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Help or Hindrance? The Impact of Harmonised Standards on African Exports†

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We test the hypothesis that product standards harmonised to de facto international standards are less trade restrictive than ones that are not. To do this, we construct a new database of European Union (EU) product standards. We identify standards that are aligned with International Organisation for Standardisation (ISO) standards (as a proxy for de facto international norms). We use a sample-selection gravity model to examine the impact of EU standards on African textiles and clothing exports, a sector of particular development interest. We find robust evidence that non-harmonised standards reduce African exports of these products. EU standards which are harmonised to ISO standards are less trade restricting. Our results suggest that efforts to promote African exports of manufactures may need to be complemented by measures to reduce the cost impacts of product standards, including international harmonisation. In addition, efforts to harmonise national standards with international norms, including those through the World Trade Organisation Technical Barriers to Trade Agreement, promise concrete benefits through trade expansion.

JEL Classification: *F13, F15*

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† The findings, interpretations and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the view of the World Bank, its Executive Directors or the countries they represent.

In a world of continued cuts in tariff rates of protection, the trade effects of non-tariff measures—including product standards—assume greater importance in research and policy-making. This is particularly true for African exports, many of which now enjoy, at least in principle, duty-free access to major developed country markets, in particular the European Union (EU). This paper explores the impact of harmonised EU product standards on African exports.

Product standards may not be protectionist in intent or developed to directly affect trade. Instead, they may respond to legitimate concerns of consumers or producers relating to, for example, product quality or fitness for purpose. There is evidence, moreover, that certain standards increase and expand trade opportunities in certain sectors (Moenius, 2004). However, product standards can also impact the marginal and/or fixed costs of foreign exporters, and can thereby offer an advantage to domestic industries.

There is reason to believe that these cost effects are particularly relevant to developing country exporters, in particular those in Africa. On the one hand, developing countries have largely not been involved in talks on Mutual Recognition Agreements (MRAs) and other agreements designed to mitigate compliance costs (Baldwin, 2000). In the absence of such measures, compliance costs can be substantial.

Table 1 provides summary data on the investment costs required to comply with product standards, as a percentage of firm sales, taken from the World Bank's Technical Barriers to Trade Database.[1] In Sub-Saharan Africa—the region that is of primary interest for this paper—the average is 7.65% of sales, but the range reported by firms runs from 0.01 to 124%. In Latin America, by contrast, the average is only about one-third as high (2.56%) and the range is much narrower (0.01–13.36%). A similar pattern is apparent in the last row of Table 1, which summarises the data for textile and clothing producers in all the sample regions. The average cost is 2.73% of sales, but the range is once

[1] This firm-level survey database is described in detail by Wilson and Otsuki (2004), and is publicly available at http://go.worldbank.org/LFPMGEO1K0. For econometric analysis using these data, see Maskus *et al.* (2005) and Chen *et al.* (2006). These data represent the only developing country evidence on the economics of standards at the firm level.

Table 1: *Investment Costs to Comply with Technical Requirements (% of Firm Sales)*

	Mean	Standard deviation	Min	Max	No. of observations
Sub-Saharan Africa	7.65	23.12	0	124	39
Eastern Europe	3.74	8.26	0.03	55.65	38
Latin America	2.56	3.28	0.01	13.36	21
Middle East	6.67	11.59	0.04	44.1	20
South Asia	1.79	3.04	0.02	15.75	41
Textile and clothing sector (all regions)	2.73	6.8	0.01	44.1	46

Source: Maskus *et al.* (2005).

again very wide: 0.01–44.1%. It seems reasonable to expect that part of this variation is due to differences in firm size and productivity—with the largest impacts being felt by the smallest and least productive.[2] Foreign product standards are therefore likely to be a particular constraint on small and medium-sized businesses, which makes this issue a vital one for developing countries seeking to stimulate that part of the economy via increased contact with world markets.

Even in the presence of significant compliance costs for exporters, however, the trade policy question in this area cannot simply be one of 'rolling back' product standards, as if they were protectionist tariffs or quotas. Rather, the emphasis should be on limiting—where present—the negative spillovers that legitimate product standards can have for exporters in other countries. This is the difficult line that the WTO *Agreement on Technical Barriers to Trade* traces. One way the Agreement attempts to do so is by encouraging the use of de facto international standards: Article 2.5, for example, creates a rebuttable presumption that technical regulations aligned with international standards do not constitute 'unnecessary obstacles to international trade'. The idea is relatively simple: complying with one 'international' standard—and there

[2] Henson and Jaffee (2005) show through case studies that management capacity and strategic choices also play an important role.

can be any number of de facto 'international' standards—should be less costly for all concerned than complying with multiple national or regional standards, and help promote a relatively level playing field for exporters.

This paper presents empirical evidence indicating the potential benefit in the approach taken by the WTO *Agreement on TBTs* related to the alignment of national standards with international ones. We show that internationally harmonised EU product standards restrict African textile and clothing exports far less than do EU standards not aligned with international norms. Thus, international harmonisation of product standards may be an important complementary policy in support of recent efforts to extend more generous and easily accessible preferences to the developing world (see e.g., Collier and Venables, 2007). As Brenton and Hoppe (2007) argue, expanding African exports of manufactured goods in traditional development sectors, such as clothing, is much more than just a question of preferential rates of duty.

Our results are consistent with a framework in which standards impact trade through at least two channels. Compliance with standards increases the marginal costs of exporting and thereby can reduce export flows (the intensive margin of trade). At the same time, exporters must also pay a fixed cost to adapt products to suit foreign standards. This can reduce the probability that a country will export at all (the extensive margin). Our results provide support for the proposition that it is possible to reduce the fixed and marginal costs associated with product standards by using de facto international standards as the basis for harmonisation.

Our results build on and extend the existing literature in three ways.[3] First, we use the Perinorm database (Swann *et al.*, 1996; Moenius, 2000, 2004, 2006) and the online catalogue of the European Committee for Standardisation (CEN) to create an original database of EU product standards applied to textiles and clothing. Our data distinguish between standards that are equivalent to International Organisation for Standardisation (ISO) standards—a proxy for international harmonisation—and those that are not. This allows us to address a different policy question from the one

[3] For a general review of the empirical literature, see WTO (2005). On the theoretical side, see, for example, Fischer and Serra (2000), Casella (2001), Gandal and Shy (2001) and Ganslandt and Markusen (2001).

examined by, for example, Moenius (2004, 2006). In these papers, the author focuses on the extent to which bilaterally shared standards promote trade.

Second, we examine the impact of voluntary standards since they represent an important, but under-analysed, part of the standards landscape in Europe. Our results are therefore complementary to existing work dealing exclusively with mandatory standards, such as Brenton *et al.* (2001), Henry de Frahan and Vancauteren (2006), Fontagné *et al.* (2005), Chen and Mattoo (2008), Disdier *et al.* (2008) and Baller (2007). These studies generally find some evidence that product standards impact negatively on trade with 'outsiders'—i.e., those countries outside the harmonisation zone. The effect is not uniform, however, and tends to vary from one sector to another (see also Moenius, 2004).

Third, we examine the trade impacts of product standards both at the extensive and intensive margins. Our results therefore complement existing analyses on mandatory standards (Baller, 2007; Chen and Mattoo, 2008) and firm-level survey data (Chen *et al.*, 2006). Moreover, in specifying an over-identified version of our sample selection gravity model, we also produce evidence corroborating recent theoretical work on the importance of credit constraints in trade models with fixed costs. Our results can be interpreted as supporting the view that standards create fixed product adaptation costs, which need to be financed (e.g., Chaney, 2005; Manova, 2008).

Against this background, our paper proceeds as follows. The next Section describes the EU's approach to product standardisation and harmonisation, and its interactions with WTO disciplines. We then outline the World Bank EUSDB in Section 3, contrast it with previous data collection efforts and present some descriptive results. Section 4 contains our gravity model specification and empirical results. We draw some policy conclusions in Section 5, and sketch a number of possible directions for future research.

1. Product Standards and Harmonisation in the EU

In this Section, we outline the legal regime governing product standards and their harmonisation in the EU. In general, we can distinguish between technical regulations (which are mandatory) and product standards (which are voluntary). The framework of

mandatory harmonised regulations in Europe applies only to a limited number of sectors—those covered by a harmonisation directive—and does not cover textiles and clothing.

In sectors without mandatory harmonised regulations, the responsibility for product standards devolves to standard-setting bodies across Europe. Those bodies include both pan-European ones (like the CEN—a trans-national association established by national standard-setting bodies across Europe) and national standards bodies (such as AFNOR in France, BSI in the UK and DIN in Germany). CEN issues European standards after a consensus-based process, concluded by a vote of adoption. National standard-setting bodies are required to implement CEN standards in their respective countries, and to ensure that any conflicting national standards are withdrawn. CEN had issued 12,357 standards and approved documents by the end of 2006, with another 3,510 in preparation (see http://www.cen.eu/cenorm/aboutus/information/statistics/index.asp, accessed on 2 February 2007).

What are the key points that emerge from the standards regime in the EU? For present purposes, there are at least two. First, it is not just technical regulations that potentially matter for trade. As we have shown, both technical regulations and product standards play a simultaneous and sometimes symbiotic role in the EU standardisation context. Thus, both are relevant to African manufacturers interested in exporting to the EU. Both are also connected, though in very different ways, with the WTO *Agreement on TBTs*.

Second, CEN's own work—independent of EU mandatory Directives—leads to standardisation in Europe. And as the figures in the previous paragraph suggest, CEN has been most active in performing this role. It is therefore important to have an idea of the economic impact of CEN's standards, in particular from a development point of view.

2. The World Bank EUSDB

The empirical literature referred to in Section 1 makes clear the difficulty of assembling reliable and consistent data on product standards. (See WTO, 2005, for a review of the various data sources that are available.) In order to investigate the impact of EU standards on African textile and clothing exports, we have collected original data on the extent of European standardisation in that

sector over the period 1995–2003.[4] In this Section, we briefly discuss our methodology, compare it with alternative approaches and present some basic descriptive results from the World Bank EUSDB. For further details, see Shepherd (2006).

As discussed above, there are no New Approach Directives covering the textile and clothing sector. It is therefore not possible to use dummy variables for the application of Directives, as was done in previous work such as Brenton *et al.* (2001), Henry de Frahan and Vancauteren (2006), Chen and Mattoo (2008) and Baller (2007).

One alternative would be to use TBT notification data from the WTO, as in Fontagné *et al.* (2005) and Disdier *et al.* (2008).[5] However, we do not favour that approach for two reasons. First, WTO rules only require Members to notify technical regulations, not product standards (Article 2.9 of the *Agreement on TBTs*). Given the importance of voluntary product standards in Europe, it seems unduly restrictive to focus only on mandatory measures. Second, it is far from clear that individual Members interpret Article 2.9 in the same way, thereby raising concerns of data consistency. For instance, Belgium has lodged 207 TBT notifications since 1995, whereas Ireland has apparently not submitted any.[6] It seems unlikely that such a large discrepancy can be fully explained by substantive differences in standardisation practices between the two countries. As a result, we are not convinced that WTO notifications data always provide an accurate picture of the standards environment in all Members.

In assembling the World Bank EUSDB, we follow the approach of Swann *et al.* (1996) and Moenius (2000, 2004, 2006). We rely primarily on Perinorm (www.perinorm.com), an extremely rich bibliographic database maintained by the British, French and German standard-setting bodies. It contains over 1.1 million records from 22 (mostly OECD) countries. Each record corresponds to a single national, regional or international standard. It provides a short verbal description, from which it is usually possible to identify

[4] The World Bank EUSDB is available from http://go.worldbank.org/6OEYNCYSD0.

[5] The non-tariff measures section of UNCTAD's TRAINS database only has EU data for the year 1999.

[6] See the online search feature available through http://www.wto.org/english/tratop_e/tbt_e/tbt_e.htm, accessed on 31 January 2007.

the product or sector to which the standard applies. Perinorm also indicates when links exist to equivalent standards in other jurisdictions, including at the regional (CEN) and international (ISO) levels. It is therefore possible to identify with precision both the stock of EU standards, and the subset of them that translate ISO norms into local practice. We refer to this second category of European standards as being 'harmonized with ISO standards' or 'internationally harmonized'.[7]

It is important to highlight that Perinorm is not primarily intended as a tool for research. On the one hand, this is a strength: Perinorm is designed to facilitate industry access to—and purchase of—product standards, which suggests that there is a commercial incentive to ensure completeness.[8] This end-user focus makes Perinorm somewhat unwieldy for application to international trade work. In particular, Perinorm classifies standards according to the International Classification for Standards (ICS), for which there is no concordance to the product classifications commonly used in trade analysis. For textiles and clothing, the ICS is relatively imprecise in its classifications: heading 61.020 'clothes' is distinguished from 61.040 'headgear' and 61.060 'footwear'. It is not possible to drill down to any lower level of disaggregation. We therefore have to rely both on the ICS classification and on verbal descriptions to manually map standards to Harmonised System products.

The data collection process for the World Bank database works as follows. First, Perinorm is searched for EU standards (coded as 'EN'). Basic information is extracted manually from individual records. We limit attention to those documents identified as 'standards' by Perinorm, and exclude all other document types included in the database. (Moenius, 2000, identifies 39 partially overlapping

[7] We are using equivalency with ISO standards as a proxy for harmonisation with de facto international standards. Due to lack of data, our analysis excludes private standards, or norms issued by other bodies, which might also fulfil a similar role. However, we are confident that we are capturing an important part of international standardisation activity in this area, since ISO has issued over 300 standards affecting the textiles and clothing industry. These standards focus on test methods and specifications that help promote product consistency and conformity to expectations (ISO, 2004). ISO's work in this area involves 25 participating countries and 52 observers (http://www.iso.org/iso/en/stdsdevelopment/tc/tclist/TechnicalCommitteeDetailPage.TechnicalCommitteeDetail?COMMID=1479, consulted on 26 February 2007).

[8] It can be argued that the incentive structure in place for TBT notifications works in the opposite direction, since Members do not want to 'invite' WTO disputes by providing information on changes in their technical regulations.

document types in Perinorm.) Data captured for each standard include the dates of entry into force and withdrawal, and a 1–0 dummy variable indicating harmonisation with an ISO standard. That variable is coded according to whether or not Perinorm includes an ISO standard in its list of linked standards within each record, along with a code indicating that it is 'equivalent' or 'identical'. In the second stage, each standard is mapped to one or more HS 4-digit products using the short, verbal description provided by Perinorm, as well as its ICS code. Next, we cross-check all of the above information against CEN's online standards catalogue (http://www.cen.eu/catweb/cwsen.htm). Finally, we produce simple counts of the number of standards affecting each HS 2- and 4-digit product category over the period 1995–2003.[9] A standard is considered to be in force for a given year if it has come 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.

It is useful to provide a simple example of the above process. Standard number EN 20105 provides a series of tests for determining the colour fastness to washing of textiles. It is typical of the type of standards the World Bank database captures, since they mostly relate to testing and product specifications. CEN introduced EN 20105 in 1992, and amended some parts of it in 1994. It is therefore considered to be in force at all times during the database sample period (1995–2003). Since EN 20105 implements ISO standard 105, it is coded as being harmonised with ISO standards. The standard applies to all textiles, and is therefore mapped to all HS 2- and 4-digit codes that cover that product category, namely Chapters 50–63. As this example clarifies, individual standards often have very wide product coverage.[10] It is for this reason that in what follows, we aggregate the data so as to distinguish among three

[9] We use counts in order to compare the extent or density of standardisation—a proxy for compliance costs—across multiple sectors. Without detailed scientific and commercial knowledge, it is not possible to directly calculate compliance costs within sectors, let alone compare costs between sectors. Perinorm does not provide any data on this point, beyond a short verbal description of each standard. As in past work such as Moenius (2004), we therefore use counts as the best available proxy in this case. Since the standards in EUSDB tend to map to a wide range of 4-digit products, it is not feasible to use alternative measures of standardisation, such as frequency or coverage indices.

[10] The correspondence table in Moenius (2000) between ICS and SITC categories discloses the same dynamic.

'sub-sectors' rather than 14 HS Chapters. Those sub-sectors are clothing (HS 61–63), fabrics (HS 56–60) and fibres (HS 50–55).

Table 2 contains some basic descriptive results from the World Bank database. A number of trends are apparent over the sample period (1995–2003). First, EU standards are distributed unevenly across sub-sectors. Clothing accounts for only a modest fraction of the overall number of harmonised standards, a little over 10%. The main standardisation activity has been in relation to fibres and fabrics, each of which account for around 45% of the total number of harmonised standards. This division is reasonably constant throughout the sample period.

Aggregating across sub-sectors, Table 2 shows that the total share of internationally harmonised EU standards increased between 1995 and 1999, before falling for the remainder of the period. The overall movement involved is not large, however: the extreme shares are 45 and 56%. A more stark contrast appears when we compare the experiences of the three sub-sectors. The share of harmonised standards for both clothes and fabrics increases markedly over the sample period, from an admittedly low baseline in both cases. However, the opposite dynamic is apparent for fibres: the

Table 2: *Count by Type of EU Standards, 1995–2003*

Year	Clothing (HS 61–63)		Fabrics (HS 56–60)		Fibres (HS 50–55)	
	ISO standards	Non-ISO standards	ISO standards	Non-ISO standards	ISO standards	Non-ISO standards
1995	1	14	4	45	48	5
1996	1	17	9	50	60	6
1997	1	19	11	62	84	7
1998	5	23	21	65	93	8
1999	6	26	31	70	108	14
2000	6	22	33	86	116	14
2001	7	25	34	97	117	20
2002	8	27	37	99	123	22
2003	8	33	43	106	127	27

Source: World Bank EUSDB.

share of harmonised standards rises slightly between 1995 and 1998, but then falls markedly for the remainder of the period. The contrast between the three sub-sectors at the end of the sample period is also interesting: for fibres, over 80% of standards are harmonised with ISO standards, while the figure is just 20% for clothes and a little under 30% for fabrics.

It is important to stress that at this stage, the World Bank data cover Community-level standards only. Since the standard-setting body in each EU Member State is required to translate such norms into local standards, our data therefore also capture part of the standardisation activity of each individual country. However, we do not currently have data on country-specific standards in EU Member States. There are two main reasons for this. First, data availability in Perinorm varies considerably from country to country. Without any simple cross-check, such as the CEN online catalogue, it is difficult to be sure that a data set of national standards is in fact capturing all relevant information. Second, standardisation at the country level has been ongoing for a much longer time span than at the regional level. As a result, it is necessary to go much further back in history in order to make a reliable assessment of the total stock of standards in force at any given time. Not unexpectedly, Perinorm's coverage becomes more patchy the further back one goes (Moenius, 2000), thus rendering it particularly difficult to obtain accurate stock information for those countries with a long history of standardisation.

3. Model and Estimation Results

In this Section, we provide some basic intuition for the empirical question we are examining in this paper. We then present our empirical model and estimation results. We keep the theoretical presentation highly stylised in order to make the basic mechanisms as clear as possible. (For recent formal models that are largely in line with our presentation here, see: Shepherd, 2007; Felbermayr and Jung, 2008.)

Starting from a benchmark of free and standard-less trade, the introduction of foreign product standards imposes two sorts of costs on exporters. On the one hand, there is a fixed cost of product adaptation to meet the foreign standard. In addition, there is the marginal cost of demonstrating conformity, in addition

Table 3: *Factors in not Exporting or Expanding Exports, % of Surveyed Firms, Broken Down by Source*

	Sub-Saharan Africa	Eastern Europe	Latin America	Middle East	South Asia
Reasons for not exporting					
Design costs	58	90	67	69	65
Testing/certification costs	59	91	73	64	64
Important factors in expanding exports					
Technical regulations	69	79	75	50	57

Source: World Bank Technical Barriers to Trade Database.

to any higher per unit production costs the standard itself may imply. Table 3 presents some firm-level evidence on the extent of these effects, taken from the World Bank's Technical Barriers to Trade Database (Wilson and Otsuki, 2004; Maskus *et al.*, 2005). Although this is admittedly a very small sample, it is the only developing country evidence on the economics of standards at the firm level. Based on the data reported, design costs and testing/certification costs play a significant role in a firm's decisions whether or not to export, and how much. Table 3 also shows that technical regulations are an important factor in expanding exports for most firms (e.g., 69% of survey respondents in Sub-Saharan Africa).

For simplicity, we assume that the costs of compliance are uniform across countries.[11] Intuitively, there are two main channels through which standards can affect trade flows.[12] On the one hand,

[11] Relaxing this assumption could be a promising avenue for future research. Intuitively, differential compliance costs would provide an additional mechanism whereby the effects of standards on 'insiders' would differ from those on 'outsiders'—including developing countries.

[12] For simplicity, we leave to one side the kinds of information benefits posited by Swann *et al.* (1996), and Moenius (2004, 2006). Due to data constraints in the empirical part of the paper, we also exclude the possibility of cumulative effects, whereby standards relating to intermediate inputs indirectly impact the fixed and variable production costs of final products.

higher variable costs mean that exporting firms tend to export less due to the presence of increased trade frictions. Nevertheless, in addition, higher fixed costs make it harder for producers to export at all, since the hurdle they must jump in order to gain access to a foreign market is higher. In other words, standards can plausibly be linked both to effects on export volume and the propensity to export (Chen *et al.*, 2006; Baller, 2007; Chen and Mattoo, 2008).

Next, we consider introduction of an internationally harmonised standard in one potential export market.[13] This means that the same standard applies in that market as in a composite 'rest of the world' region. In comparison with a standard-less benchmark, this scenario will still tend to reduce trade through the two mechanisms discussed in the previous paragraph. That effect will generally be weaker than if each harmonising country implemented its own distinct standard: instead of paying one fixed and variable market access cost for the whole region, an exporter would have to pay multiple costs. Therefore, for the harmonisation of standards to have a beneficial impact on trade, it is important that that exporter sells products to markets with different applicable standards, which are potentially replaced with a single harmonised standard. We will discuss the evidence of this later in the text.

Summarising, the impact of non-harmonised standards on the exports of a third country can be explained theoretically in at least two ways. The first one is that the presence of a different product standard in the exporting market than in the home market would imply an additional cost on foreign producers. The second way is that home firms exporting to more than one market would have to meet multiple market-specific standards, which would imply additional product adaptation costs. We expect international standards harmonisation to reduce both types of costs.[14] Given the data we have available, our working

[13] We assume that the fixed and variable costs of compliance do not vary too much across standards. We are therefore in the 'horizontal' standards paradigm, in which differing norms reflect culturally influenced preferences and traditions rather than objective restrictiveness (Baldwin, 2000).

[14] Since the policy question that motivates our research relates to the differential effect of harmonised versus non-harmonised standards, it is not strictly necessary for us to make any particular hypothesis with regard to the sign of the individual coefficients. It should still be possible to test our hypothesis even in the presence of the type of positive information effects found by Moenius (2004).

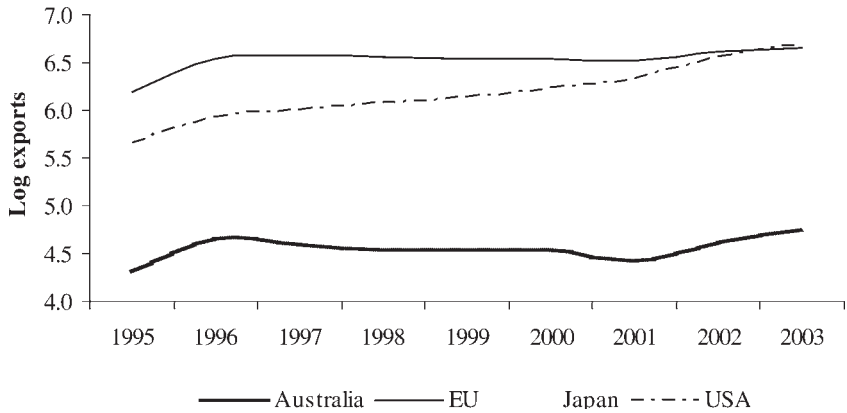

Figure 1: *Exports of Fabrics, Textiles and Fibres from Sub-Saharan Africa. Source: WITS-COMTRADE.*

hypothesis is therefore the following: EU standards that are harmonised with international standards (proxied here by ISO standards) exert a less negative impact on African export volumes and propensity than those standards which are not.

On a descriptive level, the data tend to support this hypothesis, and the mechanism we have postulated. As noted above, the primary impact of harmonisation is on firms selling to multiple overseas markets. The only firm level evidence on the prevalence of this practice in Sub-Saharan African is the World Bank's Enterprise Survey database. Of the 134 textile, leather and garment firms reporting data on export markets served, around 40% (86 firms) report exporting to at least two markets; 6% deal with at least three foreign markets.[15] At the aggregate (country) level, trade data disclose increasing geographical diversification of African textile and clothing exports over the sample period in terms of the major developed country markets (see Figure 1). Although capacity constraints surely limit the ability of African firms to enter multiple export markets, the available data suggest

[15] These data are freely available from www.enterprisesurveys.org. Firms can list up to three of their most important export destinations. The summary data presented in the text were calculated on the basis of responses to survey questions c211c2x, c211c3x and c211c4x, limiting the sample to African firms in the textile, garment and leather industries. Data should be interpreted with caution due to the small sample size in this case.

that the practice is sufficiently prevalent to make the reduction of multiple entry costs through harmonisation a potentially important factor in export expansion.

Table 4 shows the composition of African textile and clothing exports to the EU, the USA, Japan and Australia. Exports to the EU are concentrated in fibres and clothing with the latter being more important at the end of the sample. On the other hand, exports to the US are mainly clothing. On an average during 1995–2003, 93.9% of all exports to the US are clothing. Additionally, Yoshino (2008) finds that the textile, garment and leather exports to the US account for 8.7% of the total African exports. Given the links between African countries and a number of important export markets, we would indeed expect that internationally harmonised standards could be beneficial for African exporters.

To provide some preliminary evidence on the relation between exports and standardisation, Figures 2 and 3 each show a scatter diagram with percentage changes in exports to the EU and percentage changes in the standardisation activity in the EU by the type of standard (harmonised versus non-harmonised) over the period 1995–2003. Each sector is considered separately. Although the number of data points is limited, the figure shows a positive correlation between changes in harmonised standards and changes in exports. The reverse is true for non-harmonised standards. These findings are in line with our hypothesis.

3.1 Empirical Model

To examine our hypothesis, we use a standard gravity model of international trade applied to data on EU-15 imports of textiles and clothing from Sub-Saharan Africa (see Table 5 for variable definitions and sources, and Table 6 for countries included in the sample).[16] Our sample period is 1995–2003. As previously noted, individual EU standards in this area often tend to cut across numerous HS product lines, which makes it desirable to aggregate the trade data to a higher level of generality. We therefore retain the

[16] We estimate at the country-sector-year level in order to be able to take account of sector-year variation in standardisation, as well as country-level variation in common trade cost proxies such as distance, common language and colonial history. We adjust standard errors for clustering by country-pair.

Table 4: *Exports of Fibres, Fabrics and Clothing from Sub-Saharan Africa to Selected Developed Country Markets (% of Total)*

	EU			United States			Japan			Australia		
	Fibres	Fabrics	Clothing	Fibres	Fabrics	Clothing	Fibres	Fabrics	Clothing	Fibres	Fabrics	Clothing
1995	43.1	1.1	55.8	5.5	2.4	92.1	85.4	6.5	8.2	67.5	20.1	12.5
1996	41.8	1.3	56.9	7.7	2.4	89.9	82.5	5.4	12.1	63.9	19.4	16.8
1997	45.8	1.1	53.1	6.4	1.8	91.8	82.8	5.7	11.5	60.7	21.3	18.0
1998	44.6	1.3	54.2	5.9	1.7	92.4	74.7	9.6	15.7	57.3	27.4	15.3
1999	37.5	1.3	61.2	5.2	1.7	93.1	70.9	9.0	20.0	51.9	31.1	17.0
2000	36.7	1.4	61.9	2.8	2.1	95.1	68.9	10.4	20.7	49.8	32.8	17.4
2001	35.0	1.5	63.6	2.2	1.6	96.2	55.2	13.8	31.0	46.3	29.9	23.8
2002	35.9	2.3	61.8	1.4	1.4	97.1	64.5	12.9	22.6	44.8	35.3	19.9
2003	34.3	2.5	63.2	1.1	1.1	97.8	59.7	15.8	24.4	33.1	45.1	21.7

Source: WITS-COMTRADE.

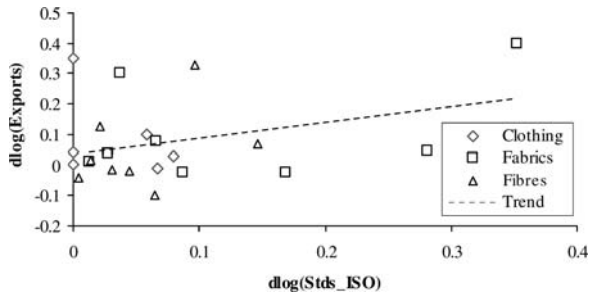

Figure 2: *Percentage Changes in Exports to the EU versus Percentage Changes in the Number of Harmonised Standards, 1995–2003.*
Source: WITS-COMTRADE, EUSDB.

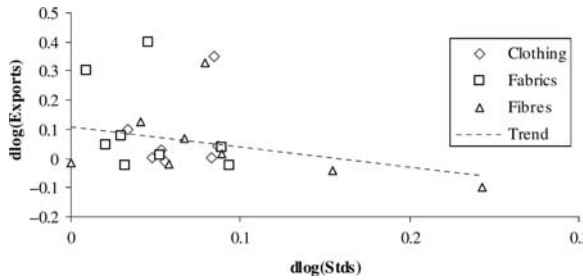

Figure 3: *Percentage Changes in Exports to the EU versus Percentage Changes in the Number of Non-harmonised Standards, 1995–2003.*
Source: WITS-COMTRADE, EUSDB.

distinction between clothes (HS 61–63), fabrics (HS 56–60) and fibres (HS 50–55) that was used above, and we aggregate all data to those categories.

We take the micro-founded gravity model formulation of Anderson and Van Wincoop (2003, 2004) as our starting point:

$$\log\left(X_{ijt}^{k}\right) = \log\left(E_{jt}^{k}\right) + \log\left(Y_{it}^{k}\right) - \log\left(Y_{t}^{k}\right) + (1-\sigma_k)\log\left(t_{ijt}^{k}\right) - (1-\sigma_k)\log\left(P_{jt}^{k}\right) - (1-\sigma_k)\log\left(\Pi_{it}^{k}\right) + \varepsilon_{ijt}^{k}, \quad (1)$$

where: X_{ijt}^{k} = Exports from country i to country j in sector k for year t; Y_{it}^{k} = Output of country i in sector k for year t; E_{jt}^{k} = Expenditure

Table 5: *Data and Sources*

Variable	Description	Year	Source
Colony_{ij}	Dummy variable equal to 1 if country i colonised country j at any time, else zero	NA	Mayer and Zignago (2006)
Distance_{ij}	Great circle distance between the largest cities in countries i and j	NA	Mayer and Zignago (2006)
$\text{Domestic Credit}_{jt}$	Domestic credit to the private sector (% of GDP)	1995–2003	World Development Indicators
Imports_{ijkt}	Imports of country i from country j in sector k for year t. HS 2-digit data aggregated to three sectors: fibres (50–55), fabrics (56–60) and clothing (61–63)	1995–2003	WITS-COMTRADE
$\text{ISO standards}_{kt}$	Count of ISO-harmonised EU standards in sector k for year t (One is added prior to conversion to logarithms)	1995–2003	World Bank EUSDB
Language_{ij}	Dummy variable equal to 1 if countries i and j have a common official language, else zero	NA	Mayer and Zignago (2006)
$\text{Non-ISO standards}_{kt}$	Count of non-ISO-harmonised EU standards in sector k for year t (One is added prior to conversion to logarithms)	1995–2003	World Bank EUSDB

Table 6: *Countries Included in the Data set*

Country group	Members
Importers (EU-15)	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, UK
Exporters (Sub-Saharan Africa)	Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Democratic Republic of Congo, Republic of Congo, Côte d'Ivoire, Equatorial Guinea, Eritrea, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe

of country j in sector k for year t; Y_t^k = Aggregate (world) output in sector k for year t; σ_k = Elasticity of substitution in sector k; t_{ijt}^k = Trade costs facing exports from country i to country j in sector k for year t; ω_{it}^k = Country i's output share in sector k for year t; ω_{jt}^k = Country j's expenditure share in sector k for year t; and ε_{ijt}^k = Random error term, satisfying the usual assumptions. Inward resistance $(P_{jt}^k)^{1-\sigma_k} = \sum_{i=1}^N \Pi_{it}^{\sigma_k-1}\omega_{it}^k(t_{ijt}^k)^{1-\sigma_k}$ captures the fact that j's imports from i depend on trade costs across all suppliers. Outward resistance $(\Pi_{it}^k)^{1-\sigma_k} = \sum_{j=1}^N P_{jt}^{\sigma_k-1}\omega_{jt}^k(t_{ijt}^k)^{1-\sigma_k}$, in contrast, captures the dependence of exports from i to j on trade costs across all importers.

We modify the component of bilateral trade costs of the standard model so as to explicitly include our standards counts, differentiating between the number of EU standards that are harmonised with ISO standards (stds_iso) and the number that are not (stds_non). The trade cost function also includes, as is usual in this literature, the distance between pairs of trading countries (dist) and dummy variables to take account of important geographical and cultural links such as a common border (contig), colonial links (colony) and a common official language (comlang_off).[17] We therefore specify:

$$\log\left(t_{ijt}^k\right) = \gamma_1 \log(\text{stds\_iso}_t^k) + \gamma_2 \log(\text{stds\_non}_t^k) + \beta_1 \log(\text{dist}_{ij}) + \beta_2 \text{colony}_{ij} + \beta_3 \text{comlang\_off}_{ij}. \quad (2)$$

As Anderson and Van Wincoop (2003, 2004) suggest, estimation of their model can be simplified by replacing the 'multilateral resistance' terms with appropriate fixed effects. In this case, a strict interpretation of their structural model requires fixed effects in the importer-sector-time, exporter-sector-time and sector-time dimensions (compare Baldwin and Taglioni, 2007, on this point). In principle, it would also be necessary for the trade costs coefficients to vary across sectors due to differences in the intra-sectoral elasticity of substitution. However, this approach necessitates

[17] There are two reasons why we do not include applied tariffs in the trade costs function. First, most African countries have had access over the sample period to very low or zero duty access to the European market in this sector. Second, the most significant set of trade policy measures affecting textiles and clothing over this period was the ATC quota system, not tariffs.

estimation of a large number of parameters. In order to obtain useful results, it requires substantial variation at a very fine level in the independent variables. For our baseline model (3), we therefore prefer a simpler formulation using fixed effects only in the exporter (θ_j), importer (δ_i), product (ψ_k) and year (τ_t) dimensions.[18] These fixed effects control for country-specific, time-invariant factors, along with time-varying factors that affect all exporting countries. This last category includes reform of the EU quota system—for which we do not have direct data—during implementation of the WTO *Agreement on Textiles and Clothing*. It also captures the general effects of rules of origin, another relevant factor for which we do not have direct data.

$$\begin{aligned}\log\left(\text{imports}_{ijt}^{k}\right) = {} & \delta_i + \theta_j + \psi_k + \tau_t + \gamma_1 \log(\text{stds\_iso}_t^k) \\ & + \gamma_2 \log(\text{stds\_non}_t^k) + \cdots + \beta_1 \log\left(\text{dist}_{ij}\right) \\ & + \beta_2 \text{colony}_{ij} + \beta_3 \text{comlang\_off}_{ij} + \varepsilon_{ijt}^{k}. \qquad (3)\end{aligned}$$

The above formulation captures the impact of trade costs on bilateral trade volumes. In terms of our working hypothesis and the theoretical framework set out above, we expect that $\gamma_2 < \gamma_1 < 0$.

The impact that we are capturing is conditional on trade taking place between the two countries, i.e., on $\text{imports}_{ijt}^{k} > 0$. Zero or missing trade flows are excluded from the effective sample in (3), which has been shown to bias the resulting coefficient estimates (e.g., Helpman *et al.*, 2008). Moreover, (3) on its own does not allow us to say anything about the second part of our working hypothesis, which has to do with export propensity.

To address these two problems together, we use a Heckman (1979) sample selection model.[19] It postulates two equations,

[18] As a check for robustness, we have estimated two additional Heckman models. The first has fixed effects in the importer-sector, exporter-sector and year dimensions. The second has fixed effects by importer-year, exporter-year and sector. Results in both cases are in line with those reported here: ISO standards have a slightly negative but statistically insignificant coefficient, while non-ISO standards have a strongly negative and 1% significant coefficient. Tests of equality between the two coefficients are rejected at the 1% level.

[19] For other examples in the standards context, see Baller (2007) and Chen and Mattoo (2008). Heckman (1979) models have also been used in the wider gravity model literature: e.g., Helpman *et al.* (2008), Francois and Manchin (2007) and Brenton and Hoppe (2007).

namely an outcome equation that takes the form of (3), and a selection equation. The selection equation determines the probability that a given observation is included in the effective sample for the outcome equation. The two equations are linked by a correlation ρ, which compensates for the sample selection bias that would pertain under OLS. For the time being, we assume that the same explanatory variables appear in both equations. The model is therefore just-identified, and parameter estimates can be obtained by maximum likelihood estimation of the two equations jointly. (Davidson and MacKinnon, 2004, argue that it is desirable for the model to be over-identified, and we return to this point below.)

Before moving to our empirical results, it is important to address the question of possible endogeneity of our standards count variables, stds_iso and stds_non. The number of standards in a particular sector could, in a general sense, be endogenous to imports through a political economy process. However, none of the African countries we are dealing with here has a large European market share. It is therefore unlikely that sector-wide standards—which apply to both domestic production and imports from all sources—are set in response to unexpectedly large imports from a single African country in a single year. Although we do not expect major endogeneity problems in this case, we ensure the robustness of our results by using alternately current and lagged standards counts (1, 2 and 5 years).

3.2 Baseline Results

We now move on to our results (Table 7). OLS estimates (Column 1) have coefficients with the expected signs and reasonable magnitudes. Among the standard gravity variables, distance is negative and statistically significant, whereas a colonial relationship (statistically significant) and common official language (statistically insignificant) are both positive. We find that both of our standards counts, lstds_iso and lstds_non, are negative. However, only the coefficient on lstds_non is statistically significant. It is also of far greater magnitude than the coefficient on lstds_iso—the two differ by a factor of around five—which suggests that in terms of both economic and statistical significance, it is primarily non-harmonised EU standards that exert a negative impact on African textile and clothing exports. While there is evidence of a negative

Table 7: *Baseline Regression Results*

	OLS	Heckman		Heckman		Poisson
		Outcome	Selection	Outcome	Selection	
ISO standards	−0.099	−0.098	0.006	−0.069	0.017	0.029
	[0.107]	[0.109]	[0.049]	[0.109]	[0.050]	[0.046]
Non-ISO standards	−0.532**	−0.846***	−0.324***	−0.851***	−0.326***	−0.423***
	[0.211]	[0.232]	[0.091]	[0.231]	[0.093]	[0.121]
Distance	−1.543*	−2.504***	−0.990***	−2.441**	−0.950***	−3.992**
	[0.890]	[0.941]	[0.288]	[0.953]	[0.293]	[1.551]
Colony	0.689***	0.866***	0.337***	0.874***	0.361***	−0.362
	[0.246]	[0.241]	[0.097]	[0.245]	[0.102]	[0.260]
Language	0.15	0.520**	0.427***	0.550**	0.427***	1.911***
	[0.209]	[0.227]	[0.086]	[0.229]	[0.088]	[0.335]
Domestic credit					0.004**	
					[0.002]	
Constant	16.902**	16.388**	10.190***	18.079**	10.338***	43.414***
	[7.353]	[8.032]	[2.665]	[7.962]	[2.733]	[14.239]
Observations	5,026	19,035	19,035	18,270	18,270	19,035
R^2	0.49					
H0: ISO = Non	5.49**	13.23***	19.51***	14.49***	20.21***	12.84***

(*continued on next page*)

Table 7: (*continued*)

	OLS	Heckman		Heckman		Poisson
		Outcome	Selection	Outcome	Selection	
Rho		0.66***		0.65***		

Dependent variable is log(imports) for OLS and Heckman, and imports for Poisson. All independent variables except domestic credit are in logarithms. All models contain fixed effects by exporter, importer, sector and year (estimates omitted for brevity). Robust standard errors corrected for clustering by country pair are in brackets. Statistical significance is indicated using *(10%), **(5%) and ***(1%).
H0: ISO = Non is a test of the null hypothesis that the two standards coefficients are equal, using the appropriate *F* or chi-squared statistic. Rho is the estimated correlation between the selection and outcome equation errors in the Heckman model.

effect also for harmonised standards, it is much weaker. A formal hypothesis test of equality between the two coefficients confirms this view (rejection at the 5% level).

Columns 2–3 of Table 7 present results for the baseline Heckman (1979) model, in which the selection and outcome equations both have the same set of explanatory variables (i.e., the model is just-identified). Coefficient estimates in the outcome equation are broadly comparable to the OLS case, but there are some important differences in terms of economic and statistical significance. The distance elasticity increases (in absolute value terms) from -1.5 to -2.5, and is significant at the 1% level. Both the colonial link and common official language dummies are now significant at the 1 and 5% levels, respectively, and the coefficient for the latter is considerably larger. We take these changes as evidence that, in the present context, the presence of zero trade flows in our data set can lead to a noticeable bias if OLS estimates are not corrected. This is supported by the relatively high estimated correlation between the error terms in the selection and outcome equations (Rho $= 0.66$).

In terms of our variables of primary interest, namely lstds_iso and lstds_non, we find that Heckman estimation makes a significant change to the latter only: its coefficient is now larger in absolute value than under OLS, -0.8 versus -0.5. The coefficient on internationally harmonised EU standards remains negative but statistically insignificant, and is now smaller in absolute value than the coefficient on non-harmonised standards by a factor of nearly 10. Again, a formal hypothesis test confirms the significance of the difference between the two coefficients at the 1% level.

In addition to correcting some apparent bias in the OLS estimates, the Heckman results also contain some useful information in their own right. We interpret the estimated coefficients of the selection equation as summarising the impact of different variables not directly on trade flows, but on the propensity to export. Following Helpman *et al.* (2008), we can go further and relate the selection equation to fixed cost effects, and the outcome equation to marginal cost effects. With this interpretation in mind, we can see that the results in Column 3 of Table 7 are consistent with sensible analytical priors with regard to the coefficient sign: distance is negative and statistically significant, whereas colonial links and a common official language are both positive and statistically significant.

Interestingly, we find that non-harmonised European standards exert a negative and statistically significant influence on export propensity. However, standards that are aligned with ISO standards carry a statistically insignificant and (slightly) positive coefficient. These standards impact export propensity only very weakly but to the extent that we can measure such an impact, and hence it would appear that these types of EU standards actually increase export propensity (cf. Moenius, 2004).

The combined results from the selection and outcome equations therefore suggest that EU standards not harmonised to international norms tend to impose significant added costs on exporters, both fixed and variable. In both the selection and outcome equations, the difference in impact between ISO and non-ISO standards is statistically significant at the 1% level.[20]

3.3 Robustness Checks

The above discussion is subject to a well-known caveat: the estimated coefficients from a just-identified Heckman model like the one presented in Columns 2–3 of Table 7 tend to exhibit considerable instability (Davidson and MacKinnon, 2004). It is preferable to specify an over-identified form of the same model, which can be achieved by including at least one variable in the selection equation that does not appear in the outcome equation. However, the existing literature has highlighted the difficulty of finding such a variable in practice. On empirical grounds, Baller (2007) uses WTO membership. Helpman *et al.* (2008) use (alternately) common religion, and a measure of the cost of starting a business taken from the World Bank's *Doing Business Report*. The disadvantage of using data from *Doing Business* is that they are only available for the years 2003–06. Given that our sample runs between 1995 and 2003, it is not feasible in our case to take the same approach as Helpman *et al.* (2008).

We therefore propose an alternative. In developing countries, and particularly in Africa, the ability of firms to cover the fixed costs of complying with foreign standards is influenced by the level of financial development in the exporting country. If credit is expensive and/

[20] In additional results, available on request, we find that this conclusion is unchanged if we drop countries like South Africa and Mauritius from the sample, on the basis that their firms are likely to have greater adaptation capacity than those in other African textile and clothing exporting countries.

or hard to come by, then it will be more difficult for firms to pay the fixed costs of exporting. We therefore expect a measure of the exporter's financial development to be directly correlated with export propensity.[21] Even though such a measure could conceivably be correlated with export-conditional trade flows as well—since firms might need credit to support ongoing costs in addition to the fixed costs of start-up—we expect that the connection will be much weaker, thereby justifying inclusion of financial development in the selection equation but not in the outcome equation.[22] (For recent theoretical work in this vein, see Chaney, 2005, and Manova, 2008.)

Results from this approach are presented in Columns 4–5 of Table 7. As expected, financial development—as measured by domestic credit to the private sector as a percentage of GDP—is positively and significantly (5%) associated with export propensity.[23] We interpret this as indicating that credit constraints can exert a significant impact on African textile and clothing exporters. All other estimated coefficients have the same signs and very similar magnitudes to those obtained using the just-identified Heckman model discussed above. That our results are consistent in this way suggests that our conclusions are robust to the parameter instability that is often a feature of just-identified Heckman models.

As noted above, another potential difficulty with our results is the possible endogeneity of the measures of our standards. To deal with this issue, we re-run the model in Columns 4–5 of Table 7 using one, two and five period lags of lstds_iso and lstds_non. Table 8 presents our results. Qualitatively, they are identical to those from our baseline model: non-ISO standards exert a negative impact on trade values and export propensity, although the latter relationship is only statistically significant at the 10% level in one of the three formulations. The estimated coefficients on harmonised standards, on the

[21] We leave it to future research to examine the possible role of foreign direct investment in loosening the credit constraint postulated here.

[22] We check this assumption empirically by conducting an additional regression (not reported) that includes financial development in both the selection and outcome equations. We find, as expected, that the coefficient is positive and 5% significant in the former, but positive and insignificant at the 10% level in the latter. In all other respects, the results are very similar to those reported in Columns 4–5 of Table 13. (Cf. Manova, 2008, who finds evidence that financial development is significant in both the selection and outcome equations.)

[23] Note that domestic credit as a percentage of GDP enters the equation in levels, not logarithms. Hence, the estimated coefficient can be interpreted as an elasticity.

Table 8: *Regression Results Using Lagged Standards Measures*

	Heckman		Heckman		Heckman	
	Outcome	Selection	Outcome	Selection	Outcome	Selection
ISO standards ($t-1$)	0.158	0.039				
	[0.121]	[0.052]				
Non-ISO standards ($t-1$)	−0.387*	−0.284***				
	[0.224]	[0.097]				
ISO standards ($t-2$)			0.089	0.133***		
			[0.114]	[0.050]		
Non-ISO standards ($t-2$)			−0.707***	−0.136		
			[0.223]	[0.098]		
ISO standards ($t-5$)					0.263**	0.052
					[0.112]	[0.053]
Non-ISO standards (t − 5)					−4.023***	0.086
					[1.304]	[0.610]
Distance	−2.334**	−0.929***	−2.515**	−0.881***	−3.016***	−0.950***
	[0.972]	[0.305]	[0.991]	[0.324]	[1.009]	[0.354]
Colony	0.862***	0.382***	0.842***	0.410***	0.813***	0.482***
	[0.251]	[0.106]	[0.257]	[0.111]	[0.296]	[0.137]
Language	0.540**	0.415***	0.574**	0.423***	0.660**	0.414***
	[0.230]	[0.091]	[0.233]	[0.096]	[0.264]	[0.118]
Domestic credit		0.007*		0.006		0.008
		[0.004]		[0.005]		[0.007]

Constant	15.173*	9.396***	17.524**	5.651**	28.336***	9.470***
	[8.526]	[2.868]	[8.628]	[2.813]	[8.993]	[3.515]
Observations	16245	16245	14220	14220	8235	8235
H0: ISO = Non	7.17***	15.9***	13.84***	9.51***	10.19***	0
Rho	0.66***		0.66***		0.68***	

Dependent variable is log(imports). All independent variables except domestic credit are in logarithms. All models contain fixed effects by exporter, importer, sector and year (estimates omitted for brevity). Robust standard errors corrected for clustering by country pair are in brackets. Statistical significance is indicated using *(10%), **(5%) and ***(1%).
H0: ISO = Non is a test of the null hypothesis that the two standards coefficients are equal, using the appropriate *F* or chi-squared statistic. Rho is the estimated correlation between the selection and outcome equation errors in the Heckman model.

other hand, are uniformly positive. With two lags, the effect is statistically significant at the 1% level in the selection equation, while with five lags it is 5% significant in the outcome equation. In all cases except one—the selection equation for the model using five lags—the difference between the estimated coefficients on harmonised and non-harmonised standards is statistically significant at the 1% level. If anything, accounting for endogeneity by using lags tends to strengthen our initial results.

As a final check for robustness, we re-estimate the baseline model using the Poisson estimator advocated by Santos Silva and Tenreyro (2006). Those authors show that the Poisson estimator produces consistent estimates in the presence of zero trade values. Moreover, the estimator is known to be consistent under relatively weak assumptions (i.e., the data need not follow a Poisson process at all), and it does not suffer from the incidental parameter problem which generally gives rise to inconsistency and bias concerns in nonlinear fixed effects models (including the Heckman model).[24] It therefore represents a flexible and increasingly common alternative to the Heckman estimator in a gravity context, even though it comes at the price of losing direct information on export propensity.

Poisson results are presented in Column 6 of Table 8. With the exception of the colony dummy, all estimated coefficients have the expected signs and economically sensible magnitudes. (The colony coefficient, though negative, is not statistically significant at the 10% level.) The distance and language effects are noticeably stronger in the Poisson estimates than in other formulations. Most importantly, we find that non-harmonised standards have an estimated coefficient which is negative and 1% significant, whereas the coefficient on harmonised standards is slightly positive but statistically insignificant. Once again, a formal test rejects the null hypothesis of equality between the two coefficients at the 1% level. We can be confident, therefore, that our results are robust to the use of this common alternative estimator.

4. Conclusions

We have shown that there is empirical evidence to support the hypothesis that EU standards harmonised with international

[24] On these points, see Greene (2004) and Wooldridge (1997).

norms (proxied here by ISO standards) exert a less negative impact on African export volumes and propensity than standards that are not harmonised. Previous empirical work has supported the existence of an insider–outsider dynamic in terms of the trade effects of standardisation. This paper, however, considers explicitly the impact of international harmonisation on trade flows.

The policy implications of these results are of significant interest. Our analysis suggests that it is indeed appropriate for the WTO *Agreement on TBTs* to champion the use of international standards whenever possible. If Members follow this path, they can help limit the negative effects of standardisation and harmonisation on outsiders—and in particular, on developing countries. Furthermore, our evidence—combined with existing results due to Swann *et al.* (1996) and Moenius (2004, 2006)—suggests that it is not just mandatory technical regulations that can have significant trade impacts, but voluntary product standards as well. As previously noted, the WTO's treatment of these two groups of norms is asymmetric: technical regulations are subject to relatively stringent requirements that are directly enforceable through WTO dispute settlement proceedings, whereas the position for product standards is considerably more blurred. There may well be a case to be made in the future for redressing this imbalance.

With regard to future research work in this area, we view three areas of particular interest. First, it will be important to test the applicability of our findings to other sectors, in particular those that are of export interest to developing countries and with a focus on regions outside of Africa. Second—and flowing from the previous point—there is likely to be a high payoff from investing in improved data in this area. Research on non-tariff measures generally, and product standards in particular, suffers from a chronic lack of detailed, reliable and comprehensive data. Clearly a major effort is required to remedy this situation, in particular if attention is to be paid both to mandatory technical regulations and voluntary product standards.

Finally, the World Bank EUSDB discloses significant cross-sectoral differences in the number and type (harmonised or not) of standards. Future work could usefully investigate the determinants of that variation. Just as political economy has proved a useful tool for analysing cross-sectoral variation in trade policy measures, so too do we expect it to play an important role in elucidating similar variation in standard-setting behaviour.

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