The Impacts of Alignment with Global Product Standards on Exports of Firms in Developing Countries

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Abstract

Complying with global standards and technical norms can be costly, making them potential impediments to trade, but can also expand export opportunities. Two policies available to governments are alignment of domestic technical regulations with international standards and entry into mutual recognition agreements (MRAs). We study the effects of such decisions on the volume of exports to developed markets by firms in developing countries, using data from a World Bank firm-level survey of awareness of global product norms. Both standards alignment and MRAs are associated with more exports to developed countries, but only MRAs significantly promote exports. This finding is consistent with theoretical predictions that MRAs should reduce the fixed costs of exporting more than standards alignment, permitting more firms to enter export markets in higher volumes. Governments in developing countries hoping to encourage exports may wish to favor the negotiation of mutual recognition of testing and certification procedures with major trading partners as a more affirmative avenue to expanding international sales.

Key words: International standards, mutual recognition agreements, developing countries.
JEL codes: F13, F15.

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1. INTRODUCTION

As traditional trade barriers, such as tariffs and quotas, have diminished in importance, increasing attention has been paid to the trade impacts of regulatory policies, such as technical regulations and performance requirements. There can be considerable benefits from more harmonized global standards, including economies of scale, product compatibility, and consumer acceptance of imports. At the same time, it is costly to comply with international technical regulations, which therefore might be impediments to trade.[1]

The compliance challenges are amplified for exporters in developing countries (DCs) that try to penetrate markets in industrial nations. Compliance costs may be significantly higher for such firms due to lower initial domestic standards. Nonetheless, compliance with industrial nations' standards may provide export gains to firms in developing countries due to larger demand for their products and greater incentives to upgrade quality and production processes (Ganslandt and Markusen, 2001; Jaffee and Henson, 2004).

In this paper we offer the first firm-level study of this empirical question, using data acquired from a detailed World Bank survey of exporters in several industries located in developing countries. We examine two types of government initiatives – mutual recognition agreements (MRAs) and alignment of domestic standards with international norms. An MRA is a pact between two or more countries that commits each party to recognize the results of product testing or certifications of the other in specified sectors. Thus, it does not harmonize regulations, but rather recognizes that each member's testing procedures are adequate to guarantee product safety. It should liberalize trade by reducing the cost of duplicative testing, inspection, and certification.

In contrast, alignment means harmonizing national regulations with international standards, such as the ISO 9000 system. This approach may increase market access by signaling to consumers in all

[1] Surveys may be found in Sykes (1995), Maskus and Wilson (2001), and Baldwin (2000).

foreign markets that certified products achieve reliable quality and safety. However, harmonization imposes higher compliance costs than MRAs. It becomes an empirical question as to which approach is likely to raise exports by more (or reduce them by less).

Our empirical contributions are two-fold. First, we employ a firm-level data set (from the World Bank Technical Barriers to Trade Survey, described below) of exporters in developing countries. All previous studies used aggregate trade flows by industry. Second, we distinguish between two different types of policies: negotiating MRAs and aligning home measures with international standards. More specifically, we examine how MRAs and harmonization of domestic regulations with international standards influence firm-level decisions on how much to export to five industrial regions (the United States, the European Union, Canada, Japan, and Australia). We consider exports to developed countries because the issue of quality standards will most sharply arise there.

Our econometric analysis finds that where poor countries negotiated MRAs there is a significant export-promoting effect for their firms, a finding that survives extensive robustness checks. However, alignment with international standards, though positively associated with such exports, does not have a significant impact.

2. RELATION TO PRIOR LITERATURE

The empirical literature on the trade impacts of standards harmonization is scarce, mostly due to data limitations and measurement problems. An early study was by Swann, et al (1996), who used counts of voluntary national and international standards recognized by the United Kingdom and Germany from the PERINORM database at the three-digit industry level.[2] They found that increases in the number of British national standards raised both manufacturing imports and exports, while the number of international standards to which Britain was a party had a significantly positive effect on exports but not imports.

[2] PERINORM is a proprietary database listing detailed product regulations, primarily in developed countries.

Moenius (2004) extended that analysis by constructing a comprehensive data set on industry-specific standards that existed in common between bilateral trading partners. He found that standards had large trade-promoting effect among the nations sharing them, while country-specific standards promoted trade in manufacturing sectors but hindered trade in agriculture. He attributed the latter effect to information costs. Manufactured goods must be adapted to foreign markets and country-specific standards offer information on particular requirements. In contrast, agricultural commodities may not require such adaptation and specific standards are exclusionary.

Chen and Mattoo (2008) examined the effects of regional harmonization within the European Union. In their empirical analysis they employed a data panel covering imports from 28 OECD and 14 developing countries at the three-digit level of manufacturing industries between 1986 and 2001. Using figures on the counts of harmonization directives and MRAs at the industry level, the authors found that harmonization increased intra-EU trade, while raising exports of industrialized non-member countries and reducing exports of most developing countries. However, a higher number of MRAs between the EU and non-member countries promoted trade among all parties, including developing nations.

A few recent studies specifically address the effects of MRAs on trade. Baller (2007) studied standards policies among OECD countries between 1986 and 2003 in two sectors, telecommunication equipment and medical devices, in which MRAs and harmonization coverage are widespread. He found that MRAs had a strong positive influence on both export probabilities and trade volumes for partner countries. Harmonization, however, had negligible effect on parties to the agreement. Vancauteren and Weiserbs (2003) used panel data for 15 EU countries between1990 and 1998 and found that sectors with MRAs exhibited the smallest home bias among all industries subject to some kind of standards harmonization. Amurgo-Pacheco (2007) examined the effects of MRAs between the EU and the United States on third countries in a set of pharmaceutical products. He found that MRAs are trade-promoting instruments among members, but diminish exports from other nations. Finally, a report to the European

Commission (2003) that focused on the MRA between the EU and Australia found a positive but insignificant effect of the MRA in creating trade in four industries.

Case studies of the effects of MRAs on trade are almost non-existent, perhaps because such agreements are relatively recent, especially with developing countries. Two surveys were undertaken by the European Commission (1998, 2002), though it is likely that trade impacts were biased downward by the industry selection. The results suggested that for straightforward products that pose few safety concerns, such as bicycles, tanks and containers, the MRA generally raised trade within the EU. On the other hand, the application of mutual recognition principles to technically complex products, such as buses, trucks, and road safety equipment, or products with safety concerns, such as food supplements, had little impact.

There are a few case studies of alignment with international standards by developing-country governments, though all focus on agricultural commodities. Stanford (2002) described efforts by the government and avocado growers in Mexico to impose international standards on producers in that industry, which resulted in lifting of the USDA ban on avocado imports to the United States in 1997. Henson and Mutillah (2004) discussed Kenyan exports of Nile perch. The government of Kenya has invested in administrative structures, inspection and certification procedures, upgrades of laboratory facilities, and training. While these costs have been considerable, there are significant benefits in terms of more effective quality control. Today most perch exporters have diversified their export base beyond the EU to Australia, Japan, the United States and other locations. Jaffee and Henson (2004) examined three case studies of exports of Guatemalan raspberries, Kenyan fresh produce, and Peruvian asparagus, all of which showed that quality upgrading to international and industrial-countries standards contributed to export growth.

The theoretical literature on standards and trade is more plentiful, though most of it focuses on the potential cost-raising impacts of alignment and harmonization (Maskus and Wilson, 2001).

Borrowing from elements of new trade theory, it is not difficult to understand why MRAs may be more export-promoting than international standards alignment. As emphasized by Melitz (2003), highly productive firms are more likely to enter international markets because they can overcome the fixed costs of exporting more readily than can inefficient firms. Taking this as his point of departure, Baller (2007) sets out a model in which MRAs reduce fixed exporting costs because they do not force local firms to invest in testing and certification procedures that are equivalent to those abroad, which is required under harmonization. As a result, his model predicts a larger export-promoting impact from MRAs than alignment, a finding that is widely anticipated in the policy literature, at least as a matter of degree (Baldwin, 2000; Maskus and Wilson, 2001; Chen and Mattoo, 2008).[3]

3. DATA AND ECONOMETRIC SPECIFICATION

Our econometric approach is driven in part by the nature of the available data. Thus, we first describe the standards data before discussing specification issues.

3.a. The World Bank Survey

In 2001-02 researchers in the Development Economics Group at the World Bank commissioned a major survey in order to address how familiar firms in developing countries were with international product standards and how they responded to them.[4] That effort generated the World Bank Technical Barriers to Trade Survey, described in detail by Wilson and Otsuki (2004). The survey covers 689 firms in 25 industries in 17 developing countries and transition economies for either 2000 or 2001. The primary goal of that project was to evaluate the impact of foreign standards and technical barriers to trade on the operations of firms in DCs. Firms were asked extensive questions about their knowledge of such regulations in five main developed regions (United States, EU, Canada, Japan, and Australia) and their reactions to them. Questions also were posed about domestic government policies and whether they hindered or enhanced the respondent firm's ability to export.

[3] In his review of EU experience, Pelkmans (2003) adds a further advantage of MRAs, in that they are less subject to capture by those who might engage in costly overregulation.

[4] See Maskus, Otsuki and Wilson (2001) for an extensive discussion of these issues.

The data we employ form a subset of the overall survey. Appendix Table A1 presents the detailed industry and country composition of our data set after cleaning and omitting observations with missing values for the variables we analyze. Our firms cover both manufacturing and agricultural products. As can be seen in Appendix Table A1, 40.9 percent of the observations in our sample come from India, while the representation of other countries in the sample varies from 0.7 percent (Senegal) to 7.6 percent (South Africa). In terms of industry composition, textiles and apparel constitute 29 percent of the sample, followed by processed food and tobacco (11 percent) and raw agricultural products (10 percent). The percentage of other industries varies from 0.5 percent (materials) to 7.1 percent (miscellaneous manufacturing commodities).

Our sample contains 421 firms, each of which reported their exports, if any, to the five developed regions mentioned above and total world exports. Values were converted into thousands of U.S. dollars at contemporaneous exchange rates.

Our two policy variables are taken from the survey as well. The first, which we call STANDARD, is the total number of international standards with which the country's government has aligned its domestic regulations, as reported by firm managers. Specifically, firms were asked the following question: "With which international standards did your government choose to align their national regulations?" The question listed as choices the International Standards Organization (ISO), International Electrotechnical Commission (IEC), International Telecommunications Union (ITU), Codex Alimentarius (CODEX), Office International des Epizooties (OIE), and the Food and Agricultural Organization's International Plant Protection Convention (IPPC). For each choice the response was either yes or left blank.

We constructed STANDARD as the sum of all positive responses. Thus, if a firm reported that its government had aligned domestic regulations with ISO only, STANDARD would equal one; if it also had adopted CODEX, STANDARD would be equal to two, and so on. Detailed information is available

in a supplementary data appendix on request. In summary, approximately 70 percent of the firms did not report any known alignment with international standards, while 26 percent reported alignment with only one standard and only four firms mentioned three. Some firms in all countries reported at least one such alignment. At the industry level, there was at least one firm in all sectors except petroleum, leather products, and paper products that listed positive alignment with international standards. The largest absolute numbers of responses arose in textiles and apparel, followed by processed food and tobacco, and raw agricultural products. As a proportion of total firms in each industry claiming alignments, the highest were in instruments and photographic and optical goods (66 percent) and primary metals (60 percent).

The second policy variable is MRA, which was constructed from the question: "Are any of your top five revenue-generating products subject to mutual recognition agreements in any of the following countries/regions: US, EU, Canada, Japan, Australia?" Similar to STANDARD, variable MRA is the sum of positive responses, with the highest reported value being the maximum of five. To summarize, most firms did not report any MRAs (87.9 percent). For example, no firms from India, Senegal, and Iran operated under any MRA with the five developed countries. These governments have not placed emphasis on negotiating such agreements on behalf of exporting firms. Among those firms reporting agreements, 35 mentioned MRAs with one developed country and 16 reported MRAs with multiple regions.

Overall, adherence with international standards is more prevalent in the data than membership in MRAs, perhaps because the former may be less strict than what developed countries require in the latter. Further, alignment with international standards is a unilateral decision, which is easier than concluding an MRA. Summary statistics for exports and the policy variables are in Table 2.

3.b. Econometric Specification

In our data set 18 percent of all firms do not export to any of our five developed regions. Thus, our main approach is to use Tobit estimation of the following equation:

$$EXP_{ijk} = \beta' X_{ijk} + \lambda z_{ijk} + a_j D_j + \delta_k D_k + \varepsilon_{ijk}$$

This equation determines the amount of firm *i*'s exports (in log form) in industry *j* from country *k*, EXP_{ijk}, summed across five developed markets (United States, EU, Canada, Australia, and Japan) as a function of firm characteristics, $X_{ijk,}$ and government policies toward compliance with the international standards, z_{ijk}.[5] The equation also includes fixed effects for industry and exporting country.

The X_{ijk} vectors include several firm characteristics reported in the survey. The first is years since the enterprise was founded (AGE), since it is likely that older firms have established domestic and international markets. Second is fixed assets (FIX_A) to control for the firm's size.[6] A third factor is the extent of foreign ownership (F_OWN), which might enhance the ability to penetrate foreign markets. A fourth characteristic is the average growth rate of sales in the past three years (GR_PAST). Finally, we control for the type of the firm through the use of dummy variables that indicate whether the firm is a state enterprise, private company, subsidiary of a multinational firm, joint venture, or other type. Variables AGE and FIX_A enter the estimation in natural logs.

The industry dummies control for unobserved industry-specific characteristics, such as technological intensity, trade barriers in importing nations, and market structure. The exporter country dummies reflect geographical characteristics, aggregate trade policies of local governments, unobserved treatment by industrial countries of a particular developing country, such as preferential trade agreements, and any other international trade considerations that differ by exporting country. We

[5] Because exports were zero for some firms, we actually take logs of one plus exports.

[6] We also tried both sales and employment to control for size and the results were qualitatively the same. However, due to concern about contemporaneous endogeneity of those variables we chose the size of fixed assets since investment decisions generating capital stocks are made in previous periods, making fixed assets predetermined. In our sensitivity section we treat fixed assets as endogenous and use instrumental variables to purge correlation with unobserved firm effects. As shown below, the main regression results are very similar.

assume that ε_{ijk} is a random disturbance term symmetrically distributed about zero and uncorrelated with the explanatory variables.

3.c. Blank Entries

A primary problem with the construction of our policy variables was how to treat blank entries on firms' responses about MRAs and international standards. Those entries could either indicate that there were no such measures or that the firm managers were unaware of them. In principle, we would expect most such answers to mean the absence of measures since the firms in our sample are exporters or indicated an intention to export, suggesting that managers would be aware of product regulations in foreign markets. Nonetheless, we developed several versions of the policy variables based on different assumptions.

First, we assumed that blank entries truly signify no MRAs (MRA = 0) or no incorporation of international standards (STANDARD = 0).[7] Second, we assumed that the number of MRAs and standards should be similar by country and industry, so we assigned average values of MRA or STANDARD, calculated by country and industry code, to missing answers. Third, we used the maximum value of STANDARD and MRA by industry and country instead of average value. Finally, we experimented with assigning averages and maximum values to all firms, not just to those with blank answers, in our fourth and fifth versions, respectively. Our primary reported regressions employ assumption two, assigning average values for MRA and STANDARD to the blank entries, because it seems to be most realistic. However, we show results for all versions for comparison purposes.

3.d. Endogeneity and Instrumental Variables

The most significant problem we face is that our sample is a cross section, rather than a panel.[8] This issue makes identification of the causal impacts of our policy variables on exports difficult. The reason is that STANDARD and MRA may be endogenous, since the government could decide to

[7] Even if managers were unaware of existing measures, a blank entry would suggest they do not take such measures into account in their decision making.

[8] Unfortunately, the World Bank decided not to replicate the survey in later years.

negotiate more MRAs and align with international standards in sectors of particular comparative advantage or where exports are growing rapidly. Note that MRA negotiations and harmonization with international standards take years, suggesting that such policies might be considered predetermined. However, firms and sectors with significant exports in the cross section may have been high-growth entities in the past, generating a channel from exports to policy. Alternatively, both the decisions to export by firms and government involvement with trade issues might be influenced by an unobserved third factor.

We address endogeneity concerns by incorporating, as instrumental variables, several standard political-economy measures at the country-industry level. Specifically, the decision to negotiate MRAs and align with international standards may be influenced by a variety of economic and political factors. Thus, for economic instruments in the manufacturing sectors we extracted several series from the World Bank's "Trade, Production and Protection 1976-2004" data set.[9] That database contains exports, employment, investment, and other measures by country and industry at the 3-digit International Standard Industrial Classification (ISIC) level. We developed a concordance between the ISIC and our industry breakdown, which is available in a supplemental appendix. For the agricultural sector we compiled similar figures from the *World Development Indicators*.

We use data from these sources to construct the following variables, which are sensible instruments for interests that could affect MRA and standards policy, while plausibly uncorrelated with the error terms in export regressions using data for individual firms, given that our sample covers only a small number of enterprises in each sector-country pair.

First, IND_EXP_GR is the growth of industry exports for each country in our sample between 1989 and 1996. Since we do not have the information on when MRAs and international standards were

[9] These data were compiled by the Trade Research Group in Development Economics and are available at the World Bank website. The most recent figures contain data for all of the countries in our database. Some data are missing for particular years and industries, which is why we use averages.

enacted, we chose this period to make sure that we are looking at the industry's export growth before those initiatives came into effect.

Second, COMP_ADV is the average industry's revealed comparative advantage between 1989 and 1996, calculated as:

$$\frac{(Exp_{jk} / \sum_{k} Exp_{jk})}{(\sum_{j} Exp_{jk} / \sum_{j}\sum_{k} Exp_{jk})}$$

This measure captures country k's share of industry j's exports in total world exports of industry j, divided by country k's share of total world exports. A higher ratio "reveals" higher comparative advantage, though there are problems with that interpretation.[10] Calculated at the industry level it is a sensible instrument for trade-policy interests of individual firms.

Third, EMPL is the average industry employment share by country between 1989 and 1996, calculated as the ratio of industry employment over the country's labor force.[11] Finally, HERF is the Herfindahl index of industry concentration in the United States for 1992, acquired from the U.S. Census Bureau.

In addition to economic factors, domestic political structure can also influence the amount of government involvement in trade policy. For this reason we add to the pool of instruments two government structure variables. These include a democratization index, derived from Gastil's political rights index (Freedom House, various years), averaged over 1989-1996, and the relative size of the government, defined as the share of government spending as a percentage of GDP between 1989 and 1996. We also incorporate interaction terms between our economic instruments and government structure variables.

[10] See Ballance, et al (1987) for an extensive discussion and Balassa and Bauwens (1988) for an application.
[11] Labor force figures were taken from the World Bank, *World Development Indicators*.

In the estimation, we choose the instruments used for each specification from the pool of constructed IVs using the following criteria. First, they have significant correlation with the policy variables. Second, they satisfy the overidentification tests of instrument exogeneity (Hansen's J-test). Third, we consider whether the exclusion restrictions are appropriate by testing whether the instruments have no independent influence on the dependent variable, beyond that exercised through the policy variables. We check that by entering each instrument in the second stage and testing its significance.

Precise definitions of all variables and their units are presented in Table 1, while summary statistics are in Table 2.[12]

4. ECONOMETRIC RESULTS

We turn next to the presentation and discussion of the statistical analysis, beginning with the base case and working through endogeneity analysis and robustness checks.

4a. Basic Specification

First, we estimate our regression equation using Tobit in the cross-section of firms summarized in the data section, but without instrumental variables. Table 3 presents our initial estimation results using version two (average values of MRA and STANDARD are assigned to the blank entries) of our policy variables. Here we include firm characteristics and country and industry dummies. The table contains three specifications, with the policy variables entering separately and together.

The estimation results in columns (1)-(3) show that both alignment with international standards (STANDARD) and negotiating mutual recognition agreements (MRA) are positively and significantly (at 5% and 1% significance level, respectively) associated with exports to the five developed regions. The magnitude of the coefficients is similar for both policy variables. In terms of economic effects, the coefficients in this regression imply that, on average, having an MRA with an additional developed country (or region) in our sample, or aligning with one additional international system of standards, is

[12] A correlation matrix is available in the supplementary data appendix.

associated with approximately 122 percent more exports of individual firms to these developed markets.[13]

The magnitudes of these coefficients, though large, seem plausible. Most of the firms in the sample list no or one MRAs with developed countries, so negotiating the first such agreement might have a large impact on the exports to industrial nations for a number of reasons. It could raise demand for a firm's products by signaling to importers abroad that those products may be brought in without further certification. Further, entry into an MRA could substantially decrease the cost of exporting and there may be learning effects that can encourage exporting to other rich nations. Similarly, almost 70 percent of the firms reported no adoption of international standards. Thus, a harmonization policy could require them to undertake substantial investments in production process and quality upgrading. Alternatively, since the direction of causality is not clear in this basic Tobit case, the government may have adopted international standards in sectors that were already exporting and complying with those norms.

Concerning other control variables, the size of fixed assets is positively associated with exports to developed countries. It also appears that subsidiaries of domestic companies tend to export less to developed regions.

4b. Endogeneity and Instrumental Variables Estimation

Next we address the endogeneity concerns regarding our policy variables, while below we consider endogeneity of fixed assets. As discussed earlier, we develop a series of potential IVs from independent data sources at the World Bank. The second-stage IV-Tobit regression results are shown in Table 4.[14] We note from the first-stage regressions (not shown here) that MRA is a function of several political-economic factors, including the Herfindahl index, democracy and the interaction between them, and interactions between industry export growth and the size of the government, and industry export

[13] We calculate percentage change in EXP as $100(e^{0.8} - 1) = 122.5$ percent.
[14] These regressions were run with the ivtobit routine in Stata. In order to conserve space we do not show first-stage results here but they are available on request.

growth and democracy. Specifically, MRAs are more likely to be negotiated in more concentrated industries and less democratic societies. In addition, for an average firm in our sample industry export growth is associated with higher number of MRAs.[15]

Column 1 shows the second-stage regression for the case where only MRA is potentially endogenous. Of primary interest is that the coefficient for MRA remains positive and significant at the ten-percent level. Its magnitude rises from 0.87 without instrumentation in Table 3 to 0.92 in this case. Thus, once we purge MRA of its political and economic determinants, its effect on exports to developed economies becomes even greater.

The second column shows the corresponding IV-Tobit estimation accounting for endogeneity of STANDARD. First-stage results suggested that alignment with international standards is more prevalent in less democratic societies and for an average firm it is negatively associated with industry export growth. In terms of our main question, the second-stage results find that, unlike MRA, the magnitude of the coefficient on STANDARD falls with IV estimation. Further, the coefficient is not significant, suggesting that there is little evidence of a causal relationship from standards alignment to exports to developed countries. In this context, MRAs appear to be more determinative means of expanding exports than are international standards for firms in poor countries.

Finally, the third column shows the results when both policy variables enter the IV-Tobit estimation. Here the coefficient for MRA is still positive and significant at the ten-percent level, while that for STANDARD is not. Overall, our evidence suggests that alignment with international standards may not promote exports to developed countries as much as negotiation of MRAs. For further perspective, we present in Appendix Table A.2 descriptive statistics for two groups of firms, those covered by MRAs and those not covered. As the figures reveal, firms that report the existence of MRAs are younger and larger on average and have a larger share of foreign ownership. None is state owned or

[15] By average we mean a firm that comes from a country with the average share of government expenditure in relation to GDP (14 percent) and the average democracy index (4.65).

a subsidiary of a domestic enterprise. However, a larger portion is either a subsidiary of a multinational firm or part of a joint venture. It seems that, at least in this sample, having foreign ownership or a JV partnership is correlated with the ability to use an MRA for export growth. This outcome may be due to local subsidiaries having easier access to higher-quality standards from their investment partners. There also may be greater trust in product quality if a firm has foreign business partners.

4c. Sensitivity Checks.

Given that our policy variables are measured somewhat indirectly, it is important to subject the basic results to sensitivity and robustness checks. As mentioned above, we also ran the same types of regressions using the other four versions of our policy variables, with zero entries treated in different fashion. In Table 5 we summarize the coefficients only for the policy variables, since the results for other regressors were almost identical.[16] Coefficient estimates of the policy variables are similar for versions (2) - (5). In version (1) the coefficients for MRA in the export equation are almost double those in the other versions and suggest unrealistically high trade elasticities. The main conclusions are consistent across the other treatments of zero entries in computing the policy variables. In the remaining analysis we only employ version two, which, as we argued above, seems the most natural construct and has the advantage over versions four and five of preserving variation across firms, rather than just across industries and countries.

As a second sensitivity check, we introduced country-industry interaction dummies in addition to country and industry dummies, a rigorous specification of controls. Since our data have a limited set of observations, for this purpose we aggregated countries into five regions (Eastern Europe, Latin America and Caribbean, Middle East, South Asia and Sub-Saharan Africa) and industries into five groups (raw food, processed food and related goods, equipment, materials, and textiles). This resulted in 32 dummy variables (24 interaction, four industry and four country dummies) in our regression equations. We

[16] Full results are available upon request.

simply summarize the results here. The MRA coefficients remain positive and significant in all equations, though again only marginally so in the IV-Tobit case with both policy variables included. Thus, our earlier conclusion holds up: MRAs are effective policy initiatives for export promotion, while alignment with international standards does not seem to have much impact on firm-level manufacturing exports to developed countries.

Next, we address another endogeneity concern that relates to the size of a firm, measured here by the value of fixed assets. Though the size of fixed assets is in principle predetermined from prior investments, there might still be unobserved firm characteristics that influence both the size of the firm and the amount of exports. One example is having ties with the government, which might be helpful in both export growth and asset expansion. Furthermore, a firm might make export decisions based on the discounted present value of future assets. Thus, we treat fixed assets variable also as endogenous. The results for the case where we treat MRA and fixed assets as endogenous are in the fourth column of Table 4. In the second stage we find that the coefficient on MRA is quite similar to that in the first column. To conserve space we do not show the results for the cases with STANDARD included, for those coefficients are consistent with earlier findings.

As a fourth robustness exercise we consider potential heteroskedasticity in the second-stage IV-Tobit regression residuals. When such residuals have unequal error variances, the consistency of Tobit estimates is in question (Wooldridge 2003). The most likely source of heteroskedasticity is variation in firm size, as captured by fixed assets. Thus, to address this problem we first regress the squared residuals from the IV-Tobit specification of the export equation with MRA as the only policy variable, taken from Table 4. This regression yields:

$$\hat{\varepsilon}_{ijk}^{\,2} = \underset{(.1430)}{.5539} + \underset{(.0211)}{0.0896}^{*} FIX\_A_{ijk} + u_{ijk}$$

This result suggests there is positive correlation between squared residuals and the size of fixed assets. Accordingly, we scale all variables by the square root of (0.5539 + 0.0896*FIX_A) and run the new regression equation, verifying that the squared residuals in the new specification are not statistically significantly related to asset size. The coefficient estimate on MRA in the scaled regression is 1.062, similar to those in Table 4, and remains significant at the 10 percent level. This finding confirms that our main results still hold and the size of the coefficient for MRA is close to that in the basic specification.

A further question to check is whether our results are dominated by the high number of Indian firms in the data sample. As noted earlier, such firms comprise nearly 41 percent of the firms overall, yet report no MRAs in their survey responses. Running the IV-Tobit estimation after removing Indian enterprises, we find that the responsiveness of exports to the number of MRAs is somewhat larger than that in the base case in the first column of Table 4 and remains significant.

As a final check, we also consider the relationship between our policy variables and total exports, rather than just exports to the five developed regions. In these specifications, MRA includes all mutual recognition agreements, not just those with the developed countries. As shown in the final column of Table 4, the IV coefficient on MRA becomes insignificant. That the responsiveness of exports to all MRAs is lower when we include all export destinations accords with intuition, because standards for achieving mutual recognition are generally less rigorous in other developing countries than in developed markets. In turn, the impact on consumer acceptance in export destinations may be less.

5. CONCLUDING REMARKS

This paper offers the first firm-level econometric evidence on the effects of aligning domestic product standards with international norms and of negotiating mutual recognition agreements on firm-level manufacturing exports of developing nations. Without considering endogeneity of the policy variables, we found that both measures are associated with more exports to developed countries.

However, when we apply instrumental variables to deal with the problem of endogeneity we found that the influence of MRAs remains significantly positive, but that of standards alignment becomes insignificant. Note that there is no evidence from this analysis that linking with international standards actually causes exports from developing-country firms to be reduced through higher costs. These results are consistent with the findings in Baller (2007).

On this evidence, it seems that MRAs are particularly stimulating for exports, presumably because they reduce the direct costs of exporting associated with certification and testing. Alignment with international standards, such as ISO and CODEX, has lesser ability to expand exports from poor countries, perhaps because those norms may be insufficient to meet the requirements of developed-country markets.

These results suggest that if governments of developing countries are interested in increasing export to developed countries' markets, resources could be spent on negotiating MRAs. Of course, in making such choices governments are constrained by their available resources and often it is costly to negotiate comprehensive MRAs. Further, it is not evident from these results that this approach is the first-best means of expanding exports. Overall, however, the findings in this paper support the notion that some forms of linkage to international product norms can enhance export performance of individual firms, rather than serve as export barriers.

APPENDIX

Appendix Table A1. Industry and Country Composition.

		Number of Observations																	
Code	**Industry**	Argen-tina	Bul-garia	Chile	Czech Rep	Hon-duras	India	Iran	Jor-dan	Ke-nya	Nige-ria	Paki-stan	Pa-nama	Po-land	Sene-gal	South Afr	Ugan-da	**Total**	***Percent***
1	Raw agricultural products	1	1	7	1	1	4	0	2	12	8	0	0	2	0	0	3	42	*9.98*
2	Meat and fish products, livestock	1	1	0	1	1	0	0	0	0	0	1	3	0	0	0	2	10	*2.38*
3	Electrical and electrical equipment	1	2	0	6	0	9	1	0	0	0	0	0	5	0	1	1	26	*6.18*
4	Fabricated metal	1	1	0	0	0	6	0	1	0	0	0	0	0	0	6	0	15	*3.56*
5	Industrial machinery and equipment	1	1	0	0	0	7	0	0	0	0	0	0	0	0	1	0	10	*2.38*
6	Industrial or agricultural chemical	2	3	2	5	0	1	4	1	0	0	0	1	3	2	2	0	26	*6.18*
7	Instruments and photographic and optical goods, watches and clocks	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	3	*0.71*
8	Leather and leather products	0	1	0	0	0	15	1	0	0	0	2	0	0	0	0	1	20	*4.75*
9	Paper and allied products	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	*0.71*
11	Processed food and tobacco	6	2	2	3	2	11	1	7	3	3	0	2	2	0	4	3	51	*12.11*
12	Rubber and plastic products	4	0	2	0	0	1	0	2	0	1	1	2	0	0	3	0	16	*3.80*
13	Telecommunications and terminal equipment	0	0	0	3	0	1	0	0	0	0	0	0	0	0	1	0	5	*1.19*
14	Textiles and apparel	1	5	1	3	1	87	2	3	0	1	6	1	6	0	5	0	122	*28.98*
15	Transportation equipment and automotive parts, and dealers	4	1	0	5	0	4	0	0	0	0	0	0	3	0	4	0	21	*4.99*
16	Lumber, wood and furniture	0	0	1	3	1	0	1	0	0	0	0	0	0	0	0	0	6	*1.43*
18	Primary metal and metallic ores	0	0	0	0	0	0	0	1	0	0	0	0	1	0	2	1	5	*1.19*
19	Petroleum and other nonmetallic minerals	0	0	0	0	0	0	2	3	0	0	0	0	0	0	2	1	8	*1.90*
20	Miscellaneous manufactured commodities	0	0	0	0	0	25	1	0	1	0	1	0	0	1	1	0	30	*7.13*
22	Material	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*0.48*
	Total	24	20	15	31	6	172	13	20	16	14	12	9	22	3	32	12	421	*100.00*
	Percent	*5.70*	*4.75*	*3.56*	*7.36*	*1.43*	*40.86*	*3.09*	*4.75*	*3.80*	*3.33*	*2.85*	*2.14*	*5.23*	*0.71*	*7.60*	*2.85*	*100.00*	

Appendix Table A2. Descriptive Statistics for Firms According to MRA Experience

	Reported MRAs					*Did not report MRAs*				
Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
EXP	51	6.821	2.248	0.403	11.76	370	4.858	3.270	0	11.724
EXP_all	51	7.46	2.135	1.785	12.48	361	6.494	2.314	0	11.724
STANDARD	51	0.588	0.726	0	3	370	0.324	0.568	0	3
GR_PAST	51	0.23	0.31	-0.31	1.5	370	0.189	0.328	-0.200	3.000
AGE	51	2.602	0.738	0.693	4.644	370	2.821	0.842	0.693	4.956
FIX_A	51	7.179	2.056	3.398	13.2	370	6.291	2.297	0.722	12.235
F_OWN	51	1.51	0.809	1	3	370	1.197	0.547	1	3
PRIVN	51	0.608	0.493	0	1	370	0.559	0.497	0	1
PRIVL	51	0.176	0.385	0	1	370	0.162	0.369	0	1
SUBD	51	0	0	0	0	370	0.008	0.090	0	1
SUBM	51	0.078	0.272	0	1	370	0.030	0.170	0	1
JOINTD	51	0.059	0.238	0	1	370	0.022	0.146	0	1
JOINTM	51	0.039	0.196	0	1	370	0.016	0.126	0	1
STATE	51	0	0	0	0	370	0.016	0.126	0	1

REFERENCES

Amurgo-Pacheco, A. (2007), 'Mutual Recognition Agreements and Trade Diversion: Consequences for Developing Nations,' HEI Working Papers No. 20-2006 (Economics Section, The Graduate Institute of International Studies).

Balassa, B. and L. Bauwens (1998), *Changing Trade Patterns in Manufactured Goods: An Econometric Investigation* (Amsterdam: North-Holland).

Baldwin, R. (2000), 'Regulatory Protectionism, Developing Nations and a Two-Tier World System,' Centre for Economic Policy and Research Discussion Paper No. 2574 (London).

Ballance, R. H., H. Forstner, and T. Murray (1987), 'Consisency Tests of Alternative Measures of Comparative Advantage,' *Review of Economics and Statistics*, 69, 1, 157-161.

Baller, S. (2007), 'Trade Effects of Regional Standards Liberalization. A Heterogeneous Firms Approach,' World Bank Policy Research WP 4124 (World Bank).

Chen, M. X. and A. Mattoo (2008), 'Regionalism in Standards: Good or Bad for Trade?' *Canadian Journal of Economics*, forthcoming.

European Commission (1998), *Technical Barriers to Trade,' Volume 1 of Sub-series III: Dismantling of Barriers of The Single Market Review*, (Luxembourg: Office for Official Publication).

European Commission (2002), *Report From the Commission to the Council, the European Parliament and the Economic and Social Committee. Second Biennial Report on the Application of the Principle of Mutual Recognition in the Single Market*, (Brussels: European Commission).

European Commission. (2003), *The Economic Impact of Mutual Recognition Agreements on Conformity Assessment: A Review of the Costs, Benefits, and Trade Effects Resulting from the European Community MRAs Negotiated with Australia and New Zealand*, Final Report (Brussels: European Commission).

Freedom House. (Various years). *Freedom in the World: Political Rights and Civil Liberties*. (New York: Freedom House).

Ganslandt, M. and J. R. Markusen (2001). 'Standards and Related Regulations in International Trade: A Modeling Approach,' in K. E. Maskus and J. S. Wilson (eds.), *Quantifying the Impact of Technical Barriers to Trade: Can it be Done?* (Ann Arbor: University of Michigan Press).

Henson, S. and W. Mitullah (2004), 'Kenyan Exports of Nile Perch: Impact of Food Safety Standards on an Export-Oriented Supply Chain,' World Bank Policy Research Working Paper 3349 (World Bank).

Jaffee, S.and S. Henson (2004), 'Standards and Agro-Food Exports from Developing Countries: Rebalancing the Debate,' The World Bank, *Policy Research Working Paper Series* 3348 (World Bank).

Maskus, K. E., T. Otsuki, and J. S. Wilson (2001), 'An Empirical Framework for Analyzing Technical Regulations and Trade,' in K. E. Maskus and J. S. Wilson (eds.), *Quantifying the Impact of Technical Barriers to Trade: Can It Be Done?* (Ann Arbor: University of Michigan Press).

Maskus, K E. and J. S. Wilson (2001), 'A Review of Past Attempts and the New Policy Context,' in K. E. Maskus and J. S. Wilson (eds.), *Quantifying the Impact of Technical Barriers to Trade: Can It Be Done?* (Ann Arbor: University of Michigan Press).

Moenius, J. (2004), 'Information versus Product Adaptation: the Role of Standards in Trade,' Kellogg School of Management working paper (Northwestern University).

Pelkmans, J. (2003), 'Mutual Recognition in Goods and Services: an Economic Perspective,' European Network of Economic Policy Research Institutes, Working Paper 16.

Stanford, L. (2002), 'Constructing "Quality": The Political Economy of Standards in Mexico's Avocado Industry,' *Agriculture and Human Values*, 19, 4, 293-310.

Swann, P., P. Temple, and M. Shurmer (1996), 'Standards and Trade Performance: The UK Experience,' *Economic Journal*, 106, 1297-1313.

Sykes, A. O. (1995), *Product Standards for Internationally Integrated Goods Markets*. (Washington, D.C.: Brookings Institution).

Vancauteren, M. and D. Weiserbs (2003), 'The Impact of Removal of Technical Barriers to Trade on Border Effects and Intra-Trade in the European Union,' Working Paper (Universite Catholigue de Louvain).

Wilson, J. S. and T. Otsuki (2004), 'Standards and Technical Regulations and Firms in Developing Countries: New Evidence from a World Bank Technical Barriers to Trade Survey,' The World Bank, working paper (World Bank).

Wooldridge, J. M. (2003), *Introductory Econometrics: A Modern Approach, 2d Edition* (Mason OH: Thomson South-Western).

Table 1. Variable Definitions.

LHS variables	Description
EXP	Log of Exports to developed countries – EU, USA, Canada, Japan, Australia (exports are in 2001 US $1,000)
EXP_all	Log of total exports (exports are in 2001 US$1,000)
RHS variables	
STANDARD	The number of international standards with which the country's government chose to align their national regulations (ISO, IEC, ITU, CODEX, OIE, IPPC)*.
MRA	The sum of positive responses to the questions whether any of the top 5 products are subject to MRA with US, EU, Canada, Japan, or Australia.
GR_PAST	Average growth rate of sales in the past 3 years (%)
AGE	Log of firm's age = Log (2001 – year of establishment)
FIX_A	Log of value of plant's fixed assets (in 2001 US$1,000)
F_OWN	Share of foreign ownership: 1 – no foreign ownership, 2 – less (or equal) than 50% , 3 – more than 50% foreign ownership
	Type of Ownership (Dummies)**
PRIVN	Headquarter local of a privately held, non-listed company
PRIVL	Headquarter local of a publicly traded or listed company
SUBD	Subsidiary/division of a domestic enterprise
SUBM	Subsidiary/division of a multinational firm
JOINTD	Joint venture of a domestic enterprise
JOINTM	Joint venture of a multinational firm
STATE	Completely or partially state-owned company
Instruments	
IND_EXP_GR	Average growth of industry exports in each country between 1989-1996
COMP_ADV	Average industry *j*'s revealed comparative advantage for country *k* between 1989-1996, calculated as $\frac{(Exp_{jk} / \sum_k Exp_{jk})}{(\sum_j Exp_{jk} / \sum_j \sum_k Exp_{jk})} / 10$
EMPL	Average industry employment share by country between 1989-1996, calculated as the ratio of industry employment over country's labor force*1000 (number of employees per thousand of labor force)
HERF	Herfindahl index of industry concentration in the US for 1992 (divided by 1000)
GOVT	Average government expenditures as a share of GDP (in %) between 1989-1996
DEM	Average democracy index (= 8 - Gastil's political rights index) between 1989-1996

* ISO – International Standards Organization
IEC – International Electrotechnical Commision
ITU – International Telecommunications Union
CODEX – Codex Alimentarius Commission
OIE – Office International des Epizooties
IPPC – FAO International Plant Protection Convention

** The benchmark type of ownership is cooperative/collective.

Table 2. Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
EXP	421	5.096	3.226	0	11.758
EXP_all	412	6.613	2.312	0	12.476
STANDARD	421	0.356	0.595	0	3
MRA	421	0.185	0.593	0	5
GR_PAST	421	0.194	0.325	-0.311	3.000
AGE	421	2.794	0.832	0.693	4.956
FIX_A	421	6.398	2.285	0.722	13.201
F_OWN	421	1.235	0.593	1	3
PRIVN	421	0.565	0.496	0	1
PRIVL	421	0.164	0.371	0	1
SUBD	421	0.007	0.084	0	1
SUBM	421	0.036	0.186	0	1
JOINTD	421	0.026	0.160	0	1
JOINTM	421	0.019	0.137	0	1
STATE	421	0.014	0.119	0	1
IND_EXP_GR	421	0.309	0.362	0.002	2.158
COMP_ADV	421	0.034	0.119	0.000	0.845
EMPL	421	0.152	0.129	-0.531	0.727
HERF	421	0.948	0.397	0.255	1.873
GOVT	421	14.071	4.160	8.854	21.755
DEM	421	4.657	1.201	2.125	6.500

Table 3. Tobit Estimation of Export Equations.

	(1)	(2)	(3)
MRA	0.870*** (0.232)		0.816*** (0.231)
STANDARD		0.818*** (0.304)	0.715** (0.300)
GR_PAST	0.752 (0.497)	0.736 (0.502)	0.687 (0.494)
AGE	0.211 (0.216)	0.184 (0.218)	0.208 (0.214)
FIX_A	0.594*** (0.088)	0.610*** (0.088)	0.581*** (0.087)
F_OWN	0.531 (0.368)	0.572 (0.371)	0.552 (0.365)
PRIVN	-0.143 (0.514)	-0.244 (0.520)	-0.218 (0.511)
PRIVL	-0.202	-0.197	-0.283

	(0.630)	(0.636)	(0.626)
SUBD	-6.866*** (2.383)	-8.113*** (2.428)	-7.306*** (2.392)
SUBM	1.652 (1.226)	1.664 (1.236)	1.684 (1.216)
JOINTD	-0.855 (1.341)	-1.223 (1.350)	-0.857 (1.332)
JOINTM	-0.195 (1.304)	-0.837 (1.325)	-0.606 (1.306)
STATE	-1.489 (1.486)	-1.360 (1.503)	-1.243 (1.485)
Log-likelihood	-952.57	-955.91	-949.76
Pseudo-R^2	0.0859	0.0827	0.0886
Obs	421	421	421

All equations include industry and country fixed effects. ***Significant at 1%, ** significant at 5%, *significant at 10%

Table 4. IV-Tobit Estimation of Second-Stage Export Equations.

	MRA (1)	STANDARD (2)	MRA and STANDARD (3)	MRA and FIXED_ A (4)	MRA_ALL (5)
MRA	0.924* (0.534)		0.969* (0.594)	1.001* (0.589)	
STANDARD		0.606 (1.380)	-0.231 (1.513)		
FIXED_A				0.717* (0.403)	
MRA_ALL					0.612 (0.643)
GR_PAST	0.748 (0.497)	0.756 (0.519)	0.770 (0.518)	0.709 (0.514)	0.598** (0.272)
AGE	0.212 (0.216)	0.184 (0.217)	0.213 (0.217)	0.131 (0.336)	0.136 (0.126)
FIX_A	0.592*** (0.089)	0.614*** (0.092)	0.593*** (0.092)		0.636*** (0.055)
F_OWN	0.529 (0.368)	0.568 (0.371)	0.527 (0.372)	0.450 (0.446)	0.249 (0.198)
PRIVN	-0.141 (0.514)	-0.221 (0.537)	-0.116 (0.542)	-0.170 (0.523)	0.128 (0.284)
PRIVL	-0.209 (0.632)	-0.171 (0.654)	-0.192 (0.652)	-0.489 (1.088)	0.454 (0.344)
SUBD	-6.827*** (2.406)	-8.046*** (2.457)	-6.915*** (2.512)	-7.064*** (2.525)	0.183 (1.104)
SUBM	1.654 (1.225)	1.648 (1.237)	1.622 (1.234)	1.491 (1.333)	1.117* (0.660)
JOINTD	-0.836 (1.351)	-1.235 (1.350)	-0.856 (1.358)	-0.835 (1.355)	-0.756 (0.780)
JOINTM	-0.184 (1.307)	-0.721 (1.512)	-0.059 (1.582)	-0.344 (1.406)	0.153 (0.710)
STATE	-1.474 (1.490)	-1.443 (1.598)	-1.586 (1.602)	-1.611 (1.557)	-0.441 (0.772)
Obs	421	421	421	421	412
Wald $\chi^2(43)$	284045.42	36567.00	2046.69	7627.15	416.92
Hansen J-test (p-value)	0.90767	0.34229	0.82703	0.81440	0.67357

Column headings indicate variables subject to IV estimation in first stage. All equations include industry and country fixed effects. Standard errors are in parentheses. ***Significant at 1%, ** significant at 5%, *significant at 10%

Table 5. Summary of Coefficients for Different Versions of STANDARD and MRA in Export Equations

EXP	Tobit			IV-Tobit		
	(1)	(2)	(3)	(1)	(2)	(3)
Version 1: Blank entries treated as zero						
MRA	1.229*** (0.290)		1.174*** (0.289)	2.550* (1.401)		2.683* (1.594)
STANDARD		0.802*** (0.290)	0.717*** (0.285)		1.515 (2.328)	-0.395 (2.663)
Pseudo-R^2	0.0878	0.0829	0.0908			
Wald χ^2				1155.20	3375.83	702.90
Version 2: Blank entries assigned the mean value for MRA and STANDARD by industry and country						
MRA	0.870*** (0.232)		0.816*** (0.231)	0.924* (0.534)		0.969* (0.594)
STANDARD		0.818*** (0.304)	0.715** (0.300)		0.606 (1.380)	-0.231 (1.513)
Pseudo-R^2	0.0859	0.0827	0.0886			
Wald χ^2				284045.42	36567.00	2046.69
Version 3: Blank entries assigned the max value for MRA and STANDARD by industry and country						
MRA	0.681*** (0.200)		0.623*** (0.200)	0.931* (0.513)		0.979* (0.601)
STANDARD		0.784*** (0.287)	0.676** (0.285)		0.585 (1.277)	-0.201 (1.460)
Pseudo-R^2	0.0848	0.0828	0.0875			
Wald χ^2				10571.31	37199.82	1798.74
Version 4: STANDARD and MRA are country-industry means						
MRA	0.896*** (0.234)		0.833*** (0.234)	0.911* (0.525)		0.968* (0.595)
STANDARD		0.855*** (0.317)	0.724** (0.314)		0.618 (1.351)	-0.275 (1.510)
Pseudo-R^2	0.0862	0.0828	0.0888			
Wald χ^2				2.93e+06	31876.26	2014.93
Version 4: STANDARD and MRA are country-industry maxima						
MRA	0.788*** (0.203)		0.694*** (0.205)	0.893* (0.485)		0.923 (0.583)
STANDARD		0.854*** (0.278)	0.674** (0.279)		0.591 (1.253)	-0.118 (1.438)
Pseudo-R^2	0.0864	0.0838	0.0892			
Wald χ^2				56985.58	20082.73	2351.96

All equations include industry and country fixed effects. Standard errors are in parentheses.
***Significant at 1%, ** significant at 5%, *significant at 10%