\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma}+\frac{d^j}{\sigma}\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma}-f_d^i\right)dG\left(c\right)+}_{\text{Expected profits from sales within the harmonization zone}}$$

$$\underbrace{\int_0^{c_x^{iH}}\left(\frac{d^H}{\sigma}\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma}-f_x^{iH}\right)dG\left(c\right)}_{\text{Expected profits from export sales to } H}=f_e,\ \ (i,j\in\{F,R\}\,;i\neq j) \quad (13)$$

The system to be solved now has nine equations: the three modified free entry conditions (12) and (13) together with the unchanged domestic cutoff for H (4), the two unchanged export cutoffs for F and R to H (6), and the three modified cutoffs (9) and (11). The number of unknowns is also equal to nine: three demand shifters d^i, three domestic market cutoffs f_d^i, and three export market cutoffs c_x^H, c_x^{FH}, and c_x^{RH}.

2.4 Simulation Results

To gauge the impact of product standard harmonization in F and R on the extensive margin of trade, I compare numerical simulations of the pre- and post-harmonization models over a range of reasonable parameter values. This requires making some assumptions as to the relative and absolute values of the various fixed cost parameters.[7] To fix ideas, I focus on the case of "harmonizing up": i.e., the initial standard in R is more costly to comply with than the initial standards in H and

[7] See Baldwin (2000) for examples of the many ways in which these parameters can be varied to capture aspects of different types of harmonization.

F, so bringing F's standards into line with R's entails an increase in restrictiveness. Intuitively, harmonizing up should be less favorable to product variety growth in third countries than "harmonizing down" to a less costly standard in R. These results can therefore be interpreted as putting a lower bound on harmonization's impact.

Prior to harmonization, $f_x^{iH} = f_x^{iF} = 0.15$ (export costs into H and F) and $f_d^H = f_d^F = 0.1$ (costs of domestic market entry in H and F). To consider different levels of compliance costs in R, f_x^{iR} (export costs into R) varies over the range 0.15 to 0.2, while f_d^R varies over the range 0.1 to 0.15. It is important to allow both of these parameters to vary, in order to reflect the fact that more costly standards in R impact both foreign and domestic producers. Post harmonization, f_x^{iH} remains unchanged but f_x^H (the new export threshold for firms in H) varies over the range 0.15 to 0.2, while $f_d^R = f_d^F$ varies over the range 0.1 to 0.15. For the values of invariant parameters, I follow Bernard et al. (2007).[8]

Figure 1 shows simulated equilibrium export cutoffs for all three countries. Simulation results are expressed as percentage changes following harmonization. The first simulation point represents the limiting case in which F and R impose different but equally costly standards prior to harmonization. Moving from left to right across the figure shows changes in the impact of harmonization as the additional cost burden associated with R's initial standard becomes larger.

At all points in the parameter space used here, harmonization raises the export cutoffs in all countries. This is the case even though the harmonized standard is moderately more costly to comply with than the unharmonized one in F (the difference is around 33% at the upper boundary). The intuition behind this is that reduction in the multiplicity of fixed market entry costs dominates a moderate increase in compliance costs. However, a very burdensome standard in R could entail a rise in compliance costs for F that would dominate the reduction in multiplicity and produce a negative impact on H.

The largest harmonization effects are felt in the two harmonizing countries F (dotted and dashed line) and R (crossed line). The percentage jump in F's effective export threshold to R

[8] Like those authors, I assume: $\sigma = 3.8$, $k = 3.4$, $L = 1000$, $\beta = 0.5$, $\bar{c} = 0.2$, and $f^e = 2$.

declines only slowly with increasing compliance costs under harmonization, but for R this effect is much more rapid. This difference reflects the fact that from R's point of view, harmonization leads to the imposition of a more burdensome standard in F; however, from F's point of view, the standard prevailing in R does not change.

Although the impact of harmonization on H's export cutoff is positive vis-à-vis both foreign markets, the effect varies substantially by destination. The effective rise in the export threshold to R remains approximately constant over the full range of compliance costs considered here. This again reflects the fact that R's standard does not change due to harmonization. On the other hand, F's standard does change, and this results in an export cutoff increase that declines sharply in the costs of compliance under harmonization: with equally burdensome standards in F and R, harmonization lifts H's export threshold by just under 13%, but when R's compliance costs are 33% higher than F's, the rise is limited to 4.6%.

3 Data and Stylized Facts

The remainder of the paper tests the hypothesis that international harmonization is associated with an increase in partner country export variety in a way consistent with the mechanics set out above. This section presents two new data sources that play an important role in the empirical 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.[9] 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

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

Mattoo (2004) and Baller (2007) focus on transnational mandatory standards (EC Directives). Only Czubala et al. (2007) look 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. 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.)

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.[10] 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 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 transnational standards.[11] 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. 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

[10] 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.

[11] An anternative approach is taken in recent papers by Fontagné et al. (2005) and Disdier et al. (2007). They use WTO notifications under the SPS and TBT Agreements to build databases of mandatory national standards. This is a promising approach, but one which currently suffers from the inconsistent reporting behavior of WTO Members.

it is "identical" or "equivalent" to an ISO standards. 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).[12] It also counts the number of those standards that are treated as being internationally harmonized using the above definition. Table 1 presents basic descriptive statistics, which disclose a number of notable features (see 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. In the context of instrumental variables estimates below, some of the possible reasons for this non-uniformity will become apparent.

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 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 (2006):

$$\Lambda_{xst} = \frac{\sum\limits_{l \in V_{s,t}^{x}} \overline{p_l^w q_l^w}}{\sum\limits_{l \in V_s^w} \overline{p_l^w q_l^w}} \tag{14}$$

The denominator is the total value of world exports in a particular sector, summing across all

[12]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.

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.[13] 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).

Table 2 provides some basic descriptive statistics for this variety measure, broken down by sector and year. (Full results are available on request.) 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 just a little above zero to 0.8 or 0.9. The fact that the median is so low within this range suggests that most countries 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

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

from Eurostat may be picking up some amount of re-exports or processing trade. I cannot be sure as to the exact extent of this issue, but I come back to it below in the context of implementing robustness checks for the empirical model.

4 Empirical Model and Estimation Results

The theoretical model suggests that international harmonization of EU standards in the textiles, clothing, and footwear sectors should be positively associated with partner country export variety, provided that any additional compliance costs imposed by harmonized standards are not too high.[14] To test this hypothesis empirically, I use EUSDB to calculate the number of internationally harmonized standards (iso_{st}) as a percentage of the total number of EU standards ($stds_{st}$) for each sector-year. I use this measure $\frac{iso_{st}}{stds_{st}}$ as a proxy for the degree of international harmonization. To take account of the overall cost burden imposed by EU standards, I include $\ln(stds_{st})$ as a separate regressor.

In addition to these factors, the theoretical model and past empirical work suggest that bigger markets (proxied by exporter GDP), more developed exporter technology (proxied by per capita GDP), and lower variable trade costs (tariffs τ_{xst}) should also impact product variety positively.[15] I use the estimating equation (15) to test these predictions, taking advantage of the availability of panel data to include fixed effects that control for unobserved heterogeneity in the exporter, sector, and year dimensions.[16] These fixed effects absorb influences such as EU GDP (which varies by year only), sectoral expenditure shares (on the assumption that they are reasonably stable over time), exporter resource endowments, and the type of international transport costs usually proxied by great circle distance. To take account of the possible influence of quota arrangements under the Agreement on Textiles and Clothing (ATC) and associated bilateral agreements between the

[14] Due to lack of data, I do not consider intersectoral linkages or the possibility of cumulation of standards as goods pass from one processing stage to another.

[15] I source GDP data (aggregate and per capita) in constant 2000 US dollars from the World Development Indicators. Simple average tariff rates (effectively applied) come from the UNCTAD-TRAINS database accessed via WITS.

[16] I do not convert the $iso_{st}/stds_{st}$ term to logarithms, since it is already a percentage. $\beta_2/100$ is therefore the elasticity of export variety with respect to international harmonization.

EU and some non-WTO members, I include a dummy variable ($quota$) equal to unity only for countries subject to such quotas.[17] Two other 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 2 and 3 of ATC implementation.[18] I also interact these dummies with $quota$ to allow for differences in impact across quota and non-quota countries.

$$\ln(\Lambda_{xst}) = \beta_1 \ln(stds_{st}) + \beta_2 \frac{iso_{st}}{stds_{st}} + \beta_3 \ln(1+\tau_{xst}) + \beta_4 \ln(gdp_{xt}) + \beta_5 \ln(gdppc_{xt}) + \beta_6 atc2_{st} + \beta_7 atc3_{st} + \beta_8 quota_{xs} + \beta_9 quota_{xs} * atc2_{st} + \beta_{10} quota_{xs} * atc3_{st} + \varepsilon_{xst} \quad (15)$$

Baseline results using OLS appear in the first column of Table 3.[19] The overall fit of the model is good, with $R^2 = 0.68$. All of the substantive coefficients carry the expected signs: GDP and per capita GDP are both positive, while tariffs are negative. This is in line with previous work, although these coefficients are not statistically significant in this case. Countries subject to ATC quotas tend to export a narrower range of varieties, and this effect is statistically significant at the 1% level. The impacts from ATC liberalization are as expected in terms of sign (positive for quota countries, negative for the others), but are not statistically significant.

In line with the model's predictions, the total standards count enters with a negative coefficient, while the extent of international harmonization is strongly positive. Both are statistically significant at the 1% level. In terms of magnitude, a 1% increase in the total number of EU standards is associated with a 0.8% decrease in export variety, while an increase of one percentage point in the proportion of those standards which are internationally harmonized is associated with a 0.02% increase in export product variety. While this latter effect is quite small, I would argue that it

[17] Countries considered to be subject to quotas over the 1995-2003 period are: Argentina, Belarus, Bosnia and Herzegovina, Brazil, China, Hong Kong China, India, Indonesia, Macao China, Malaysia, North Korea, Pakistan, Peru, the Philippines, Serbia and Montenegro, Singapore, South Korea, Sri Lanka, Taiwan China, Thailand, and Vietnam. (Source: WTO Trade Policy Reviews of the European Union, various years.)

[18] 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.

[19] Since the two standards measures vary in the sector-year dimension, the robust standard errors are adjusted for clustering at that level.

could nonetheless be significant in an economic sense. This is particularly true for the sectors under consideration here, which are of considerable importance to developing countries in the early stages of industrialization. These results highlight, however, that in terms of assessing the impact on exporting countries, harmonization needs to be considered within the context of the overall level of compliance costs involved.

4.1 Instrumental Variables Results

It is important to be sure that these results are not biased due to the possible endogeneity of product standards (and tariffs) with respect to export variety.[20] It is commonplace to view endogenous tariffs as the outcome of a lobbying process in which a government balances support from lobbies seeking protection against the national welfare costs of imposing that protection (e.g., Grossman and Helpman, 1994). Since harmonization can, like tariff liberalization, lower the cost barriers facing foreign firms, local incumbents have an interest in lobbying against it. For the moment, the political economy of this process remains to be examined in detail in the literature.[21] I draw on the general framework that has emerged from the endogenous tariffs literature to identify some likely determinants of endogenous standards, which I then use as instruments.

In the EU context, the type of firm-to-government lobbying envisaged by Grossman and Helpman (1994) is accompanied by an additional layer of government-to-government lobbying within centralized EU bodies.[22] This is due to the fact that both trade policy and the EU standards under consideration here are not decided unilaterally by national governments, but by European bodies (the Commission and CEN). To capture the lobbying potential of industries on an EU-wide basis, I use total sector value added and employment.[23] The first of these measures proxies a sector's

[20] Moenius (2004) addresses endogeneity by using five year lags of his standards variables as instruments for their current levels. Chen and Mattoo (2004) use harmonization of closely related sectors as an instrument for harmonization of a given sector. In both cases, instrumental variables estimation does not substantially change the results.

[21] Essaji (2005) is the only empirical study dealing with the political economy of standards in a trade setting.

[22] Balaoing and Francois (2006) report that after controlling for the size of an industry, its "nationality" remains an important determinant of the level of protection it receives through the EU common external tariff.

[23] An alternative approach could be to instrument using data on antidumping actions taken by each industry, using the dataset compiled by Bown (2007). This is a promising avenue for future research, but it is not pursued here for two reasons. First, the instruments used in this paper are arguably more likely to be exogenous to partner country

political "muscle", i.e. the potential lobbying resources at its disposal. The second measure proxies a different dimension of sectoral politics, namely the direct voting power of an industry's workers. In addition, I capture the lobbying potential of national governments using Herfindahl indices of value added and employment across EU member states. These measures proxy the extent to which each sector is geographically concentrated in particular countries, and thus the extent to which governments have a perceived economic or political interest in protecting "their" industry.[24]

Treating all independent variables in (15) except standards and tariffs as exogenous, I re-estimate the equation using two stage least squares (TSLS). Second stage results are in the second column of Table 3. Rejection of the null by a Hausman test (1%) indicates that endogeneity is indeed a problem in these data, but correcting for it leaves the basic conclusions unchanged: the coefficient on the total number of standards remains negative, while the percentage of harmonized standards still enters the equation positively.[25] The magnitudes of both coefficients change slightly–becoming larger for the percentage of harmonized standards, and smaller (in absolute value) for the total number of standards–but remain statistically significant at the 5% level (total number of standards) and the 1% level (proportion of harmonized standards). The tariff coefficient increases markedly in absolute value terms, but remains statistically insignificant. Amongst the remaining variables, only per capita GDP undergoes an (unexpected) sign change, but it remains statistically insignificant.

How valid is this choice of instruments? Unconditional correlation coefficients between the endogenous explanatory variables and the instruments range from 0.14 to 0.68 for $stds_{st}$, 0.1 to 0.29 for $\frac{iso_{st}}{stds_{st}}$, and 0.05 to 0.12 for $\ln(1+\tau_{xst})$. First stage estimates in columns 3-5 of Table 3 suggest that when used jointly, the instruments do a relatively good job of explaining the variation

export variety, and to satisfy the second stage exclusion restriction. Second, it is desirable for the final model to be overidentified, but it would be difficult to achieve this using antidumping data since only a small number of independent data series would be available.

[24]These data come from Eurostat annual enterprise statistics on industry and construction, freely downloadable from http://epp.eurostat.ec.europa.eu. Series codes are V12150 (value added at factor cost) and V16110 (number of persons employed). I construct the Herfindahl indices as the sum of the squared country shares for each indicator. For the textiles, clothing, and footwear sectors, I use NACE industry codes DB17, DB18, and DC193 respectively.

[25]For this and the test of instrument validity below, I use the regression based tests set out in Wooldridge (2002, pp. 118-124).

in standards and tariffs. R^2s are high: over 0.7 for tariffs, and over 0.9 for both standards variables. In all three columns, a Wald test of the joint significance of the four instruments rejects the null hypothesis at the 1% level.

The pattern of signs in the first stage regressions is broadly but not perfectly consistent with the political economy story set out above: larger sectoral value added is associated with less international harmonization and higher tariffs, as is greater geographical concentration in particular member states. Only the coefficients in the tariff equation are individually statistically significant, however. A higher number of employees is also associated with less harmonization, but the geographical dispersion of employment does not carry the expected sign in either case. Results in relation to the total number of standards are mixed: higher employment and greater geographical concentration of employment are both associated with a higher standard count, but the two value added variables carry unexpected negative signs. While these results suggest that it would clearly be desirable to flesh out in more detail the political economy mechanisms behind standards and harmonization, they nonetheless support the relevance of the instruments in this case.

The second point of view from which the validity of these instruments can be tested is their exogeneity with respect to export variety. To do this, I exploit the fact that the model is overidentified (four instruments and three endogenous explanatory variables). A test of the validity of the overidentifying restriction does not reject the null hypothesis at the 10% level (see Table 3), thereby suggesting that the instruments are indeed exogenous. Taking these results together with the first stage regressions, I conclude that the TSLS estimates appropriately correct for endogeneity bias as it affects standards and tariffs, but that the empirical extent of that bias is relatively limited in this particular case.

4.2 Robustness Checks: Quotas, Income Levels, and Regional or Preferential Agreements

Thus far, the estimation sample has covered all exporting countries for which data are available (with the exception of the EU-15). The presence in the dataset of a wide variety of very different countries can be used to examine the potential for factors that are omitted in (15) to influence the results. For instance, it could be argued that the dummy variables in (15) are inadequate to take account of the impacts of ATC quotas on constrained countries. I therefore eliminate those countries from the sample and re-run the TSLS version of (15). Results (column 1 of Table 4) are not greatly changed, although the elasticities for the total number of standards and the extent of harmonization are both larger in absolute value.

Next, I focus on countries at relatively low income levels so as to indirectly gauge the extent to which low levels of development might negatively impact firms' ability to make the investments necessary to comply with foreign standards. It is conceivable, for instance, that lack of access to technology, skills, or finance could effectively raise the costs of compliance with multiple foreign standards for firms in developing countries, thereby making foreign standards more burdensome and harmonization more beneficial. Columns 2-4 of Table 4 present the results from using narrower country samples: in addition to excluding ATC quota countries, I progressively exclude high income countries, upper middle-income countries, and lower middle-income countries.[26] (All country groups are based on World Bank classifications.) The basic thrust of the results remains unchanged. The coefficient on the total number of standards is negative in all cases, and does not change too much in magnitude. It loses statistical significance, however, in the last two columns. The situation is more interesting for the extent of harmonization: it generally increases in magnitude as income falls. The estimated coefficient using low income countries only is 3.0, which is over 50% higher than the estimate obtained using the full sample. The same progression can also be seen for tariffs, although comparison is made more difficult by the lack of precision with which this parameter is estimated. While these results should be interpreted with caution due to the small sample size in column 4, the data are nonetheless suggestive of development-based differences in compliance costs.

As a final check, I consider the possibility that the omission of data on regional and preferential trade agreements could lead to biased estimates in (15). It could be argued, for instance, that

[26] Focusing on low income countries also alleviates the possible difficulties with re-exports and processing trade that were mentioned earlier in relation to variety measures for some high income countries.

such agreements indicate a degree of economic and/or political proximity to the EU that could be associated either with the use of similar product standards domestically, or the existence of EU aid or technical support aimed at assisting the compliance process. I therefore re-estimate the model excluding (in addition to ATC quota countries) those countries that have a regional trade agreement with the EU, and the African, Caribbean, and Pacific group of countries that benefit from preferential treatment under the Lomé Convention and the Cotonou Agreement.[27]

Results are in Table 4 columns 5-6. Estimated coefficients for the two variables of primary interest are in line with those found previously: both are statistically significant at the 5% level, with magnitudes slightly larger in absolute value than those reported in Table 3 column 2. The remaining coefficients are not statistically significant, but generally have signs and magnitudes that are consistent with earlier estimates. The only exception is EU tariffs, which enter column 5 with an unexpected positive sign, and the two ATC liberalization dummies, which enter column 6 with unexpected negative signs. However, given the lack of statistical significance of these coefficients, no strong conclusions are drawn from them at this stage.[28]

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, international harmonization can act as an important mitigating factor. Based on instrumental variables estimates, I conclude that a 10% increase in the total number of standards leads to a 6% decrease in partner country export variety, but that a 10 percentage point increase in the proportion of internationally harmonized standards leads to a 0.2% increase in export variety. I find evidence that this latter effect is around 50% stronger for low income countries. The empirical results prove to be extremely robust to changes in country sample,

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

[28] An additional issue, not pursued here, is rules of origin. While such measures can undoubtedly impose additional cost burdens on exporters (e.g., Cadot and de Melo, 2007), they are in effect held constant within this sample because only one importing market (the EU) is included.

and the use of instrumental variables based on a simple political economy framework. They are consistent with a view of the world in which product standards impose fixed costs of adaptation, of which harmonization tends to reduce the multiplicity.

These are significant findings from a development point of view, 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 an upwards shift in the export marginal cost 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 and the rationalization of barriers to domestic market entry within developing countries (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. One direction for possible expansion would be the addition of further countries, including data on national standards in EU-15 member states. At the current time, the data do not permit an assessment of the impact of product standard harmonization on geographical export diversification; however, the relatively weak (but statistically significant) elasticity found here suggests that geographical diversification, rather than product variety, might be the more important channel for trade growth in this case. It is to be hoped that future work will investigate this possibility.

It would of course also be desirable to increase the sectoral reach of standards data. In particular, it would be useful to include products of interest to middle income developing countries, such as electronic goods. Building on previous efforts to exploit the Perinorm bibliographic database (e.g., Swann et al., 1996; Moenius, 2004) would likely prove very beneficial to empirical work in this area.

TSLS estimates suggest that the size of a sector and its geographical distribution across EU member states are important determinants of the total number of standards and the degree of international harmonization. This constitutes important preliminary support for a political economy view of trade-related standards and harmonization, in which these measures are influenced by the kinds of factors more commonly associated with endogenous tariffs. However, that argument is only briefly sketched out here, and results are not uniformly consistent with it. To my knowledge, only Essaji (2005) addresses the political economy of product standards and trade from an empirical perspective. A future expansion of his approach to a multi-country framework, along with incorporation of Perinorm data, would provide important insights into the mechanisms at work. Such research would have important policy implications since it could help lay the foundations for a rigorous identification of those standards which are unduly tainted by protectionist pressures.

References

Balaoing, Annette, and Joseph Francois, 2006, "The Political Economy of Protection in a Customs Union: What Drives the Tariff Structure of the EU?", Mimeo, www.intereconomics.com/francois/doc/EU_May06.pdf.

Baldwin, Richard E., 2000, "Regulatory Protectionism, Developing Nations, and a Two-Tier World Trade System" in Susan M. Collins and Dani Rodrik (eds.), *Brookings Trade Forum 2000*, Washington, D.C.: Brookings Institution Press.

Baldwin, Richard E., and James Harrigan, 2007, "Zeros, Quality, and Space: Trade Theory and Trade Evidence", Working Paper No. 13214, NBER.

Baller, Silja, 2007, "Trade Effects of Regional Standards Liberalization: A Heterogeneous Firms Approach", Policy Research Working Paper No. 4124, The World Bank.

Bernard, Andrew B., Stephen J. Redding, and Peter K. Schott, 2007, "Comparative Advantage and Heterogeneous Firms", *Review of Economic Studies*, 74, 31-66.

Bown, Chad P., 2007, "Global Antidumping Database Version 3.0", Mimeo, http://people.brandeis.edu/~cbown/global_ad/bown-global-ad-v3.0.pdf.

Broda, Christian, and David E. Weinstein, 2006, "Globalization and the Gains from Variety", *The Quarterly Journal of Economics*, 121(2), 541-585.

Cadot, Olivier, and Jaime de Melo, 2007, "Why OECD Countries Should Reform Rules of Origin", Discussion Paper No. 6172, CEPR.

Chen, Maggie Xiaoyang, and Aaditya Mattoo, 2004, "Regionalism in Standards: Good or Bad for Trade?", Policy Research Working Paper No. 3458, The World Bank.

Collier, Paul, and Anthony J. Venables, 2007, "Rethinking Trade Preferences: How Africa Can Diversify its Exports", Discussion Paper No. 6262, CEPR.

Czubala, Witold, Ben Shepherd, and John S. Wilson, 2007, "Help or Hindrance? The Impact of Harmonized Standards on African Exports", Mimeo, http://siteresources.worldbank.org/ INTTRADECOSTANDFACILITATION/Resources/EU_Standards_and_TC_Trade.pdf.

Disdier, Anne-Célia, Lionel Fontagné, and Mondher Mimouni, 2007, "The Impact of Regulations on Agricultural Trade: Evidence from SPS and TBT Agreements", Working Paper No. 2007-04, CEPII.

Essaji, Azim, 2005, "The Political Economy of Technical Regulations", Mimeo, www.wlu.ca/documents/6388/pol_econ_tr.pdf.

European Commission, 2000, "Guide to the Implementation of Directives Based on the New Approach and the Global Approach", http://europa.eu.int/comm/enterprise/newapproach/ newapproach.htm.

Feenstra, Robert C., 1994, "New Product Varieties and the Measurement of International Prices", *The American Economic Review*, 84(1), 157-177.

Feenstra, Robert C., and Hiau Looi Kee, 2006, "Export Variety and Country Productivity: Estimating the Monopolistic Competition Model with Endogenous Productivity", Mimeo.

Feenstra, Robert C., and Hiau Looi Kee, 2007, "Trade Liberalization and Export Variety: A Comparison of Mexico and China", *The World Economy*, 30(1), 5-21.

Fischer, Ronald, and Pablo Serra, 2000, "Standards and Protection", *Journal of International Economics*, 52, 377-400.

Fontagné, Lionel, Friedrich von Kirchbach, and Mondher Mimouni, 2005, "An Assessment of Environmentally-Related Non-Tariff Measures", *The World Economy*, 28(10), 1417-1439.

Gandal, Neil, and Oz Shy, 2001, "Standardization Policy and International Trade", *Journal of International Economics*, 53, 363-383.

Ganslandt, Mattias, and James R. Markusen, 2001, "Standards and Related Regulations in International Trade: A Modeling Approach", Working Paper No. 8346, NBER.

Grossman, Gene M., and Elhanan Helpman, 1994, "Protection for Sale", *American Economic Review*, 84(4), 833-850.

Helpman, Elhanan, Marc Melitz, and Yona Rubinstein, 2007, "Estimating Trade Flows: Trading Partners and Trading Volumes", Working Paper, www.economics.harvard.edu/faculty/ helpman/papers/TradingPartners.pdf.

Helpman, Elhanan, Marc J. Melitz, and Stephen R. Yeaple, 2004, "Export Versus FDI With Heterogeneous Firms", *The American Economic Review*, 94(1), 300-316.

Hoekman, Bernard, 2007, "Doha, Development, and Discrimination", *Pacific Economic Review*, 12(3), 267-292.

Hummels, David, and Peter J. Klenow, 2005, "The Variety and Quality of a Nation's Exports", *The American Economic Review*, 95(3), 704-723.

Kee, Hiau-Looi, Alessandro Nicita, and Marcelo Olarreaga, 2006, "Estimating Trade Restrictiveness Indices", Policy Research Working Paper No. 3840, The World Bank.

Kehoe, Timothy J., and Kim J. Ruhl, 2003, "How Important is the New Goods Margin in International Trade", Research Department Staff Report No. 324, Federal Reserve Bank of Minneapolis.

Maskus, Keith, Tsunehiro Otsuki, and John S. Wilson, 2005, "The Cost of Compliance with Product Standards for Firms in Developing Countries: An Econometric Study", Policy Research Working Paper No. 3590, The World Bank.

Melitz, Marc J., 2003, "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity", *Econometrica*, 71(6), 1695-1725.

Moenius, Johannes, 2000, "The BISTAN Data Retrieval Reference", Working Paper, University of California at San Diego.

Moenius, Johannes, 2004, "Information Versus Product Adaptation: The Role of Standards in Trade", International Business and Markets Research Center Working Paper, Northwestern University.

Pelkmans, Jacques, 1987, "The New Approach to Technical Harmonization and Standardization", *Journal of Common Market Studies*, 25(3), 249-269.

Salop, Steven C., and Scheffman, David T., 1983, "Raising Rivals' Costs", *The American Economic Review*, 73(2), 267-271.

Swann, Peter, Paul Temple, and Mark Shurmer, 1996, "Standards and Trade Performance: The UK Experience", *The Economic Journal*, 106(438), 1297-1313.

Wooldridge, Jeffrey M., 2002, *Econometric Analysis of Cross Section and Panel Data*, Cambridge, MA: MIT Press.

World Bank, 2005, *Food Safety and Agricultural Health Standards: Challenges and Opportunities for Developing Country Exports*, Washington, D.C.: The World Bank.

Tables

Table 1: Descriptive statistics for the EU Standards Database (EUSDB).

	Clothing[1]		Footwear[2]		Textiles[3]	
	Total	% ISO	Total	% ISO	Total	% ISO
1995	15	6.67	5	0.00	102	50.98
1996	18	5.56	10	40.00	125	55.20
1997	20	5.00	15	33.33	164	57.93
1998	28	17.86	18	27.78	187	60.96
1999	32	18.75	31	54.84	223	62.33
2000	28	21.43	39	56.41	249	59.84
2001	32	21.88	57	64.91	268	56.34
2002	35	22.86	60	61.67	281	56.94
2003	41	19.51	67	58.21	303	56.11

1. HS chapters 61-63.
2. HS chapter 64.
3. HS chapters 50-60.
4. Total refers to the total number of CEN European standards in force for each sector-year. % ISO is the proportion of the total number of standards that are internationally harmonized (i.e., identical or equivalent to an ISO standard).

Table 2: Descriptive statistics for product variety (Λ_{xst}).

	Clothing[1]			Footwear[2]			Textiles[3]		
	Median	Max.	Countries	Median	Max.	Countries	Median	Max.	Countries
1995	0.22	0.94	185	0.26	0.96	134	0.08	0.81	180
1996	0.21	0.95	193	0.27	0.99	135	0.08	0.82	179
1997	0.28	0.95	185	0.34	0.99	131	0.10	0.82	168
1998	0.24	0.95	187	0.34	0.99	129	0.09	0.83	166
1999	0.26	0.96	186	0.32	0.99	135	0.08	0.83	178
2000	0.26	0.96	191	0.26	0.99	137	0.10	0.83	171
2001	0.28	0.96	203	0.27	0.99	145	0.08	0.83	179
2002	0.28	0.96	200	0.36	0.99	136	0.09	0.83	179
2003	0.27	0.96	204	0.33	0.99	141	0.07	0.82	187

5. Λ_{xst} is calculated as described in the text, using 8-digit Eurostat import data.

Table 3: Regression results.

	OLS	TSLS	TSLS First Stage		
	$\ln(\Lambda)$	$\ln(\Lambda)$	Ln(Stds)	ISO/Stds	Ln(1+t)
Ln(Stds)	-0.763***	-0.587**			
	[0.152]	[0.262]			
ISO/Stds	1.535***	1.816***			
	[0.334]	[0.420]			
Ln(GDP)	0.056	0.885	-0.022	-0.006	1.384***
	[0.500]	[1.848]	[0.013]	[0.004]	[0.378]
Ln(GDPPC)	0.379	-0.394	0.036*	0.011	-1.278***
	[0.470]	[1.665]	[0.021]	[0.007]	[0.334]
Ln(1+t)	-0.019	-0.617			
	[0.039]	[1.156]			
ATC2	-0.112	0.028	-1.082***	-0.04	0.024
	[0.115]	[0.214]	[0.194]	[0.079]	[0.065]
ATC3	-0.095	0.052	-0.204	-0.091*	0.052
	[0.087]	[0.130]	[0.124]	[0.046]	[0.040]
Quota	-0.347***	-0.349***	-0.001	0	-0.005
	[0.060]	[0.082]	[0.001]	[0.001]	[0.124]
Quota*ATC2	0.006	-0.04	-0.001	-0.001	-0.079
	[0.096]	[0.150]	[0.002]	[0.001]	[0.138]
Quota*ATC3	0.017	0.061	0.002	0.001*	0.073
	[0.176]	[0.172]	[0.002]	[0.001]	[0.134]
Constant	-3.501	-14.397	-33.228*	10.036	-27.295**
	[10.690]	[20.457]	[18.325]	[7.226]	[10.580]
Ln(VA)			-1.837**	-0.189	0.360**
			[0.697]	[0.277]	[0.168]
Ln(Emp)			4.329***	-0.553	-0.064
			[1.267]	[0.520]	[0.351]
Ln(Herf VA)			-4.653***	-0.341	0.820**
			[0.825]	[0.345]	[0.311]
Ln(Herf Emp)			6.710***	1.051	-0.109
			[2.051]	[0.770]	[0.420]
Obs.	3607	3607	3607	3607	3607
R2	0.68	0.65	0.99	0.97	0.77
Exogeneity (F)		14.59***			
Overidentification (χ^2_1)		0.72			
H0: Instr. = 0 (F)			13.78***	11.63***	6.23***

1. All models include fixed effects by exporter, sector, and year. Robust standard errors adjusted for clustering by sector-year appear in square brackets under the coefficient estimates. Statistical significance is indicated using * (10%), ** (5%), and *** (1%).

2. Exogeneity and overidentification tests are the regression-based tests outlined in Wooldridge (2002, pp. 118-124). The F-test is of the null hypothesis that all instruments are jointly zero.

Table 4: Robustness checks.

	No Quota	No High	No U-Mid	No L-Mid	No RTA	No ACP
Ln(Stds)	-0.638**	-0.642*	-0.424	-0.698	-0.728**	-0.621**
	[0.290]	[0.328]	[0.368]	[0.485]	[0.341]	[0.277]
ISO/Stds	2.054***	2.256***	2.148***	3.021***	2.406***	1.948***
	[0.441]	[0.548]	[0.671]	[0.986]	[0.500]	[0.510]
Ln(GDP)	0.463	1.155	0.973	-3.467	0.057	0.826
	[2.278]	[2.969]	[2.640]	[3.494]	[1.066]	[0.949]
Ln(GDPPC)	-0.049	-0.679	-0.322	3.913	0.315	-0.220
	[1.991]	[2.746]	[2.523]	[3.645]	[0.837]	[1.424]
Ln(1+t)	-0.152	-0.708	-1.857	-5.721	0.302	-0.280
	[1.224]	[1.452]	[1.625]	[3.942]	[1.619]	[1.395]
ATC2	0.059	0.108	0.319	0.272	0.116	-0.029
	[0.200]	[0.246]	[0.215]	[0.347]	[0.225]	[0.252]
ATC3	0.017	0.085	0.274	0.662	0.015	-0.067
	[0.133]	[0.211]	[0.285]	[0.396]	[0.144]	[0.126]
Constant	-9.68	-18.222	-19.502	38.929	-1.603	-17.986
	[26.209]	[33.497]	[53.348]	[45.206]	[20.707]	[19.590]
Obs.	3265	2696	2005	992	2894	1548
R2	0.66	0.59	0.34		0.63	0.66
Exog. (F)	14.92***	17.38***	19.12***	9.01***	17.21***	37.61***
Overid. (χ^2_1)	0.98	1.348	0.2	0.69	0.00	0.868

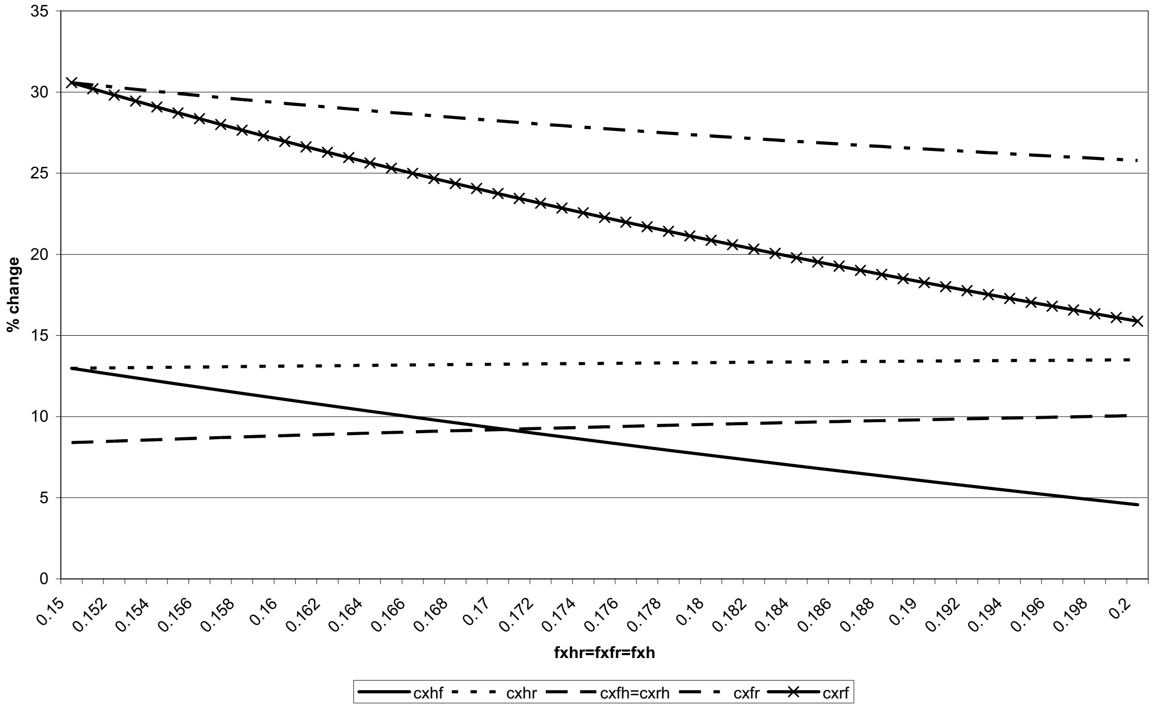
1. All models include fixed effects by exporter, sector, and year. Estimation is by TSLS (first stage results available on request). Robust standard errors adjusted for clustering by sector-year appear in square brackets under the coefficient estimates. Statistical significance is indicated using * (10%), ** (5%), and *** (1%).

2. Exogeneity and overidentification tests are the regression-based tests outlined in Wooldridge (2002, pp. 118-124).

3. Column 1 excludes countries subject to quotas under the ATC, columns 2-4 exclude (in addition) high income, upper middle income, and lower middle income countries. Column 5 excludes countries having a regional trade agreement with the EU, while column 6 excludes (in addition) all members of the African, Caribbean, and Pacific group of countries.

Figures

Figure 1: Simulated change in export marginal cost cutoffs (%) following harmonization.



1. Following Bernard et al. (2007), I use the following invariant parameters: $\sigma = 3.8$, $k = 3.4$, $L = 1000$, $\beta = 0.5$, $\bar{c} = 0.2$, and $f^e = 2$.

2. Prior to harmonization, $f_x^{iH} = f_x^{iF} = 0.15$ and $f_d^H = f_d^F = 0.1$. $f_x^{HR} = f_x^{FR}$ varies over the range 0.15 to 0.2, while f_d^R varies over the range 0.1 to 0.15.

3. Post harmonization, f_x^{iH} remains unchanged but f_x^H varies over the range 0.15 to 0.2, while $f_d^R = f_d^F$ varies over the range 0.1 to 0.15.

4. The solid line shows the percentage change in the export cutoff for H to F following harmonization. The dotted line is for H to R, the dashed line is for F and R to H, the dotted and dashed line is for F to R, and the crossed line is for R to F.