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THE ABILITY OF ORGANISATIONS TO ADOPT FOREIGN TRADE STANDARDS

Abstract

Recent empirical studies argue that the implementation of quality standards among agricultural exporters has the character of a fixed cost. However, this can be misleading if fixed costs are only understood in terms of required investments. Instead, we argue that standard adoption is the result of exporting countries' private and public organisations managing to solve the standard implementation problem. We demonstrate that a newly developed theoretical approach to the role of problem solving in the production process can be interpreted as a model of a country's ability to implement foreign trade standards. Predictions of this model are tested within a gravity framework: we compare doing business indicators as proxies for the institutional characteristics of countries that successfully export fruits, dairy products, meat, fish, and vegetables to the EU (as a high standard market) against characteristics of countries that serve all markets. Results indicate that institutional characteristics like e.g. starting a business, enforcing contracts, and getting credits are more relevant for exports to markets with relatively high quality standards than for overall exports.

Keywords: agricultural trade, food standards, organisations, institutional quality

1 Introduction

The effect of quality standards on trade flows is currently ambiguous within scientific literature. Related empirical findings appear to depend partly on the methodology that has been applied and on the specific context of a study. The debate is often entitled "standards-as-catalyst vs. standards-as-barriers".

For instance, OTSUKI, WILSON and SEWADEH (2001) found a negative effect of EU aflatoxin standards on African exports of cereals, dried fruits and nuts. They used country and year fixed effects for the time period from 1989 to 1998. XIONG and BEGHIN (2012) applied more sophisticated methods to the same case in order to enable comparisons. As a result of their findings, however, EU aflatoxin standards have not been found to reduce groundnut imports from African countries.

FERRO, OTSUKI and WILSON (2015) have investigated the effect of maximum residue limits (MRLs) within a large panel data set using standard ordinary least squares (OLS) and a two-step probit estimation (HMR) to control the large number of zeros (HELPMAN, MELITZ and RUBINSTEIN, 2008). The effect of MRLs on trade is negative as long as OLS is applied. However, the effect vanishes once HMR is applied. Also the type of the analysed standard matters greatly, as shown by MELO *et al.* (2014). Data on Chilean exports of grapes, apples, kiwis and cherries from 2005 to 2009 revealed a negative effect of standards for both OLS and Poisson-Pseudo-Maximum Likelihood (PPML) methods as long as an aggregated stringency index was used. However, if the index is broken down into different standards, i.e. MRL, phytosanitary regulations and GAP, the negative impact only remains for the first two standards. GAP certificates alone are found to enhance trade flows. This is in line with MASOOD and BRÜMMER (2014) who found a trade-enhancing effect of GlobalGAP certification of EU banana imports, using the PPML estimation technique. Mixed evidence is also provided by ANDERS and CASWELL (2009) who show that American imports from developing countries declined due to Hazard Analysis Critical Control Points whereas imports from developed countries increased.

In contrast, food quality standards – especially among exporters in developing countries – are widely perceived as nontariff barriers that impede market access (WTO and OECD 2013).

Compliance with standards is usually described as having the character of a fixed cost and is therefore presumed to constitute a major barrier to trade, especially for small countries and small companies (MASKUS, OTSUKI and WILSON, 2005; KLEINWECHTER and GRETHE, 2006; KISS and WEINGARTEN, 2003, SCHUSTER and MAERTENS, 2015, COLEN et al., 2012).

However, the concept of fixed cost suggests that potential financial investment (e.g. aid for trade programmes, foreign direct investment or the governmental effort of the exporting country) would be sufficient to overcome such trade impediments. In this context, WTO and OECD (2013) conducted a private sector survey in which they evaluated several aid-for-trade programmes. The authors identified various non-financial barriers of standard adoption, e.g. the absence of networks with governments, the absence of supply chain relationships, a lack of confidence in existing and new markets, and difficulties in collaborating with the public sector (WTO and OECD, 2013: 33). According to these findings, not all barriers of standard adoption could be eliminated by plainly providing financial support.

In this paper we therefore argue that describing the role of food standards according to their fixed cost character may fall conceptually short of addressing important institutional aspects of the ability of a company or a country to adopt standards. Institutional aspects of trade have been described in terms of contract enforceability, social networks, relevance of informal activities, information asymmetries and the availability of skilled workers e.g. by ACEMOGLU, ANTRÀS and HELPMAN, 2007; DE LA MATA, TAMARA and LLANO, 2013; NUNN, 2007; RAUCH and CASELLA, 2003; WTO and OECD, 2013; BLOOM, SADUN and VAN REENEN, 2012; and MUANGE, SCHWARZE and QAIM, 2014.

Other than the approaches in this literature, we demonstrate that recent economic theory has developed approaches that can be utilised to formally model the ability and the economic incentive of public and private organisations to work towards the adoption of a certain food standard required by a potential export destination. We further argue that a deeper understanding of the composition of fixed costs would allow agricultural economists to formulate more precise policy recommendations to facilitate standard adoption and, eventually, enhance international trade flows.

In the following section, a conceptual framework is established that allows the relationship between learning and production performance within an organisation to be modelled.

2 Modelling an organisation's ability to adopt a foreign trade standard

We break down the fixed cost character of a foreign trade standard into a monetary component and an institutional component. The institutional component is denoted by Θ and constitutes the 'trade standard adoption ability' (SAA) of an organisation (public, private, or both in collaboration) to successfully implement and adopt a certain quality standard for its exports to the standards-setting importer *j*. SAA measures the amount of implementation work that has to be performed, over and above financial investments, in order to adopt a certain standard. Thus, to match a relatively high standard, SAA has to be higher than for the adoption of a relatively low standard.

Based on the findings in literature about institutional aspects of trade (see introduction), SAA (Θ) could be expressed as a function of various indicators of institutional performance:

$$\Theta = f(social\ networks, skilled\ workers, information, contracts, \dots)$$

However, we propose a more abstract representation of SAA that expresses an organisation's ability to adopt a trade standard Θ as the cost of communication $\boldsymbol{h}$ and the cost of acquiring knowledge *c*: $\Theta = f(h,c)$.

In the next step, it is then necessary to lay out a model in which Θ explains the participation in exports to a certain destination. We argue that key to the understanding of the effect of institutional adoption power with respect to standards is the need to reflect SAA (Θ) within the op-

timisation decision of potential exporters in an exporting country. For this purpose, we utilise a recently developed production function that models the role of vertical coordination of knowledge-intensive tasks within an organisation for the productivity of output provision (ANTRÀS and ROSSI-HANSBERG, 2009; CALIENDO and ROSSI-HANSBERG, 2012; GARICANO and ROSSI-HANSBERG, 2014).

As a core insight, these theoretical approaches predict additional gains from trade due to reorganisation within firms.

2.1 Model description

In this section we present a theoretical framework that models an organisation's ability to solve management problems as a function of the cost of communication and the cost of acquiring additional knowledge. This theoretical framework is based on the models in CALIENDO and ROSSI-HANSBERG (2012) and GARICANO and ROSSI-HANSBERG (2014). However, these models do not consider the problem of standard implementation, but focus on the relationship between trade, competition, reorganisation of production in a knowledge-based economy, and productivity. However, we use a slightly different interpretation of their theoretical models and focus instead on an exporting organisation's difficulty in implementing the food quality standard of a potential import destination.

Production requires knowledge (as interpretation of capital) and labour (to be thought of as the amount of time that workers are willing to offer to the labour market). One unit of labour (e.g. 1 hour) can be supplied by two types of agents: workers (L) and managers (K). Both together solve *problems* (P) for which a minimum level of knowledge is required. *Problems* need to be solved in order to transform otherwise useless production to useable output q.

Since different problems require different levels of knowledge, and acquisition of knowledge is costly, it is not efficient to educate every worker to be a manager nor to educate all managers identically. A firm in the model therefore consists of a specific hierarchy with multiple knowledge layers (e.g. each layer has a different K/L ratio). A firm needs to decide the optimal number of layers and the optimal knowledge intensity per layer.

Workers in the lowest layer draw a problem from a cumulative distribution function of existing knowledge $F(z)$. The problem can be solved if it is included in the worker's knowledge set. The fraction of solved problems is then equal to $F(z) = 1 - e^{-\lambda z}$ with expected output quantity q=$A[1 - e^{-\lambda z_L^l}]$. Thus, A stands for the technology of the representative firm in an exporting economy; z_L^l denotes knowledge of an agent in layer l of a firm with highest layer L. The shape parameter λ of the exponential function represents the frequency of problems; the higher λ the more frequent and, thus, the easier the problem. In other words, reducing λ implies reducing the number of solved problems.

If z is not included in the knowledge set, the worker needs to ask the manager one layer above him for help. The manager spends h units of time by listening to the worker's problem and solving it. If the manager's knowledge does not include z, the problem is forwarded to the next layer in the hierarchy. The parameter h represents costs of communication between managers and workers. The costs of acquiring additional knowledge for the interval $[0; z]$ are equal to wcz. The costs of one unit of knowledge are then given by the units of time c of a hypothetical teacher who earns wage w. The production cost of an organisation with $L > 0$ layers is given by:

$$C_L(q; w) = \min \sum_{l=0}^{L} n_L^l w\left[cz_L^l + 1\right] \qquad [1]$$

Equation (1) can be explained as follows: n_L^l represents the number of agents in layer l. The layer of the workers, which is the lowest layer, is denoted by 0 and therefore, the number of workers is n_L^0. The number of workers and the number of managers one layer above depend on communication costs h in terms of units of time and the fraction of unsolved problems

$1 - F(z) = 1 - \left(1 - e^{-\lambda z_L^{l-1}}\right) = e^{-\lambda z_L^{l-1}}$ where $Z_L^{l-1} = \sum_{l=0}^{l} z_L^l$ is the cumulative knowledge of the organisation up to layer l. Hence, if each manager supplies one unit of time, the number of managers in layer l is given by: $n_L^l = n_L^0 h\, e^{-\lambda z_L^{l-1}}$. The cost in equation (1) needs to be minimised subject to the following three constraints:

i) $n_L^l = n_L^0 h\, e^{-\lambda z_L^{l-1}}$; ii) $A\left[1 - e^{-\lambda z_L^L}\right] n_L^0 \geq q$; iii) $n_L^L = 1$

The third constraint implies that the highest layer L consists of only one manager, also called the *entrepreneur*. As shown in CALIENDO and ROSSI-HANSBERG (2012), hereafter CRH, the general and marginal cost function can be derived from this constrained minimisation problem by differentiating with respect to z_L^0, z_L^l and z_L^L . Both functions are given by:

$$C_L(q; w) = \frac{wc}{\lambda}\left(\frac{h}{A} e^{\lambda z_L^L} q + \left(1 - e^{\lambda z_L^{l-1}}\right) + \lambda z_L^L + \frac{\lambda}{c}\right) \quad [2]$$

$$MC_L(q; w) = \frac{\partial C_L}{\partial q} = \frac{wch}{\lambda A} e^{\lambda z_L^L} = \phi \quad [3]$$

The marginal cost of the firm is increasing in w, cost of acquiring knowledge c and communication cost between layers h.

Demand in the framework presented here is similar to the model of MELITZ (2003) about firm heterogeneity. An entrepreneur pays sunk entry costs f^E in units of labour in order to design a product variety, which has to be distinguished from fixed costs of production f. However, instead of randomly drawing the crucial *productivity* parameter (MELITZ, 2003), the corresponding total *demand* product variety α is drawn from the Pareto distribution $G(\alpha) = 1 - \alpha^{-\gamma}$, and at least needs to compensate f. This level of demand determines the optimal organisational structure of a firm and, therefore, the productivity of this firm. The firm's decision to produce and to export is made accordingly. The product variety α enters a CES utility function U (for further details see CRH). Firms compete monopolistically and the profit maximisation problem is given by:

$$\pi(\alpha) = \max\, p(\alpha)q(\alpha) - C(q(\alpha); w) - wf \quad [4]$$

Since capital is interpreted as knowledge, and knowledge needs to be maintained in every period, the fixed costs is wf (CRH). Due to monopolistic competition, the optimal quantity produced does not only depend on marginal cost, but also on the inverse demand for the variety $p(\alpha) = q(\alpha)^{-\frac{1}{\sigma}}(\alpha R)^{\frac{1}{\sigma}}$ and thus on the drawn level of α and on total industry turnover R. Furthermore, due to monopolistic competition the standard constant mark-up is charged and prices are not equal to marginal costs. However, in contrast to MELITZ (2003) and other related models, marginal costs are endogenous because they depend on the drawn level of demand for product variety α. As a result, CRH obtain

$$p(\alpha) = \frac{\sigma}{\sigma - 1} MC(q(\alpha); w); \qquad q(\alpha) = \alpha R \left(\frac{\sigma}{\sigma - 1} MC(q(\alpha); w)\right)^{-\sigma} \quad [5a,b]$$

and marginal cost depends on the produced quantity of α. Finally, general profits are defined as:

$$\pi(\alpha) = r(\alpha) - C(q(\alpha); w) - wf = \frac{r(\alpha)}{\sigma} - w\left(\frac{c}{\lambda}\left(1 - e^{\lambda z_L^{L-1}(\alpha)}\right) + c z_L^L(\alpha) + 1 + f\right) \quad [6]$$

Similar to MELITZ (2003), the zero cut-off profit condition (ZCP) as well as the free-entry condition (FEC) are needed in order to solve the model.

ZCP determines the marginal firm that faces demand level $\bar{\alpha}$ at which profits are zero. Hence, all firms with $\alpha > \bar{\alpha}$ produce. Hereby, profits are directly linked to the level of demand of variety α:

$$\pi(\alpha) = \left[\left(\frac{\alpha}{\bar{\alpha}}\right)^{\sigma - 1} - 1\right](C + wf) \;\forall\; \alpha > \bar{\alpha} \quad [7]$$

The FEC equalises expected profits and sunk entry costs in units of labour (CRH).

$$\int_{\bar{\alpha}}^{\infty} \frac{\pi(\alpha)}{\delta} g(\alpha) d\alpha = w f^E \quad [8]$$

where δ denotes the probability of staying in the market and $g(\cdot)$ is the density of the distribution of demand $G(\cdot)$. By using the FE condition, we isolate the threshold level $\bar{\alpha}$:

$$\bar{\alpha}^{\gamma} = \frac{\sigma-1}{\gamma-(\sigma-1)} \alpha_{min}^{\gamma} w f \frac{1}{\int_{\bar{\alpha}}^{\infty} \frac{\pi(\alpha)}{\delta} g(\alpha) d\alpha} \quad [9]$$

As Equation (9) shows, lower than expected profits increase *ceteris paribus* (*c.p.)* threshold $\bar{\alpha}$.

2.2 Assessing the role of standard adoption ability for the decision to export

According to GARICANO and ROSSI-HANSBERG (2014), the purpose of a hierarchical organisation is to economise on the acquisition and communication of knowledge, and spreading knowledge becomes more relevant if the costs of acquiring knowledge are relatively high. For our problem of SAA this means the following: the implementation of a new standard requires a firm's effort in terms of time, capital and knowledge. This is especially relevant if the firm is less familiar with standard implementation than other firms since standards might require similar prerequisites. If, for example, retailers require the implementation of a new irrigation technique in order to reduce soil erosion by their African farmers, they might not know how to implement this technique that directly excludes them from the value chain. To expand this example, we could assume that some farmers belong to a cooperative and others do not. This would allow the former to ask other farmers in the cooperative how to implement the new irrigation technique. The others do not have anyone to ask. In other words, farmers in a cooperative have lower costs of communication since they can easily ask other farmers. If the irrigation technique is highly complex and new, it might even be that no other farmer in the cooperative knows how to implement it. However, a cooperative could consult external experts and invite them in to teach the farmers.

In this example, the crucial aspects are twofold: (i) one group of farmers has lower communication cost than the other group, and (ii) lower communication costs allow farmers to ask experts from upper layers. The lower the communication costs, e.g. due to very intense collaboration or a large network of available external experts, the more efficiently knowledge could be shared among farmers.

Proposition 1: *Agricultural exporters with lower communication costs are expected to earn higher profits.*

For the problem of SAA we are interested in the marginal change of profits due to a change in h. We therefore substitute equation (3) into (5a,b) and take the derivative.

$$\frac{\partial \pi(\alpha,h,c)}{\partial h} = \nu \alpha R \underbrace{(1-\sigma)}_{<0} \left(\frac{wch}{\lambda A} e^{\lambda Z_L^L}\right)^{-\sigma} \left(\frac{wc}{\lambda A} e^{\lambda Z_L^L}\right) < 0 \quad [10]$$

Since $\sigma > 1$ and all other terms are strictly greater than zero, the derivative is unambiguously smaller than zero. Hence, higher costs of communication imply lower profits. In terms of the model, a lower threshold level $\bar{\alpha}$ would be required.

Proposition 2: *The higher the cost of acquiring knowledge c, the more important the structure of an organisation becomes.*

This time, we assess the derivative of the GARICANO and ROSSI-HANSBERG (2014) profit function with regard to c.

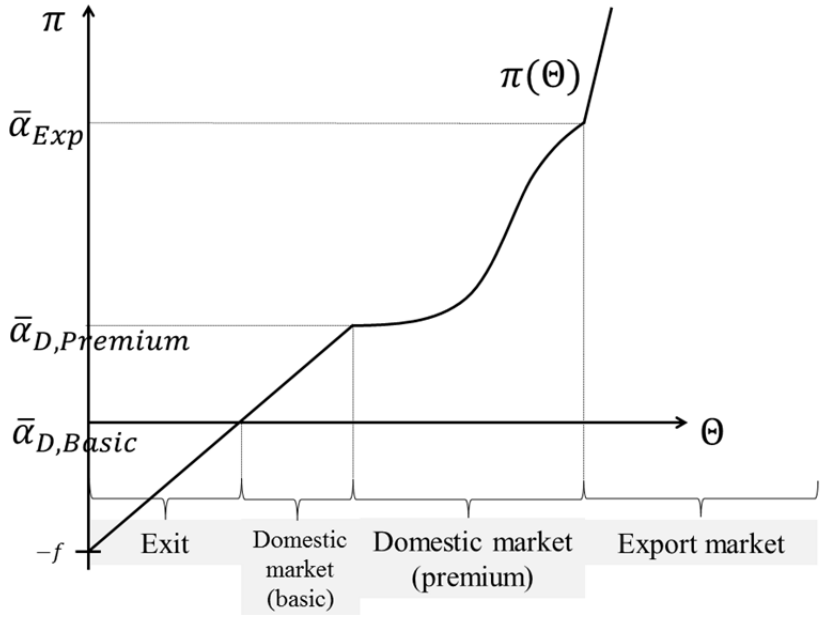
$$\frac{\partial \pi(\alpha,h,c)}{\partial c} = \nu \alpha R \underbrace{(1-\sigma)}_{<0} \left(\frac{wch}{\lambda A} e^{\lambda Z_L^L}\right)^{-\sigma} \left(\frac{wh}{\lambda A} e^{\lambda Z_L^L}\right) - w\left(\frac{1}{\lambda} + Z_L^L\right) + \frac{w}{\lambda} e^{\lambda Z_L^{L-1}} \quad [11]$$

The sign of the derivative in equation (11) is initially ambiguous. However, the sign is negative under the assumption that the last term (which is positive) is not greater than the absolute

value of the first term (which is negative). Thus, the central cost parameters h and c reduce profits, which leads to an increase in the threshold level of demand $\bar{\alpha}$.

Figure 1 plots profits as a function that is strictly increasing in SAA (note that $\pi = \pi(\Theta) \ \wedge \ \Theta = \Theta(h,c) \implies \pi = \pi(h,c)$). Figure 1 is interpreted as follows: we recall that a firm initially draws the variety-specific demand from the distribution $G(\alpha)$. The firm decides to produce in the event that $\alpha > \bar{\alpha}_{D,basic}$. Otherwise, the demand would be too low in order to accommodate the fixed costs of production f. The figure shows various threshold levels of α, which we relate to various standards that differ in terms of their degree of restrictiveness. In other words, depending on the degree of restrictiveness of a specific standard, a corresponding level of demand needs to be drawn in order to produce and to export; the stricter the standard, the higher the threshold and hence the lower the likelihood to produce and to export.

Figure 1: Profit as a function of demand parameter (α) and Trade Standard Adoption Ability (SAA), which is denoted by Θ



Source: Own depiction

Other than previous studies, we model standards as a continuum. Standards could be ordered according to their degree of restrictiveness, ranging from not very restrictive to highly restrictive. The former is denoted as $\bar{\alpha}_{D,Basic}$ and represents the threshold of demand that is needed in order to produce for the domestic basic market, which is associated with the lowest possible standards. However, premium markets are characterised by more restrictive standards. A higher threshold $\bar{\alpha}_{D,Premium}$ needs to be drawn in order to serve this domestic premium market. Producing for foreign markets requires even higher thresholds.

The landscape of standards is becoming highly heterogeneous, especially where private standards are concerned. Multinational enterprises often have their own sustainability programme with individual characteristics and requirements (UNILEVER, 2010). The more multinational enterprises implement their individual standard requirements and the more specific and different they are, the more difficult standard adoption becomes. This effect is similar to the phenomenon of relation-specific contracts described by NUNN (2007). The continuum of thresholds is exemplarily illustrated by three different thresholds on the vertical axis in Figure 1. The shape and the slope of the profit curve change at these thresholds. Profits increase linearly unless the domestic premium market is served. Here, profits initially increase more slowly for increasing levels of institutional learning and faster for higher levels. The underlying

reasoning is that the learning curve is initially flat since the required standards of the premium market are difficult to meet. However, once they are met, profits increase exponentially. If the firm exports, profits will increase linearly but more quickly than for the domestic basic market.

3 Empirical application

In the previous section a conceptual framework has been established in which the cost of acquiring knowledge and the cost of communication within an organisation are interpreted as the main components of the ability to adopt a certain trade standard. Based on that framework, it has been shown that for a given level of demand, profits are increasing with a firm's ability to acquire knowledge and benefit from lower costs of communication.

These predictions can be tested empirically in many ways. One way would be to collect company level data and assess the values of c and h empirically, e.g. based on surveys with workers and managers. However, if the predictions of the model are correct, official statistics about trade flows and trade-related standards will also implicitly contain information about the ability of the organisations within a certain country to adopt foreign trade standards. From this reasoning, the following hypothesis is derived:

Hypothesis: An exporting country is *c.p.* more likely to be observed exporting to destinations with relatively high trade-related standards if the relevant costs of acquiring knowledge and communication are lower than in other countries.

The relevance of institutions for economic prosperity was first established by NORTH (1990). In subsequent literature, the important role of institutions in economic growth has rarely been challenged in general; rather, the remaining discussion asks whether it is institutions alone or other factors as well, e.g. geography.

The effect of domestic institutions on bilateral trade flows has been less frequently investigated. The focus lies more on the effect of WTO membership and regional trade agreements (RTA) as important institutions for trade and trade policy. Studies that analyse the effect of domestic institutions on trade flows usually remain in the gravity framework by adding further proxies of institutional quality. For instance, JANSEN and NORDAS (2004) found a positive effect of institutions unless the quality of domestic infrastructure is not controlled for. Using cross sectional bilateral trade flows in the gravity framework, GROOT *et al.* (2004) found positive effects of institutional quality for the year 1998. Furthermore, similar institutions of both trading countries also enhance trade. The authors used the worldwide governance indicators (WGI) of the World Bank (KAUFMANN, KRAAY and MASTRUZZI, 2014) as proxies for institutional quality. HELPMAN, MELITZ and RUBINSTEIN (2008) also included regulation costs as an additional covariate and found it to be negatively correlated with trade flows. Finally, IWANOW and KIRKPATRICK (2007) provide empirical evidence by augmenting the standard gravity equation with trade facilitation, regulatory quality and infrastructure for positive effects of institutions on trade. Overall, the positive effect of institutions on trade flows is robust across most studies.

In the absence of company-level data we therefore refer to the empirical approaches in literature. We also test our hypothesis within a gravity framework in order to control for the effect of distance, GDP, and tariffs and we relate recently updated doing-business indicators (DBI) of the Worldbank as proxies for institutional quality to our variables of interest: the costs of communication h and costs of acquiring knowledge c: $\Theta=f(h,c)$. These measure the regulatory business environment with firm survey data and hence, aggregate firm level information to the overall business environment of a country. Thus, the doing-business indicators perfectly match our firm level approach of the theoretical model with the country-level empirical application. Table 1 contains brief definitions of all ten proxies. Furthermore, we refer to countries as representative organisations that reflect the combined standard adoption ability (SAA) of

exporting firms as well private and public institutions related to that. Column 3 of Table 2 reports the relation of the DBIs to the SAA of countries.

We test our hypothesis as follows: we choose fruit-, dairy-, vegetable-, meat-, and fish products and we select a country's exports to the EU as a case of exports to a market with higher than average standards. We treat the ten variables for institutional quality separately because these are most likely positively correlated. Hence, we include one dimension of governance at a time lagged by one year to account for potential reverse causality. The interaction term is the product of DBI and the dummy variable which is equal to one if the importing country is a member of the EU. In order to fail to reject our null hypothesis, the coefficient β_2 of the interaction term with DBI and EU-membership needs to be statistically significant. This indicates additional explanation of DBI for exports to the EU even if DBI is already controlled for. The gravity model that we estimate looks as follows:

$$X_{ijt} = \beta_0 + \beta_1 DBI_{it-1} + \beta_2 DBI_{it-1} * D_{EU} + \beta_3 GDP_{it} + \beta_4 GDP_{jt} + \beta_5 Dist_{ij} + \beta_6 T_{ijt} + \beta_7 \Omega_{ijt} + \eta_i + \nu_j + \mu_t + \epsilon_{ijt}$$

Exports, GDP, distance and tariffs are included in logarithmic form. X_{ijt} refers to exports from country *i* to country *j* in year *t*. Ad valorem tariffs are denoted by *T*. The matrix Ω_{ijt} contains the remaining standard gravity variables' colonial history, common language, religion, and contiguity. Finally, country and year fixed effects are included to control for time-invariant multilateral resistance (ANDERSON AND VAN WINCOOP, 2003).

We estimate a panel using fixed and random effects. Most institutional proxies are available for the years 2006 to 2015. Institutional quality is proxied by ten doing-business indicators that are measured by the distance-to-frontier approach. These indicate the distance to the best performing country ranging from 0 (worst performing country) to 100 (best perming country or frontier)[1]. SANTOS SILVA and TENREYRO (2006) argue that to correctly account for heteroscedasticity, the Poisson-Pseudo-Maximum-Likelihood estimator (PPML) should be applied. In contrast, MARTÍNEZ-ZARZOSO (2013) provides empirical evidence and simulation results that no single best estimator exists. Instead, the decision for the most appropriate estimator depends on the underlying data set and therefore as many estimation techniques as possible should be applied and reported. Furthermore, many gravity data sets are characterised by a high share of zeros of the dependent variable, especially if trade flows are highly disaggregated.

Therefore, HELPMAN, MELITZ and RUBINSTEIN (2008) relax the standard gravity assumption of homogenous firms and introduce firm heterogeneity by estimating the gravity equation in a two-step procedure. This allows differentiation between zeros that are due to missing values and zeros because of missing trade. For simplicity, this paper applies standard fixed and random effects estimation techniques.

4 Empirical results

Table 2 reports the results of three out of five product categories estimated by both fixed and random effects. In total, we have 100 regressions due to ten variables for institutional quality either as fixed or as random effects for five product categories. The Hausman test actually rejects the random effects model for all ten indicators. However, the results of the random effects estimates are nevertheless reported of each indicator in Table 2. Column 4 of Table 1 summarises the findings with respect to the coefficient of the interaction term β_2.

[1] Definitions for the doing-business indicators are available at http://www.doingbusiness.org/, accessed 3rd August 2015.

For dairy, meat, and vegetables both fixed and random effect estimates strongly confirm that the positive effect of institutional quality - and hence, lower communication costs and costs of acquiring knowledge - on exports is especially relevant for exports into the EU, as our case of a market with relatively high quality standards. For fruits and fishes, results are less clear and require additional research.[2]

Table 1: Institutional indicators as approximations for c and h and empirical findings

Indicator	Brief definition	Relation to SAA	Findings for exports to EU
(1) Overall	Aggregate of all DBIs	Easier to acquire knowledge and to communicate	Statistically significant for exports to the EU for FE and RE and all three products.
(2) Starting a business	Number of procedures and days and required capital to start a business	Facilitates market entry and implies lower c & h due to more competition	Statistically significant for exports to the EU for FE and RE and for dairy and meat.
(3) Construction permits	Number of procedures and days to receive construction permit	Facilitates firm expansions; larger firms have lower c & h	Statistically significant for exports to the EU for FE and RE and all three products.
(4) Getting electricity	Number of procedures and days to get electricity	Facilitates firm expansions; larger firms have lower c & h	Statistically significant for exports to the EU for FE and RE and all three products.
(5) Registering property	Number of procedures and days, percentage of value to register property	Facilitates firm expansions; larger firms have lower c & h	Statistically significant for exports to the EU for FE and RE and for meat only.
(6) Getting credit	Strength of legal rights index and depth of credit information index	Facilitates firm expansions; larger firms have lower c & h	Statistically significant for exports to the EU for FE and RE and all three products.
(7) Paying taxes	Number of payments, hours per year, total tax rate of profit	Facilitates firm expansions; larger firms have lower c & h	Statistically significant for exports to the EU for FE and RE and all three products.
(8) Trading across borders	Documents, time, and costs to ex- and import	Allows firms to export even with higher levels of c & h	Statistically significant for exports to the EU for FE and RE and all three products.
(9) Enforcing contracts	Number of procedures and days and cost of a claim to enforce contracts	A good legal framework allows firms to export even with high c & h	Statistically significant for exports to the EU for FE and RE and for meat only.
(10) Resolving insolvency	Recovery rate and strength of insolvency framework index	Facilitates market exits and implies lower c & h due to more competition	Statistically significant for exports to the EU for FE and RE and for dairy and meat.

Source: Own, based on DBI

5 Discussion and conclusions

The scientific debate about whether standards function as catalysts or as barriers to trade is still ongoing. Various studies mention in this context that the implementation of foreign standards will typically require investments among potential exporters, and therefore either larger farms or farms otherwise more likely to undertake such investments would be the ones to benefit from export opportunities.

In this paper we have argued that limiting the analysis of standards for trade to the aspect of investment and the corresponding effect on total and variable cost of production falls short of incorporating the aspect of organisational and institutional standard adoption ability. We have defined this adoption ability of private and public organisations (e.g. farms, firms and the government) within an exporting country to be a function of the cost of communication and the cost of acquiring relevant knowledge necessary to solve the problem of implementing a specific foreign standard. Furthermore, we demonstrate that recent advances in general

[2] Estimation results of fruits and fish are not reported here due to space constraints but are available upon request. Furthermore, Table 2 only reports estimates of the coefficients of interests $\beta_1$and β_2. Estimates of the remaining standard gravity variables largely confirm general gravity findings.

Table 2: Gravity estimation results for ten indicators, using fixed effects and random effects

	Dairy (HS 04)		**Meat** (HS 02)		**Vegetable** (HS 07)	
	FE	**RE**	**FE**	**RE**	**FE**	**RE**
Overall	-0.014	-0.0140**	-0.00459	-0.00454	0.023***	0.023***
	(0.00677)	(0.00679)	(0.00987)	(0.00992)	(0.00511)	(0.00512)
Overall_EU	0.020***	0.020***	0.016***	0.017***	0.011***	0.011***
	(0.00233)	(0.00233)	(0.00284)	(0.00286)	(0.00179)	(0.00179)
StartingBusiness	-0.00505*	-0.00510*	0.018***	0.017***	-0.00325	-0.00317
	(0.00282)	(0.00283)	(0.00420)	(0.00421)	(0.00238)	(0.00239)
StartingBusiness_EU	0.005**	0.0049**	0.012***	0.012***	0.00150	0.00139
	(0.00237)	(0.00236)	(0.00268)	(0.00269)	(0.00158)	(0.00158)
Construction	-0.00631*	-0.00646*	-0.00351	-0.00368	0.008***	0.008***
	(0.00342)	(0.00343)	(0.00482)	(0.00484)	(0.00292)	(0.00292)
Construction_EU	0.008***	0.007***	0.014***	0.014***	0.005***	0.005***
	(0.00240)	(0.00239)	(0.00277)	(0.00277)	(0.00170)	(0.00170)
Electricity	-0.00783	-0.00785	0.00668	0.00668	0.016***	0.016***
	(0.00499)	(0.00501)	(0.00776)	(0.00780)	(0.00381)	(0.00382)
Electricity_EU	0.019***	0.019***	0.015***	0.015***	0.009***	0.009***
	(0.00210)	(0.00210)	(0.00258)	(0.00259)	(0.00165)	(0.00165)
Property	0.00580*	0.00584*	-0.00259	-0.00250	-0.00368	-0.00356
	(0.00331)	(0.00332)	(0.00494)	(0.00496)	(0.00282)	(0.00282)
Property_EU	0.00386	0.00385	0.012***	0.012***	0.00253	0.00242
	(0.00246)	(0.00246)	(0.00282)	(0.00283)	(0.00169)	(0.00168)
GettingCredit	0.01***	0.01***	0.0095**	0.0095**	0.008***	0.008***
	(0.00281)	(0.00281)	(0.00399)	(0.00400)	(0.00227)	(0.00228)
GettingCredit_EU	0.008***	0.008***	0.013***	0.013***	0.0046**	0.005***
	(0.00254)	(0.00253)	(0.00290)	(0.00291)	(0.00185)	(0.00184)
PayingTaxes	-0.000956	-0.00103	0.0096**	0.0095**	0.011***	0.011***
	(0.00313)	(0.00314)	(0.00438)	(0.00440)	(0.00264)	(0.00264)
PayingTaxes_EU	0.009***	0.009***	0.014***	0.015***	0.005***	0.005***
	(0.00235)	(0.00234)	(0.00273)	(0.00274)	(0.00165)	(0.00165)
TradingBorders	-0.00244	-0.00256	-0.00803	-0.00805	0.014***	0.014***
	(0.00361)	(0.00362)	(0.00553)	(0.00555)	(0.00304)	(0.00305)
TradingBorders_EU	0.008***	0.008***	0.013***	0.013***	0.005***	0.005***
	(0.00210)	(0.00209)	(0.00245)	(0.00246)	(0.00151)	(0.00151)
EnforcingContracts	-0.00654*	-0.00662*	0.020***	0.02***	0.011***	0.011***
	(0.00338)	(0.00339)	(0.00510)	(0.00512)	(0.00304)	(0.00305)
EnforcingContracts_EU	0.00467	0.00471*	0.014***	0.014***	0.000238	0.000256
	(0.00285)	(0.00283)	(0.00318)	(0.00318)	(0.00191)	(0.00190)
ResolvingInsolvency	0.016***	0.016***	0.019***	0.019***	0.012***	0.012***
	(0.00233)	(0.00233)	(0.00323)	(0.00324)	(0.00201)	(0.00202)
ResolvingInsolvencyEU	0.007**	0.007**	0.011***	0.010***	0.000947	0.00118
	(0.00295)	(0.00289)	(0.00322)	(0.00320)	(0.00198)	(0.00193)

theories about trade and organisation of production provide a flexible theoretical framework that can be conveniently adapted and interpreted for the case of an organisation trying to solve the problem of implementing a foreign agricultural trade standard.

We have used the cases of dairy, meat, fish, and vegetable exports to the European Union in comparison to exports of these products to all global destinations as an example of a country's ability to adopt the (higher) EU standard. Empirical results confirm that the positive effect of most institutional quality proxies on exports are especially relevant for exports into high standards markets. All indicators can be interpreted as approximations to *c.p.* the lower costs of communication between private and public organisations within these countries. Furthermore, all indicators can be expected to reflect a lower cost of acquiring additional knowledge for the implementation of a certain EU standard than is the case in countries with *c.p.* lower values of these indicators. Thus, our approach provides a conceptual framework that explicitly models the economic role of institutions during standard adoption and trade.

Our empirical analysis is an attempt to test hypotheses that follow from interpreting the theoretical model for the case of standard adoption by using firm survey data on the country level. Hence, we bridge the gap between the firm level of the theoretical model and the country level of the gravity framework. In contrast to many previous studies we control for reverse causality. Nevertheless, our empirical approach stays close to other studies that have analysed the role of institutions for trade in general, and therefore similar caveats (e.g. about the potentially endogenous relationship between institutions, GDP and trade) apply to our results as to most of this literature. Future research should therefore determine the true nature of this causality more precisely, and empirical studies should quantify the cost of solving the problem of standard implementation at the level of companies and governmental agencies through surveys. For both cases, the theoretical approaches described in this paper have proven to provide versatile conceptual starting points.

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