Spread of retailer food quality standards: An international perspective

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Abstract— **Privately initiated food quality standards are currently important elements in the marketing of food and agricultural products. At the same time, they stand in the centre of a discussion about potential negative effects on small farmers and farmers in developing countries. This study aims at analysing the adoption of two private food standards, BRC Technical Food Standard and GlobalGAP, at an aggregated cross-country level. The results of the econometric analysis reveal some (potential) barriers for developing countries to access this type of organisational innovation. Certificates seem to be issued more probably in larger and wealthier countries, countries with a better institutional quality, better infrastructural conditions and in former UK colonies.**

Keywords— **standards, food quality, adoption.**

I. INTRODUCTION

In his presidential address to the IAAE, von Braun [1] calls attention to the emergence of privately driven food quality standards and the various new research topics coming up with this development. Private, mainly retailer driven, food quality standards are mainly based on the definition of certain process characteristics like production conditions or traceability. However, the coverage in terms of products and type of prescriptions varies substantially across the various standards. Critics focus on a potential increase of market protection of Western European countries' agricultural and food markets. This might be especially relevant for standards which require part of the production in special regions or countries, like Red Tractor or regional marketing initiatives. In addition, there are fears that only selected groups of farmers are able to comply with those standards. Inequality between farmers within countries could increase and, eventually, result in a bifurcation of the agricultural sector. Furthermore, for farmers in developing countries, food quality standards might represent an increasing implicit market barrier for entering the global food chain because they lack the technical capacity to either produce the same quality as Western European countries or if they do, to prove that they provide equivalent quality. These arguments result in the concern that especially small farmers and/ or farmers in developing countries might be excluded from Western European export markets due to non-compliance with standards [2, 3]. Certain authors even raise the question if retailer dominated standards lead to a type of re-colonialisation [4]. On the contrary, consumers could benefit from positive spill-over on domestic markets in developing countries due to an increasing demand for higher food safety and food quality from export markets. However, a complete cost-benefit analysis of private food standards would go far beyond the scope of this paper. Rather, this paper aims at focusing on producers' access to those standards and determinants of their global spread. The global spread is modelled as this technology's adoption process by defining standards as a clearly defined technology. We further argue that the global spread of a certain standard could be modelled theoretically as any other technological innovation.

So far, existing literature evolving around these new types of governance structures focuses especially on the effects on small farmers in developing countries discussing mainly case studies or single countries (e.g. [5, 6, 7, 8]) as well as their impact on trade flows [9]. Looking at the other side of the food supply chain, Fulponi [10] describes incentives of retailers in OECD countries to set up such privately organised and to a large extent business-to-business standards. The author underlines the special importance of legal liability rules, transaction costs, improvement of retailer's reputation and flexibility in choosing suppliers as drivers of retailers' interest to establish international standards. However, available literature on evaluating private quality standards' impact on

agricultural trade and sectoral development is limited. Burrell et al. [11, 12] present an overview of the various studies in this field. Analyses of standard's adoption at farm/firm level focuses almost exclusively on ISO standards and HACCP tools. Previous studies concentrate on one or two countries and certain agricultural sectors (e.g. [13, 14, 15, 16]).

Thus, they fall short in analysing the spread of private standards on a global scale. Generally, Burrell et al. [11] criticise the mainly descriptive character of previous analyses. However, to be able to derive conclusions if certain countries might be excluded from modern food chains this perspective seems relevant. Beyond this background, in this paper we start from the somehow normative expectation that producers in every country should have a fair access to standards after controlling for geographical conditions (e.g. distance to European export market), and historical trade relations. The number of certified firms in each country is the relevant proxy for the standard's global spread. The aggregated adoption of private food standards is explained in this paper by socio-economic and geographic variables.

Our approach faces the major criticism that firms comply with standards and not countries. Subsequently, the appropriate level of analysis would be to use firm-level data. However, those are not publicly available and surveys in every country would not be feasible. The same data problem applies to the produced output under certification which would give a better indication of the standard's economic importance within the agricultural and food sector. The remainder of the paper is as follows. After giving a short literature review, the data are introduced in chapter II. The results of the econometric analysis are presented in chapter III, followed by a conclusion (chapter IV).

II. DEVELOPMENT OF HYPOTHESES AND DATA DESCRIPTION

Private standards are defined as voluntary regulations established by non-governmental organisations. Burrell et al. [12] present an overview of various recently emerged food standards and Quality Assurance Systems. Our study focuses on food standards with global relevance. Therefore, we select the two most prominent examples, BRC Food Technical Standard and GlobalGAP, to analyse the spread of retailer food quality standards from an international perspective. Both standards started in 1997/98 and have today certified producers in more than 60 countries on all continents. Whereas the first standard is directed towards processors, the second one is targeted at farm level. Both are in-chain standards, not communicated to the consumer via labels on the product.

The theoretical approaches to explain the diffusion of organisational innovations are reviewed for instance in Guler et al. [17] as well as Neumayer and Perkins [18]. The hypotheses underlying this study's econometric analysis are derived from this theory and are in most cases very similar to the knowledge about determinants of technology diffusion [19]. The theoretical background is presented more extensively in the extended version of this contribution [20]. Comin and Hobijn [19] show evidence that speed of adoption of several technologies is driven by a handful of the same factors. For example Neumayer and Perkins [18] explain the diffusion/ adoption of ISO 9000 certification. Their study shows the statistical significance of measures of trade intensity linking countries to the wider global community to explain diffusion and adoption of this standard. The share of exports to the EU and Japan on country's GDP, stocks of foreign direct investment (FDI), historical colonial ties to Europe and the availability of telecommunication drive significantly the number of ISO 9000 certificates per country. Guler et al. [17] link the diffusion of ISO 9000 to the level of inward FDI, GDP per capita and size of the labour force.

For analysing the global spread of private standards, the variable of interest is the number of firms certified in a certain country. This information is sampled from online databases published by the respective provider of the following standards: BRC Food Technical Standard and GlobalGAP. All data base on the cut off date November 2007.

Various explanatory variables are included in the econometric analysis. Descriptive statistics and sources of the data are listed in Table 1. The explanatory variables are classified into three broad groups. First, we control for historical and geographical conditions. Mitchener and Weidenmier

[21] show a significant impact of colonial history on trade flows. Distance to the standard's home country should capture costs of transportation. The second set consists of variables of infrastructure and sector conditions. Infrastructure will affect distribution of standards in two ways. Obviously, production for export purposes requires provision of transport infrastructure like roads and railways. Additionally, the above discussed standards are rather complex innovations, compared to other agricultural innovations like seeds, fertilizer or machinery. Information processing and distribution seem to be a critical prerequisite for adoption. Page and Slater [22], for instance, highlight the limited availability of commercial consultancies in developing countries' agriculture. Therefore, we control for the existence of a certified auditor in the respective country. The origin of GlobalGAP is linked to trade in fresh fruit and vegetables. Consequently, we expect to observe more certified firms in countries with a relatively high fruit and vegetable production per agricultural population. To reduce the influence of outstanding years, the average of the years 1995-2000 is used. There could be concern about a possible endogeneity of this variable as certification can lead to more trade and increasing production. However, all standards are introduced after 1998 and it is argued that possible trade intensification, if any significant increase will take place, would show up with some time lag, i.e., well after the year 2000. Finally, the third group of variables controls for some general characteristics of the business environment. The so-called rule of law serves as a proxy of the quality of institutions. The variable gives an indication of perceptions of the effectiveness and predictability of the judiciary and the enforceability of contracts. GDP per capita is included to capture endowment differences across countries that are omitted in the other variables like human capital. Interaction effects control for a potentially different access of farmers in transition and developing countries to certification. We follow the argumentation of Comin and Hobijn [19] that the explanation of the adoption of (micro-)technologies by considering overall macroeconomic factors reduces possible simultaneous bias. Obviously, it seems to be unrealistic to expect an effect of food standard adoption at farm level on total agricultural trade, infrastructure or even GDP.

Table 1 Descriptive statistics and sources of variables

Variable	Description	Mean	Source
Dependent variables			
GAP	Country has at least one certified producer under GlobalGAP standard [%]	0.443	GlobalGAP
GAP-NOPC	Certified producers of GlobalGAP [No. per 1000 inhabitants]	0.030	GlobalGAP
BRC	Country has at least one certified producer under BRC Technical Food Standard [%]	0.432	BRC
BRC-NOPC	Certified producers of BRC Technical Food Standard [No. per 1000 inhabitants]	0.002	BRC
Historical and geographical conditions			
COLONY	Former UK colony [1 – yes, 0 – no]	0.292	CIA
DIST	Distance to UK (BRC) or NL (GlobalGAP) [km]	6352.62 6172.70	Own calculation
POP	Population [in million]	33.328	[24], CIA
Infrastructure and sector conditions			
FVPPCP	Fruit and vegetable production [kg per agricultural population]	1841.31	FAO
AUDIT	Existence of domestic auditor [1 – yes, 0 – no]	0.375 (BRC) 0.151 (GAP)	GlobalGAP, BRC

Table 1 cont.

Business environment			
LAW	Rule of law	4.869	[23]
LGDPpc	Log of GDP per capita	7.740	[24], CIA
TRANS*LGDPpc	Interaction effect LGDPpc and transition country	7.536	[24]
LOWINC*LGDPpc	Interaction effect LGDPpc and low income country	6.532	[24]
MIDINC*LGDPpc	Interaction effect LGDPpc and upper middle income country	8.653	[24]

III. METHODOLOGY AND RESULTS OF THE ANALYSIS

The above described data encompasses two different aspects of the spread of private standards. The existence of certified firms within a country is a binary variable and the number of certified suppliers per country is a count variable. This type of data characteristics is called incidental truncation by Greene [25]. However, for every standard the distribution of certified firms is highly positively skewed and many countries have no certified firm at all. A second observation reveals, see table 2, that certificates of both standards are issued in many countries in parallel. Therefore, a bivariate probit model (Eq. 1) is used to explain the existence of certificates and controls for the independence of both standards.

$$z_{i1} = \beta' x_{i1} + \varepsilon_{i1} \quad y_{i1}=1 \text{ if } z_{i1}>0,\ y_{i1}=0 \text{ otherwise,}$$

$$(1)\quad z_{i2} = \beta' x_{i2} + \varepsilon_{i2},\ y_{i2}=1 \text{ if } z_{i2}>0,\ y_{i2}=0 \text{ otherwise,}$$

$$[\varepsilon_{i1}, \varepsilon_{i2}] \sim \text{bivariate normal (BVN) } [0,0,1,1,\rho].$$

The parameters β and ρ have to be estimated. Latter controls for a correlation of the two error terms. Subsequently, a Tobit estimator (Eq. 2) is used to explain the number of certificates within countries. Due to space constraints and the well-established nature of these two estimators their details are omitted here. Greene [25], for example, provides further information.

$$z_i = \beta' x_i + \varepsilon_i,\ y_i=0 \text{ if } z_i \leq 0,\ y_i=z_i \text{ otherwise} \qquad (2)$$

Table 2 shows the distribution of certified producers, as of Fall 2007, according to their continent. Only independent and internationally recognised countries are included. With respect to the distributed certificates, the two European standards show a dominating concentration on European countries. GlobalGAP reaches a higher number of producers worldwide. The countries with the highest number of GlobalGAP certificates are Spain and Italy, both more than 12,000, and Greece with more than 8000. As expected the United Kingdom leads the list of BRC certificates with more than 2000 followed by Italy with nearly 800. Interestingly, America follows on the second place in the case of GlobalGAP and Asia in the case of BRC. The first standard has more than 1,000 certified firms in Chile and Argentina and close to 1,000 in Peru. Thus, these three countries account for more than half of the issued certificates in North and Latin America (exactly 56.3%). The BRC standard is especially widespread in the Asian countries China and Thailand, again accounting for nearly two-third of all certificates issued in Asia (exactly 65%). In terms of per capita counts, issued certificates per 1000 inhabitants, mainly smaller European countries and New Zealand lead the list for both standards.

Table 2 Distribution of GlobalGAP and BRC certified producers worldwide

	Europe	America	Oceania	Asia	Africa	World
Number of countries	44	36	14	45	53	192
GlobalGAP						
Countries with cert.	31	21	2	16	19	89
Share of countries	70.45	52.78	14.29	31.11	35.85	44.27
Number of cert.	56558	6272	1993	3044	3375	71242
Share of total cert.	79.39	8.80	2.80	4.27	4.74	
BRC Technical Food Standard						
Countries with cert.	29	10	3	15	10	67
Share of countries	65.91	27.78	21.43	33.33	18.87	34.90
Number of cert.	6085	167	155	566	197	7170
Share of total cert.	84.87	2.33	2.16	7.89	2.75	

Note: cert. - certificates
Source: Own computation

A similar picture as indicated above emerges from the look on the distribution of certified producers over all countries. Although many countries have at least one certified firm, only a handful of countries represents larger groupings (i.e. more than 100) of certified firms. The box plots in Figure 1 illustrate this observation over all countries. The median is 8 certified firms regarding the BRC and 51 in the case of GlobalGAP. 75% of the countries with any certified firm (upper border of the boxes) represent 48 (BRC) and 392 (GlobalGAP) firms, respectively. Within the group of transition countries group, China ranks with 256 BRC certificates first. With respect to GlobalGAP, the first place is taken by Hungary (641).
Table 3 presents the results of the econometric analysis, the first two columns contain the results of the bivariate probit followed by the results of the Tobit model. As mentioned above, the probit model measures the existence of any certified farm or firm and controls for a joint existence of both standards in one country. The Tobit model presents evidence of the spread of certification within the respective country. Generally, the presented specifications explain the aggregated adoption of both standards quite satisfactorily.

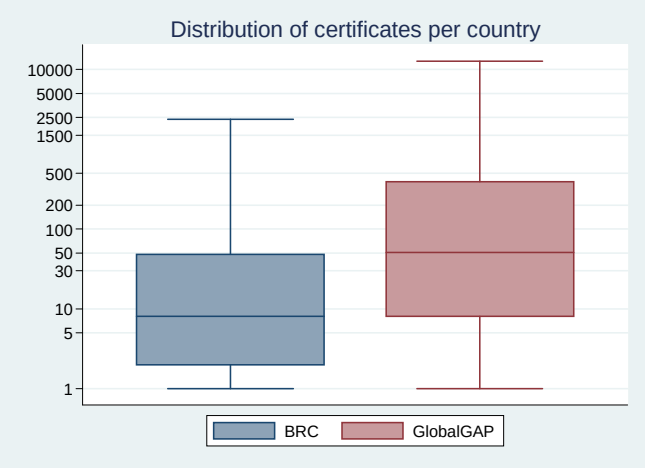

Fig. 1 Distribution of certificates per country

Source: Own computation

In the case of the bivariate probit, the cross-equation correlation is statistically significant. Thus, countries with a GlobalGAP certified farm have a statistically significant positive probability to be home of BRC certified firms, too.

Table 3 Estimation results

	Bivariate Probit		Tobit	
Dependent variable	GAP	BRC	GAP-NOPC	BRC-NOPC
Historical and geographical conditions				
COLONY	-0.228	0.248	-0.009	0.004
	(-0.89)	(0.86)	(-0.24)	(2.28)**
DIST	-0.0001	-0.0001	-7.66*E-06	-4.72*E-07
	(-1.53)	(-1.73)*	(-1.51)	(-2.13)**
POP	0.015	0.026	0.00009	-1.83*E-07
	(4.00)***	(5.00)***	(0.89)	(-0.04)
Infrastructure and sector conditions				
ROADS	-0.104	-0.242	0.061	-0.0002
	(-0.91)	(-1.90)*	(3.89)***	(-0.39)
FVPPCP	0.0001	2.88*E-07	0.00002	-1.47*E-07
	(2.28)**	(0.01)	(3.23)***	(-0.55)
AUDIT			0.143	0.008
			(3.04)***	(4.28)***
Business environment				
LAW	0.221	0.439	0.029	0.001
	(2.34)**	(3.91)***	(1.96)*	(2.11)**
LGDPpc			-0.332	0.006
			(-3.69)***	(2.12)**
TRANS	-1.314	-8.372	-2.865	0.056
	(-0.54)	(-2.08)**	(-3.07)***	(1.60)
TRANS*LGDPpc	0.246	1.137	0.289	-0.006
	(0.81)	(2.14)**	(3.02)***	(-1.64)
LOWINC	-1.273	-5.068	-3.158	0.047
	(-0.93)	(-2.94)***	(-3.49)***	(1.45)
LOWINC*LGDPpc	0.292	0.679	0.338	-0.0005
	(1.72)*	(3.10)***	(3.66)***	(-1.39)
MIDINC	6.621	-10.765	-3.812	0.028
	(0.97)	(-1.43)	(-3.01)***	(0.56)
MIDINC*LGDPpc	-0.708	1.221	0.410	-0.003
	(-0.91)	(1.43)	(3.00)***	(-0.50)
Constant	-1.736	-1.971	2.903	-0.071
	(-2.08)**	(-2.08)**	(3.26)***	(-2.29)**
Rho	0.691***			
N	183		183	185
Censored/ uncensored			101/ 82	103/ 82
Wald/ LR (df)	83.13 (24)***		75.82 (14)***	118.95 (14)***
AIC	366.95		61.64	-485.37

Note: Z-values (Bivariate probit) and t-values (Tobit) are displayed in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source: Own computation

Turning to the estimated coefficients, Table 3 reveals that historical conditions and distance seems to be more important in the case of BRC. The fact whether a country was a UK colony or not has a significant positive effect on the number of BRC certified companies in the Tobit model suggesting that former UK colonies have a higher probability of having more companies being BRC certified. Our result is comparable to findings by Neumayer and Perkins [18], where the time length of colonial status

increases the number of ISO 9000 certificates. Similarly, the distance to the UK has a significant negative impact on the probability to find at least one BRC certified firm in a country as well as the number of BRC certificates. However, the coefficient is not statistically significant at conventional levels with respect to GlobalGAP.

For both standards the coefficient for population (POP) shows a significant positive effect on the probability to have at least one certified farm/ firm in one country but has no impact on the number of certified firms. This result suggests a tendency of concentration of participation in global standards in larger countries. However, our results contradict conclusions by Neumayer and Perkins [18] who find significantly more ISO 9000 certifications per inhabitant in larger countries. It could be argued that their result suffers from the missing control for sample selection.

The estimated coefficient of the variable AUDIT suggests a significant positive impact of the existence of an auditor in a certain country on the number of certified firms in that country. This result appears for both standards and is quite robust. It proves the hypothesis stated above, the availability of domestic auditors might facilitate the adoption of the respective standard. Furthermore, we can state that the estimated coefficient of the variable FVPPCP suggests a significant positive impact of production of fruit and vegetables in a certain country on the existence and number of GlobalGAP certified firms in that country. It highlights the targeting of certification on countries with a specialised or intense production of fruits and vegetables. Especially GlobalGAP started with standards for fresh vegetables. It would be promising for future studies to analyse whether a specialisation in any other food category also influences the food standard certification.

The variable LAW has significant positive effects for countries, i.e. firms, being certified. The results suggest that in countries with a higher acceptance of legal rules and laws companies are with a significantly higher probability certified at all (probit model) and furthermore, a significantly larger number of firms obtained certification (Tobit model). Hence, a better institutional environment helps firms to take advantage of modern organisational innovations.

The GDP per capita variable displays a significant negative coefficient in the Tobit model for GlobalGAP and a positive coefficient in the Tobit model for BRC certificates after controlling for country groups like low and middle income countries. Hence, the different target groups of GlobalGAP and BRC certification seem to be opposing each other. The number of GlobalGAP certified farms decreases with the GDP per capita and the number of BRC certified firms increases. However, the controls for the different country groups reveal also a significant heterogeneity within these groups. Whereas classification as transition or low income country lowers the probability to have any certified firm, the wealthier countries within these groups exhibit significantly higher probabilities. Thus, not the pure status as transition country or low income country matters. Interestingly, it applies for the existence of BRC certification but also for the number of GlobalGAP certificates. With respect to the existence of BRC certificates, the results point to no statistically significant difference between middle and high-income countries. On the contrary, the number of GlobalGAP certificates is, following the estimated coefficients, highest in the group of high-income countries.

Extending the econometric framework and including trade related variables, like the share of exports to standard's home countries on total agricultural exports, results in a sharp drop in sample size. Many countries without any of the two certifications analysed here do not report data to international organisations. Additionally, the estimated coefficient of the export share is far from being statistically significant. One possible extension of the econometric analysis would be the inclusion of lagged numbers of certificates or even the estimation as panel. Unfortunately, data of previous years are currently not available.

IV. CONCLUSIONS

This study empirically analyses the global spread of retailer driven food standards and possible determinants using aggregated cross-country level data from GlobalGAP and BRC. Three classes of explanatory variables containing historical and

geographical characteristics, infrastructure and sector conditions, as well as business environment are used to explain the existence of certified firms within a country and the number of certified suppliers per country.

Our results show no evidence that developing or transition countries are systematically excluded from retailer driven food standards. However, a concentration of certified firms mainly in European countries is observed and less wealthier countries face a significantly lower probability to be home of at least one certified farm or firm. Furthermore, several of our findings suggest that farmers in developing or transition countries have to overcome certain barriers to get certified by a private food standard. Farmers' participation in organisational innovation is negatively affected by a poor institutional quality of their country. The fact that countries with missing data belong to the group of countries without certified producers seems to support our findings. Again our results are not suited to derive conclusions with respect to the characteristics of certified farms and to prove the potential exclusion of smallholders.

Interestingly, our results suggest that the number of GlobalGAP certified farms decreases with the GDP per capita and the number of BRC certified firms increases. Whereas classification as transition or low income country lowers the probability to have any certified firm, the wealthier countries within these groups exhibit significantly higher probabilities. Thus, for both BRC and GlobalGAP not the pure status as transition country or low income country matters.

Our study leaves room for future applications. It remains to be analysed whether a bifurcation of the market exists by observing what determines the certification process within countries at farm/ firm-level. Extending the group of explanatory variables could help to further explain the global spread of food quality standards. With respect to the econometric analysis the inclusion of lagged numbers of certificates or even the estimation as panel seems to be promising.

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