

# Contracting Institutions, Agro-food Trade and Product Quality

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## Abstract

*The agro-food sector has experienced a profound transformation of contractual arrangements along the value chain, coinciding with important technological innovations and product quality upgrading. Our understanding of the impact that this transformation has had on trade flows in the agricultural sector is very limited. In particular, we have limited knowledge about the extent to which the patterns in agro-food trade have been driven by the quality of contractual institutions. Using existing measures which capture the sensitivity of agro-food products to contractual imperfections, we show that countries with better contract enforcement specialise in the production of food which requires higher level of relationship-specific investments. We also find that countries with better contracting institutions and producing contract-intensive goods specialise in exporting high quality foods. In addition, we show that the quality of contracting institutions might importantly affect the process of product quality upgrading.*

**Keywords:** *Agro-food export; comparative advantage; contractual institutions; food quality.*

**JEL classifications:** *F14, L15, O17, O33, Q17.*

## 1. Introduction

Differences in the quality of institutions are argued to be among the main determinants of cross-countries differences in prosperity (Acemoglu *et al.*, 2005; North *et al.*, 2009). While the potential impact of institutions can be transmitted through many channels, there is a broad evidence showing that they may be an important source of

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## 1. Introduction

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evidence showing that they may be an important source of comparative advantage (see Nunn and Trefler, 2014 for a literature review). Accordingly, countries with better institutions tend to specialise in producing institutionally-intensive goods (Chor, 2010; Costinot, 2009; Levchenko, 2007; Manova, 2013; Matsuyama, 2005; Nunn, 2007). In particular, better contracting institutions are expected to promote production in sectors which intensively use contract-dependent inputs.

In this paper, we investigate whether the documented institutional effect on specialisation and international trade holds true for the agro-food sector, which is often perceived as much less contract-intensive than other manufacturing sectors. To the best of our knowledge, this paper is the first to do so. To investigate the issue we follow, and extend, the approach proposed by Nunn (2007) who developed a measure which captures the proportion of inputs that require relationship-specific investments. This measure classifies products according to the extent to which their costs are sensitive to imperfect contract enforcement, and therefore to the quality of contracting institutions. We combine Nunn's measure with data on agro-food trade, new estimates of the quality of food products, and countries' institutional quality.

Our focus is on agro-food exports to fifteen old members states in the European Union (EU 15). This choice is motivated by the fact that this destination market is commonly perceived as one of the most demanding as regards food quality standards which need to be met by agro-food exporters (Curzi and Pacca, 2015; Grunert, 2005). One may therefore assume that product quality might be of special importance for potential exporters wishing to achieve success in this particular destination. At the same time, quality requirements are very heterogeneous both between and within the EU countries (Jaffee and Masakure, 2005; Swinnen, 2007). This allows us to investigate institutional determinants of export success exploiting this variation.

Our paper is related to several strands of the literature. First, it contributes to the growing theoretical and empirical literature which has identified institutions as an important source of comparative advantage (e.g. Antras, 2005; Nunn, 2007; Levchenko, 2007; Vogel, 2007; Costinot, 2009; Chor, 2010). We differ from these papers as we not only show that institutions may affect the pattern of international trade in agro-food products, but also that this relationship holds true for the quality of exported goods, an important dimension in the agro-food sector. In addition, we document a potential channel through which this effect might work.

Other papers related to our work are those by Antras (2003), Antras and Helpman (2008) and Nunn and Trefler (2014). While these papers also study the relationship between contractual frictions and trade, their focus is different from ours. More specifically, by means of incomplete

contract theory, these studies seek to explain the internalisation decisions of multinational enterprises and investigate why some firms source inputs mainly via foreign direct investments whereas other firms source them primarily via outsourcing. However, none of these papers is concerned with the impact of contracting institutions on the quality of exported products and quality upgrading, a key issue of the current transformation of agro-food value chains (Reardon *et al.*, 2009; Reardon and Timmer, 2012; Swinnen and Kuijpers, 2018). Finally, the findings of this paper are also related to recent contributions linking institutions, trade and product quality. For example, Fan *et al.* (2015) show that trade liberalisation has led to a surge in imports of intermediate inputs and that the improved access to foreign inputs has had a large impact on firm productivity and the scope of product offerings at the firm level.<sup>2</sup> Another related paper is that by Essaji and Fujiwara (2012) who test whether contracting institutions affect specialisation in higher or lower quality goods and find that countries with higher quality institutions tend to export higher-quality varieties of goods. While these papers are similar to ours, they are not concerned with the determinants of the pattern of export and products quality in the agro-food sector.<sup>3</sup>

The remainder of the paper is organised as follows. In the next section we present our empirical approach and the identification strategy. Section 3 explains how we measure product quality and presents our key variables and data. Section 4 presents and discusses our results. The last section concludes.

## **2. Econometric Strategy**

To study the extent to which the quality of contracting institutions affects export performance and the quality of exported products in the agro-food sector, we adopt the econometric strategy suggested by Nunn (2007) and estimate the following baseline equation:<sup>4</sup>

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<sup>2</sup> Empirical evidence on firm-level productivity growth induced by imported intermediate inputs has been also found for the agro-food sector. See Chevassus-Lozza *et al.* (2014) or Olper *et al.* (2017) for France and Italian food industry, respectively.

<sup>3</sup> The issue of food quality upgrading is studied by Curzi *et al.* (2015) who showed, within the framework of Aghion and Howitt (2005), that more competition induced by trade liberalisation spurs a process of quality upgrading, but only for firms/industries close to the technological frontier. However, the focus of this study is not on institutional quality.

<sup>4</sup> Note that this specification is different from a gravity-like model of international trade (for more on comparing the two approaches see Nunn, 2007).

$$\log y_{c,h,i,j} = \gamma_c + \gamma_h + \gamma_j + \beta z_i I_c + \delta X_{c,i} + \varepsilon_{c,h,i,j} \quad (1)$$

where  $y_{c,h,i,j}$ , depending on the specification, is either the logarithm of export value or the quality of products  $j$  in industry  $i$  shipped from country  $c$  to an EU-15 country  $h$ ;  $z_i$  is a measure of the importance of relationship-specific investments (i.e. contract intensity) in industry  $i$ ;  $I_c$  measures the quality of contracting enforcement in country  $c$ ;  $X_{c,i}$  is a vector of covariates to control for other sources of comparative advantage at the country-industry level; while  $\gamma_c$ ,  $\gamma_h$  and  $\gamma_j$  are exporter, importer and product fixed effects, respectively.<sup>5</sup>

Our key variable of interest is the interaction term between  $z_i$  and  $I_c$ , which allows us to test whether institutional impact on food exports/quality differs depending on the industry's sensitivity to the quality of contracting institutions. To see this, consider the specification with the logarithm of export value as a dependent variable. A positive coefficient  $\beta$  means that countries with higher institutional quality export relatively more in sectors where the relationship-specific investments are more relevant. Put differently, countries with better contracting institutions tend to specialise in producing and exporting food in contract intensive industries. Note that the impact of un-interacted  $z_i$  and  $I_c$  variables is controlled for by using different types of fixed effects. The interpretation of the coefficient of interest when the dependent variable is product quality is conceptually the same.

It is worth noting that the above specification does not just capture the relationship between exports (product quality) and institutional quality, but also identifies whether institutions work through hold-up and under-investment in relation-specific activities (Nunn, 2007). In addition, given the presence of different types of fixed effects, our empirical approach is conceptually similar to a difference-in-difference specification (Rajan and Zingales, 1998; Romalis, 2004). Accordingly, depending on the level of aggregation of the data we work with to identify the main effect, we exploit either the within-country-industry variation or within-product-category

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<sup>5</sup> In some specifications we also control for the interactions between different types of fixed effects. Thanks to this we are able to control for the potential impact of various multilateral resistance terms that are likely to affect the patterns of trade (e.g. Anderson and van Wincoop, 2003; Baldwin and Taglioni, 2007; Head and Mayer, 2014).

variation in the main variables of interest, i.e. we control for endogeneity bias due to selection and (time invariant) omitted variables.

Obviously, the specification in equation (1) is not free from other endogeneity concerns. Both the issue of reverse causality and omitted variables bias could present potential problems. We try to attenuate these concerns in several ways. First, concerning reverse causality, in addition to running regressions where both dependent and independent variables refer to the same year, we also run regressions in which all the variables on the right hand side of equation (1) are lagged five years with respect to the dependent variable.<sup>6</sup> Given the fact that surges in agro-food exports and food quality upgrading have been dominant features of the transformation of the agro-food sector, there are no obvious reasons to expect that the trade flows or the quality of food products observed in a particular year could have affected the quality of institutions observed five years earlier. Moreover, to address the endogeneity concerns more explicitly, we use an instrumental variable approach based on Essaji and Fujiwara (2012), who instrumented countries' judicial quality using data on countries' population density, urbanisation rate and European settler mortality in 1500. This strategy follows Acemoglu *et al.* (2001, 2002), who argue that institutions created by European colonisers persisted and continue to shape economic performance today.

As regards the omitted variables problem, we try to mitigate it in the following way. Other than controlling for various fixed effects as discussed above, our models include various observable country-industry characteristics which are likely to affect comparative advantage. Specifically, the vector  $X_{c,i}$  includes traditional Heckscher-Ohlin determinants of comparative advantage, as well as several other covariates at the country-industry level that might affect the incentives and thus decisions of firms to export or not (see below for detailed definition of these variables). Importantly, the literature that investigates determinants of trade in vertically differentiated products, suggests that factor endowments will shape not only the volume of trade, but also the patterns of vertical specialisation.<sup>7</sup> This is why we control for factor endowments not only in

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<sup>6</sup> While in the former case all variables refer to 1997 (the only exception is institutional quality variable which is an average over the 1997–1998 period), in the latter case the dependent variables refer to 2002 whereas all the covariates still refer to 1997 (see further).

<sup>7</sup> Markusen (1986) or Bergstrand (1990), for example, show that richer countries specialise in exporting luxury goods because those goods happen to be capital intensive. Flam and Helpman (1987), Stokey (1991) or Murphy and Schleifer (1997) in turn explain the pattern of trade by referring to the fact that richer countries have relative technological superiority in producing higher quality goods.

models in which we explain volume of exports, but also in models in which we explain the quality of exports.<sup>8</sup> Throughout the paper all standard errors are clustered at the exporting country level.<sup>9</sup>

### 3. Data and Quality Estimations

The data used in our analysis come from different sources. Before presenting them in detail, it should be mentioned that they can be subject to two caveats. First, we use data on contracting institutions for the year 1997, which raises the issue of their validity for current conditions. There are three important reasons to believe that the findings documented here may have the general validity and should not be seen as reflecting regularities that are specific only to the late 1990s. First, an extensive economic history literature (e.g. North *et al.*, 2009; Ogilvie and Carus, 2014) suggests that institutions change only slowly and develop gradually over time.<sup>10</sup> Second, the ordering of industries with respect to contract intensity seems to be fairly stable over time.<sup>11</sup> Last but not least, the importance of contract intensity for trade patterns in the manufacturing sector has been tested by Nunn (2007) with the use of different samples – 1963, 1967, 1972, 1977, 1982, 1987 and 1997 – and the results were robust to these tests. Therefore, overall there are strong reasons to believe that our results, although based on the data from 20 years ago, are likely to be valid for current discussions. This notwithstanding, testing the relationships

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<sup>8</sup> Controlling for factor endowments when explaining the quality of exports is also fully in line with recent contributions to the empirical literature (see e.g. Schott, 2004; Khandelwal, 2010; or Essaji and Fujiwara, 2012; or Ferto, 2005; Ferto and Jambor, 2014 for studies on trade in agro-food products).

<sup>9</sup> It should be emphasised that our results are qualitatively the same if, instead of clustering standard errors at exporting country level, we cluster them at importing country level.

<sup>10</sup> This is confirmed by the fact that within-country variation in institutional quality is rather low (see, for example, the within-country variation in the World Bank index of institutional quality developed by Kaufmann *et al.*, 2003).

<sup>11</sup> Although making direct comparison between years is not so easy (as data for different years are available for a different number of industries), the data from Nunn (2007) allow us to look at the orderings of industries in 1997 and 1963. The comparison between the two years shows that the orderings of industries as far as their contract intensity is concerned is fairly stable over time. For example, condensed and evaporated dairy products has been always relatively more contract intensive than rice milling and relatively less contract intensive than ice cream and frozen desserts. As another example, canning and drying fruits and vegetables has been relatively more contract intensive than fruit farming.

documented in this paper with newer data could provide an additional test on the robustness of our findings.

The second concern is that our measure of contract intensity is not country specific but is based on an industry measure taken from the US. Clearly, this strategy is not ideal and can potentially lead to some estimation bias (e.g. Ciccone and Papaioannou, 2016). Nevertheless, for most countries these industry data are not available. Furthermore, for a wide range of goods it seems reasonable to assume that no matter where they are produced they still require the same inputs and in the same proportions. In consequence, in some industries, production processes will be more contract intensive than in other industries, regardless of the country. Finally, our approach is fully in line with other studies in the field.<sup>12</sup>

### *3.1. Contractual friction and institutional quality data*

Existing studies use different measures to capture the industry's sensitivity to institutional environment, which we also do. First, we use the measure created by Nunn (2007), which captures the extent to which relationship-specific investments are important in a given industry. This measure is calculated for 1997 and measures the proportion of each sector's intermediate inputs that are not traded on organised exchanges (following the Rauch classification) and may suffer more from contracting problems (Nunn, 2007).

Table 1 shows the importance of contract intensity in the US food industry for the year 1997, based on the index computed by Nunn using US Input-Output (I-O) Use tables. Sectors are classified according to the I-O BEA 1997 6-digit classification and are ranked from the least to the highest contract intensity sectors. It is worth noting that most of food sectors (22 out of 28) have values that are below the average contract intensity as measured by Nunn (2007) for all the US industries in 1997 (0.48), suggesting that, for food industries, contract intensity has less relevance than in other sectors. Table 1 also shows the average estimated quality and quality

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<sup>12</sup> Indeed, the international trade literature generally treats the relevant technological industry characteristics (contract intensity in our case) as unobservable and employs proxies from a benchmark country, typically the United States (for studies focusing on international trade adopting a similar approach to ours see for example Chor, 2010; Cunat and Melitz, 2012; Krishna and Levchenko, 2013; Levchenko, 2007; Manova, 2013; Nunn, 2007; Romalis, 2004). This strategy has been also used in many other contexts (e.g. Acemoglu *et al.*, 2009; Aghion *et al.*, 2007; Fafchamps and Schundeln, 2013; Rajan and Zingales, 1998).

upgrading for each of the considered food industries, obtained with the procedure presented above.

*(Insert Table 1 here)*

As an alternative measure of the sensitivity of a given industry to the quality of institutions we use the proxy taken from Levchenko (2007). It corresponds to one minus the Herfindahl index of intermediate input use, which has been computed from the US Input-Output table for the year 1992. This indicator is built with the idea that the more inputs are used, the more complex is the production of a final good and thus the more sensitive to the quality of contracting institutions it is. Finally, we also use the proxy proposed by Bernard *et al.* (2010). This measure is a weighted average of the wholesale employment share of firms importing goods in a particular sector for the year 1997. One may suspect that contracting is likely to be easier for products passing through intermediaries such as wholesalers. Testing the robustness of our findings to these different measures of contract-intensity is important as it is likely that these different proxies may capture different aspects of, and thus different sources of variation in, product contractability (Bernard *et al.*, 2010).

Moving to the institutional quality variable at the country level, the literature offers many potential indicators so we test the sensitivity of our findings to alternative approaches. In our baseline specifications we take advantage of the commonly used indicator coming from the World Bank which measures the quality of judicial systems. These data, collected by Kaufmann *et al.* (2003), refer to the years 1997 and 1998, and provide information on the level of confidence that agents have in the effectiveness and predictability of the judiciary and the enforcement of contracts in each country. Thus, the higher the quality of judicial system the better the ability of a country to enforce contracts. To check whether our results are not dependent on using this particular source of data, in some specifications we use an alternative indicator of institutional quality proposed by Kuncic (2014). This measure captures the quality of institutional environment in a country using several established institutional indicators.<sup>13</sup>

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<sup>13</sup> What should be also noted here is that results in the literature on the role of institutions in shaping comparative advantage are usually not sensitive to the measure of quality of institutions at a country level (Nunn and Trefler, 2014). Our findings confirm this result.

### 3.2. Other data

In order to test the robustness of our results, we check whether our main findings remain unaffected if we also include several additional covariates. We firstly control for countries' skilled labour and physical capital, which are relevant (neo-classical) determinants of countries' comparative advantage. We use countries' factors endowment, capital stock per worker ( $K_c$ ) and the stock of human capital ( $H_c$ ), taken from Antweiler and Trefler (2002). We then interact these variables with capital intensity ( $k_i$ ) and skill intensity ( $h_i$ ), respectively, both of which are measured at the industry level.<sup>14</sup> Descriptive statistics of the main variables of interest are presented in Table 2.<sup>15</sup>

*Insert Table 2 here*

To further check the robustness of our results, we use several other controls that might affect the trade flows. Importantly, in some specifications we include the level of exporters' GDP interacted with various covariates capturing country's financial development, TFP growth or index of intra-industry trade. Controlling for these factors is important as it reflects richer countries exporting goods of higher quality (e.g. Khandelwal, 2010; Schott, 2004).<sup>16</sup> Countries'

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<sup>14</sup> Data on physical capital refers to countries' (log) average stock per worker, while the stock of human capital refers to countries' (log) ratio of workers with high school degree over workers without high school degree. These data are from 1992, as it represents the closest year to 1997 with available data. Data on industries' capital and skill intensities refer to the United States in 1996, and measure, respectively, the ratio of the stock of capital over the value added in an industry, while skill intensity is measured as the non-production workers wage divided by the total wage in the same industry.

<sup>15</sup> Note that the statistics presented in this table are calculated based on the sample that we use when controlling for skill and capital endowments. Data on trade, quality, institutional quality and contract intensity are available for a larger sample (about 91,000 observations), as shown in regressions where we do not control for skill and capital endowments.

<sup>16</sup> Some studies suggest also that trade in vertically differentiated products may have different implications, depending on the distribution of income in the trading partners (Fajgelbaum *et al.*, 2011). While we do not directly control for the effect of income inequality, it should be captured by different types of fixed effects that we use. In this context it might be also noted that in a study that explicitly tests the impact of income inequality on agro-food exports, Bojnec and Ferto (2017) conclude that '*income distribution plays either a small or no role in quality specialization*' (p. 277).

data on per-capita GDP are taken from the Penn World Table and refer to the year 1997. Data on countries' financial development ( $CR_c$ ) for 1997, measured as the log of credits by bank and other financial entities, are taken from Beck *et al.* (1999). Industries value added and TFP growth are both taken from Bartelsman and Gray (1996): the former is calculated as the sum of total value added, divided by the overall value of shipment for each US industry  $i$  in 1996; the latter represents the industry  $i$  average TFP growth in the period 1976–1996. The share of intra-industry trade for each industry is taken from Nunn (2007), and is measured using the Gruber-Lloyd index for the US in the year 1997. Finally, data on total exports from a given country-industry to the US, that aim at capturing world-wide trends in the patterns of international trade, are taken from the World Trade Flow Database by Feenstra (2000).

### 3.3. Quality estimation

In order to estimate the quality of food products, we follow the recent literature and rely on the methodology developed by Khandelwal *et al.* (2013). In our baseline specification we use product quality estimates for the year 1997. This is motivated by the fact that our main data of interest on contract incompleteness are available for this specific year.<sup>17</sup> Essentially, the procedure we apply here allows us to estimate the quality of exported products shipped to a specific destination country via the demand equation, following a simple intuition: ‘conditional on price, a variety with a higher quantity is assigned higher quality’. Below we briefly summarise this methodology.

The starting point is a CES demand function, which defines the utility of a given consumer from the consumption of a variety  $g$  (product  $j$ , coming from the exporting country  $c$ ):

$$U = \left[ \int_{g \in G} [\varphi(g)q(g)]^{(\sigma-1)/\sigma} dg \right]^{\sigma/(\sigma-1)} \quad (2)$$

where  $q(g)$  and  $\varphi(g)$  are respectively the quantity and the quality of the variety  $g$ , while  $\sigma > 1$  represents the elasticity of substitution. The maximisation of (2) under the usual budget constraint, gives the demand of consumers for the product  $j$  coming from the country  $c$ , yielding:

$$q_{jc} = (\varphi_{jc})^{\sigma-1} (p_{jc})^{-\sigma} P_h^{\sigma-1} Y_h \quad (3)$$

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<sup>17</sup> As already mentioned, product quality has been also estimated for the year 2002, in order to test the robustness of our results to the use of another year, and to alleviate potential endogeneity concerns in our empirical analysis.

where  $p_{jc}$  and  $\varphi_{jc}$  are, respectively, the price and the relative quality given by the consumer at the product  $j$  exported from country  $c$ . The terms  $P_h$  and  $Y_h$  account, respectively, for the importing countries' price index and income level. Taking the logs of (3) and moving the (endogenous) price on the left hand side of the equation, we can derive the following OLS regression that allows estimation of the quality of the exported products:

$$\ln q_{jch} + \sigma \ln p_{jch} = \alpha_h + \alpha_j + \alpha_c + e_{jch}. \quad (4)$$

On the left hand side of equation (4) there are the quantity and the price of product  $j$  exported from country  $c$  to country  $h$  (both in logs), while on the right hand side  $\alpha_h$ ,  $\alpha_c$  and  $\alpha_j$  account for importer, exporter and product fixed effects, respectively. Finally,  $e_{jch}$  represents the error term. Quality is then retrieved from the estimated residual of (4), divided by the elasticity of substitution of country  $c$  for product  $j$  minus 1:<sup>18</sup>

$$quality = \hat{\varphi}_{jch} \equiv \hat{e}_{jch}/(\sigma - 1). \quad (5)$$

Elasticities of substitution are taken from Broda and Weinstein (2006) estimates at the country and HS 3-digit level. Following Colantone and Crinò (2014), we take the median over each HS 3-digit category and then we map them into their correspondent BEA sector, using the appropriate concordance tables.

Our quality estimation procedure requires the use of data on the price and the volume of exported food products to the EU-15 countries. Trade data come from the BACI database, which provides information on the value and the volume of traded products at the HS 6-digit level of disaggregation. One major advantage of using these data is that they provide information on FOB (free on board) prices that are obtained through a procedure that compares the declaration of the exporter with that of the importer. This provides a more reliable measure than traditional trade data that, instead, are based on the declaration either of the exporter or the importer (see Gaulier and Zignago, 2010 for further details).

#### 4. Results

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<sup>18</sup> Note that, as price and quantity are expressed in logarithms in equation (4), the estimated quality will be in logarithm form as well.

First, we estimate equation (1) with the log agro-food export volume as dependent variable. Second, we run specification (1) with the estimated measure of product quality as the dependent variable. Finally, we report some robustness checks and extensions.

#### *4.1. Contracting institutions and export performance*

The results of estimating equation (1) for the agro-food exports are reported in Table 3. The left panel uses data at industry level (comparable to Nunn, 2007 who uses this level of aggregation),<sup>19</sup> whereas the right panel uses data at the product level. Throughout the paper we report beta-standardised coefficients measuring a one standard deviation change in the dependent variable induced by a one standard deviation change in the independent variable. This simplifies considerably the interpretation of the size of economic effects.

The results in column (1) show that the coefficient of the institutional interaction term, between  $z_i$  and  $I_c$ , reported in the first line of explanatory variables, is strongly significant and positive, suggesting that contract enforcement is an important determinant of comparative advantage in the agro-food sector, consistent with Nunn (2007) who considers all the manufacturing industries. Interestingly, the magnitude of the estimated effect is similar.<sup>20</sup>

We then control for other determinants of countries' comparative advantage, and specifically for countries-sectors skill and capital endowments. In column (2) we show the results of estimating the same specification as in column (1) but on a restricted sample (as in column (3)) due to data availability for skill and capital variables. The results prove to be very consistent and robust. When controlling for skills and capital endowments, the results in column (3) show that our relationship between institutional quality interaction and industries exports is almost unaffected. In addition, both skill and capital interactions do not exert a significant effect on the agro-food export patterns.<sup>21</sup>

In column (4) we add to the specification a number of variables that can be considered as important determinants of comparative advantage, and thus reduce the risk of omitted variable bias. In particular, following Nunn (2007), several industries' characteristics are interacted with

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<sup>19</sup> In this case, and in line with equation (1), the estimated equation is, thus,  $\ln y_{c,i} = \gamma_c + \gamma_i + \beta z_i I_c + \delta X_{c,i} + \varepsilon_{c,i}$

<sup>20</sup> For example, Nunn (2007) estimated coefficient for the institutional interaction term, varies from 0.235 to 0.318 (see Nunn's table IV on p. 580), hence vary close to our figures reported in Table 3.

<sup>21</sup> This result is not surprising, because working with only the agro-food industries, the sectoral variability of skill and capital interaction terms, is quite low.

countries' income per capita, to control for richer country effects, independently of the impact of contract enforcement. We first control for the importance of financial development, by including the interaction of the ratio between countries' private credit and their per capita income and industries' capital intensity. We then control whether richer countries may have a comparative advantage in industries characterised by high value added, high level of fragmentation of the production and high technological progress. For this purpose, we interact countries' per capita income with industries' value added, intra-industry trade and TFP growth in the last 20 years, respectively. Finally, we control for the degree of input varieties, by interacting one minus the Herfindal index for industries' input concentration with countries' per capita income.<sup>22</sup> Although some of these additional covariates turn out to be significant, results in column (4) clearly show, again, that our main finding is not affected by the addition of these covariates.

In columns (5) to (8) we present the results of running the same battery of regressions using export data at the product level, rather than at the industry level. This specification provides a bridge between the Nunn analysis and our main empirical contribution which exploits variation in the quality of exported products. The results at the product level are very close to those at the industry level, both in terms of the size of the estimated effect, being just slightly lower, and in terms of the significance level.

*Insert Table 3 here*

#### *4.2. Contracting institutions and the quality of exported products*

We next study the relationship between the quality of contracting institutions and the quality of exported products. Figure A1 (in the online Appendix) plots this relationship, by averaging our

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<sup>22</sup> Although some of these additional variables are available for a limited sample (i.e. credit by banks and other financial entities, industries value added and TFP growth), the number of observations used in this specification is similar to that presented in column (4). This is because data on capital and skill endowments variables are also available only for a limited sample, which is responsible for the large drop in the number of observations as compared to the estimation from column (1).

estimates of product quality<sup>23</sup> and shows a clear positive association between the average quality of exported agro-food products (y-axis) and the country-industry interaction term between the quality of institutions and contract intensity (x-axis).

The regression results of estimating equation (1) with product quality as dependent variable are reported in Table 4. The estimates are presented following the same pattern as in Table 3. Starting from column (1), our institutional quality interaction term is positive and strongly significant ( $p$ -value  $< 0.01$ ), suggesting that countries tend to export higher quality food products in industries more sensitive to contractual frictions.

We test the robustness of this result by running the same specification on a restricted sample and controlling for other countries' sources of comparative advantage. As shown in columns from (2) to (4), the main results remain stable and robust. In addition, it is worth noting that contract enforcement seems to explain more than skills and capital endowments when considering exports' product quality.<sup>24</sup> Concerning the results obtained with the inclusion of other trade determinants, column (4) shows that these additional covariates do not seem to exert a significant effect on exports' product quality, except for the interaction term of sectoral intra-industry trade.<sup>25</sup>

*Insert Table 4 here*

As previously mentioned, our main equation (1) may suffer from endogeneity. In order to mitigate this issue, we implemented an instrumental variable (IV) approach. Our strategy follows Essaji and Fujiwara (2012), who instrumented countries' judicial quality with three

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<sup>23</sup> Product quality for the year 1997 has been averaged at the industry level by associating data on quality, that are available at the HS 6-digit level, to the corresponding 1997 6-digit BEA sector, using the appropriate corresponding tables.

<sup>24</sup> Recall that we report here beta-standardised coefficients and their size and magnitude can be directly comparable across different specifications.

<sup>25</sup> Unfortunately the nature of our data does not allow us to test our main hypothesis on a panel structure. However, we check whether our results are robust if our dependent variables (the value of exports and product quality) refer to 2002, rather than to 1997 as shown in Tables 3 and 4. The results of these tests, presented in Table A1 (online Appendix), prove to be robust and stable, even if the magnitude of the effect, in particular for exports' value, slightly changes.

different instruments, namely, countries' urbanisation rate in 1500, countries' population density in 1500 and the mortality rate in countries colonised by European countries. Their approach is based on studies by Acemoglu *et al.* (2001, 2002), who argue that the strong persistence of a country's institutional framework over time links current institutional quality to that at the time these countries were colonised.<sup>26</sup>

Table A2 (see online Appendix) presents the results of our IV regressions for both the First and Second stage regressions. Considering the first stage, it is clear that no matter the instrument combination, the instruments work well in predicting the quality of institution interaction term, a result also confirmed by the large value of the F-statistic reported in online Table A2. In addition, when more than one instrument is used, the over-identification test is always satisfied. Most importantly, the second stage results clearly show that the main results are robust, with a magnitude of the estimated institutional quality interaction effect just slightly lower than the OLS results, and always highly statistically significant.

As a final robustness check on our results, we estimate specification (1) using alternative variables for both contract enforcement and quality of institutions. The results are presented in Table A3 (online Appendix). Columns (1) to (3) present the results for regressions using as contract intensity variable one minus the Herfindahl index of intermediate input use (Levchenko, 2007). In columns (4) to (6) instead we use the weighted average of the wholesale employment share of firms importing goods in a particular sector (Bernard *et al.*, 2010). Finally, in columns (7) to (9), we use as a measure of institutional quality the one proposed by Kuncic (2014).<sup>27</sup>

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<sup>26</sup> In particular, Acemoglu *et al.* (2001, 2002) argue that European countries were accustomed to set up an institutional framework in countries they colonised that depended on the wealth that could be extracted from that territory, and to the extent to which these countries were suitable for European settlement. From this perspective, in countries with rich resources to be exploited and worse climatic conditions, European colonisers were more likely to set up a low-quality institutional framework, scarce contract enforcement and property rights, in order to be allowed to exploit the local resources without incurring legal and bureaucratic problems. On the other hand, in countries considered more suitable for their settlement, European countries were more likely to set up high-quality institutions, better contract enforcement and property rights, which were similar to those present in the home country.

<sup>27</sup> Note that the number of observations in estimations in columns (4) to (9) is different with respect to estimations in columns (1) to (3) (which have the same number of observations as in analogous

All the results in the table confirm the existence of a positive relationship between the institutional quality interaction term and the quality of the exported products. This holds also if we run the different specifications on restricted samples and control for countries' skill and capital endowments. Hence, these results again provide evidence that countries with better contract enforcement export higher quality products.

#### 4.3. Extension: quality upgrading and technological adoption

Notwithstanding these results, we need to ask whether better contractual institutions promote product quality upgrading as stressed by Acemoglu *et al.* (2007), who argue that contractual incompleteness together with technological complementarities in intermediate inputs affect the pattern of technological adoption. In line with this view, more advanced technologies should be adopted in more contractual-dependent industries.

In our specific context, technological adoption can be approximated by the rate of quality upgrading, because new technologies are often associated with product quality improvements (see Aghion and Howitt, 2005; Amiti and Khandelwal, 2013).

To test this hypothesis we run an extended version of equation (1) where the dependent variable is the *rate* of quality upgrading. Specifically, we estimate the following regression:

$$\begin{aligned} \Delta Q_{c,h,i,j} = & \gamma_h + \gamma_c + \gamma_j + \varphi Q_{c,h,i,j,t-5} + \beta (z_i I_c)_{t-5} + \\ & + \alpha (Q_{c,h,i,j} * z_i I_c)_{t-5} + \delta X_{c,i,t-5} + \varepsilon_{c,h,i}, \end{aligned} \quad (6)$$

where  $\Delta Q_{c,h,i,j}$ , is the 5-year change in product quality ( $Q$ ) over the period 1997–2002.  $c$  and  $h$ , refer to exporting country and importing country, respectively, whereas  $i$  and  $j$  refer to the Bureau of Economic Analysis (BEA) industry, and HS product category, respectively. Importantly, in equation (6), we control for lagged quality variable ( $Q_{c,h,i,j,t-5}$ ). This is done to control for the existence of convergence process, because product quality should grow systematically faster in industries further from the technological frontier (Hallak and Schott, 2011; Levchenko and Zhang, 2016). In addition, lagged quality also helps to capture some (unobserved) characteristics determining product quality in the past. Further, the vector  $X_{c,i}$  includes various observable covariates already discussed above.

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estimations in our main analysis), as data on the Bernard's contract intensity index and data on institutional quality from Kuncic are available for a restricted sample.

The key variable of interest is again the interaction term but this time between three variables: 5 year lagged quality,  $Q_{c,h,i,j,t-5}$ , and  $z_i I_c$ . This interaction allows us to see whether countries with initial more advanced technology (lagged quality variable), better contracting institutions  $I_c$  experience quality improvements (i.e. higher  $\Delta Q_{c,h,i,j}$ ) specifically in contract-intensive industries  $z_i$ . Accordingly,  $\alpha$  in equation (6) is expected to be larger than zero.

The relevant results are presented in Table 5, with exactly the same logic as before, and using Nunn's measure of contract intensity.<sup>28</sup> As expected, the five year lagged quality exerts a strong negative and significant effect on the rate of quality upgrading, suggesting that there is a process of convergence in quality. Second, the simple two way interaction between  $z_i$  and  $I_c$ , reported in the second line, is never statistically significant, suggesting that either quality upgrading in contract-intensive industries is not simply determined by the quality of institutions, or that the effect of this interaction is largely captured by the inclusion of lagged quality. By contrast, the triple interaction between institutions, contract intensity and initial quality, reported in the third line, is systematically positive and estimated with high precision ( $p$ -value  $< 0.01$ ), irrespective of the specification. This means that institutional quality affects upgrading in product quality in contract-intensive industries, conditional on the initial level of technology. Depending on the estimated model (with or without controls), a one standard deviation increase in quality-institutions interaction increases the dependent variable by 0.26–0.32 standard deviations, so not an irrelevant economic effect. In addition, and in line with Nunn (2007), we find that institutional aspects seem to overwhelm the effect of factor endowments, as shown in column (3), which reports the coefficient on human capital interaction and physical capital interaction. Finally, results in column (4) confirm that controlling for several other country-industry characteristics does not affect our main results.<sup>29</sup> Thus, we find support for the idea claiming that adopting more advanced technologies is dependent on contracting institutions and that this impact will vary with the initial level of technology used in the production processes.<sup>30</sup>

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<sup>28</sup> As before, regressions in column (2) report the same specification as in column (1) but using a limited sample as in column (3).

<sup>29</sup> In addition, these results are robust to alternative measures of contract intensity, institutional quality (see Table A4 in online Appendix) or additional covariates (including tariffs). These results can be obtained from the authors upon request.

<sup>30</sup> As a robustness test (not reported), we also checked if our findings change when other types of fixed effects are included (industry-fixed effects; or various interactions between different categories).

*Insert Table 5 here*

## **5. Conclusions**

The analysis provides three new insights on the patterns of agro-food trade. First, we show that countries with better contract enforcement export more in contract-intensive industries. Second, we find strong evidence that countries with better contracting institutions specialise in the production of higher quality foods. In addition, we show that the quality of contracting institutions might importantly affect the process of product quality upgrading. These results are relevant for three main reasons.

First, as mentioned above, studies focusing on the manufacturing sector typically classify agro-food industries as the least contract-intensive ones (see Levchenko, 2007; Nunn, 2007). From this perspective, one could argue that for agro-food industries the nature of contractual institutions should not have a relevant impact on international patterns of specialisation and comparative advantage. Our analysis provides results for the opposite and shows that the quality of contracting institutions seems to be an important source of comparative advantage also within the agro-food sector.

Second, our results robustly show that the quality of contractual institutions significantly affects not only the pattern of trade in food products, but also the quality of exported foods. This is fully in line with the growing evidence showing that the production of quality goods requires the usage of more complex inputs (Colantone and Crinò, 2016; Essaji and Fujiwara, 2012; Goldberg and De Loecker, 2014; Olper *et al.*, 2017) and represents a key result of technological innovation. Transactions involving highly complex goods, in turn, entail intensive contracting and thus should be sensitive to the institutional environment within which they take place (Antras, 2016). By documenting the relationship between the quality of contracting institutions and food quality we also complement the literature interested in exploring the determinants of food quality. This is of interest in itself given the growing concerns over the quality, health and safety of food which has to meet the needs of new, more sophisticated and more demanding

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Reassuringly, our results remain unchanged. This in turn gives further credence that what we illustrate here seems to be a robust finding.

consumers (Attavanich *et al.*, 2011; Lloyd *et al.*, 2006; Piggot and Marsh, 2004; Schlenker and Villas-Boas, 2009).

Third, our results are relevant for the debate on the growing internationalisation and interdependence of the global supply chain (see Beghin *et al.*, 2015; Swinnen *et al.*, 2015). As this debate clearly indicates, more and more firms organise their activities on a global scale and production processes in the agro-food sector have also become more and more disintegrated across borders. Both private and public food standards have emerged to ensure that firms/governments can exert appropriate control over these different production stages. As a result, in recent decades the rules which govern relationships along the agro-food chain have changed quite substantially (Curzi *et al.*, 2017; Maertens and Swinnen, 2009; Reardon and Timmer, 2007; Swinnen, 2007). Clearly, this has consistently reshaped the institutional environment within which the agro-food chain transactions take place (Reardon and Timmer, 2012; Swinnen and Kuijpers, 2018). Our findings provide indirect evidence that this might have had important consequences for what food is being produced and how. As such they also illustrate an additional way through which institutions may affect the distribution of rents along the agro-food value chain.

That being said, much work remains to be done to fully understand the link between institutions, trade and quality in the agro-food industry. There are several lines along which future work could extend our analysis. For example, our focus was on the impact of institutional quality in the exporting country. There is however some literature showing that trade may be affected also by institutional differences between countries (see for example, Bojnec and Ferto, 2012; or de Groot *et al.*, 2004). While in our approach the differences are captured by different types of fixed effects (including the interaction between exporter and importer fixed effects), one may try to more explicitly test if institutional homogeneity and institutional quality do have independent impacts on the issues analysed here. Another important avenue for further research is to better identify the exact role of the firms in fostering the process of innovation and quality upgrading. This calls for improving our understanding of the relationship between firms' organisation structure and their quality upgrading strategies. Studying potential differences in this respect between MNEs and SMEs could be one possibility. More generally, an important question concerns the relationship between contracting institutions, quality improvements and firms' decisions to participate in global value chains: either to source their inputs globally or to serve as inputs providers. Another fruitful area for future research concerns the distributional implications of these processes in both developed and developing countries.

## Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's website:

**Figure A1:** Product quality and institutional quality interaction

**Table A1.** Institutions, export performance and products quality – Year 2002

**Table A2.** Institutions, comparative advantage and quality of exported products – IV Regressions

**Table A3.** Institutions, comparative advantage and product quality: Robustness checks to various measures of contract intensity of institutional quality

**Table A4.** Institutions and quality upgrading – robustness checks to various measures of contract intensity and institutional quality

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Table 1

## Contract intensity, quality and quality upgrading in agro-food industries

BEA Sector	<i>Contract Intensity</i>	<i>Average Quality 1997</i>	<i>Average Quality Upgrading 1997-2002</i>
Poultry processing	0.024	0.013	-0.018
Flour milling	0.024	0.003	-0.024
Wet corn milling	0.036	0.009	-0.017
Rice milling	0.099	-0.016	0.018
Other oilseed processing	0.144	-0.001	-0.003
Coffee and tea manufacturing	0.173	0.004	-0.008
Frozen food manufacturing	0.200	-0.001	0.000
Other animal food manufacturing	0.227	-0.006	-0.008
Bread and bakery product, except frozen, manufacturing	0.244	-0.003	0.005
Rendering and meat byproduct processing	0.280	0.003	-0.010
Fats and oils refining and blending	0.295	-0.020	0.017
Soybean processing	0.299	0.017	-0.007
Roasted nuts and peanut butter manufacturing	0.335	0.014	-0.003
Meat processed from carcasses	0.348	-0.007	0.000
Seafood product preparation and packaging	0.353	0.019	-0.006
Confectionery manufacturing from cacao beans	0.361	0.004	-0.001
Cheese manufacturing	0.381	0.000	0.002
Spice and extract manufacturing	0.391	0.013	0.002
Wineries	0.405	-0.003	0.011
Nonchocolate confectionery manufacturing	0.434	0.037	-0.020
Fruit and vegetable canning and drying	0.450	0.016	-0.002
Animal, except poultry, slaughtering	0.462	0.008	-0.003
Dry, condensed, and evaporated dairy products	0.484	-0.005	0.002
Breakfast cereal manufacturing	0.486	-0.020	0.017
Fishing	0.517	0.017	-0.005
Distilleries	0.652	-0.003	0.011
Soft drink and ice manufacturing	0.741	0.016	0.018
Breweries	0.851	0.021	0.007

*Note:* Data on contract intensity refer to US food sectors in 1997, according to the BEA 6-digit classification (see Nunn, 2007). Data on product quality are for the year 1997, while quality upgrading refer to a change in quality between 1997 and 2002. See main text for details.

Table 2  
Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
<i>Log Export Value</i>	52,382	4.50	2.48	0.00	13.61
<i>Product Quality (t-5): <math>Q_{cj}</math></i>	52,382	-0.60	1.86	-7.88	6.79
<i>Institutional quality interaction (t-5): <math>z_{i c}</math></i>	52,382	0.38	0.16	0.02	0.85
<i>Skill interaction (t-5): <math>h_i H_c</math></i>	52,382	-0.35	0.29	-2.27	0.60
<i>Capital interaction (t-5): <math>k_i K_c</math></i>	52,382	-3.24	1.62	-14.40	-1.13
<i>Ln credit/GDP* capital: <math>k_i CR_c</math></i>	52,382	-0.40	0.56	-6.12	0.88
<i>Ln income * value added: <math>va_i * (\ln) y_c</math></i>	52,382	3.67	1.11	0.76	7.33
<i>Ln income * intra-industry trade: <math>iit_i * (\ln) y_c</math></i>	52,382	5.74	2.05	0.51	10.24
<i>Ln income * TFP growth: <math>TFP_i * (\ln) y_c</math></i>	52,382	-0.03	0.12	-0.29	0.27
<i>Ln income * input variety: <math>(1 - hi_i) * \ln y_c</math></i>	52,382	8.12	1.06	3.66	9.77
<i><math>\Delta</math> Quality</i>	46,199	0.00	0.50	-15.54	12.39
<i>Institutional quality interaction * Product quality (t-5): <math>z_{i c} Q_{cj}</math></i>	46,199	0.01	0.62	-17.09	29.74

**Note:** Descriptive statistics for log value of exports, quality of exports and institutional quality interactions are calculated only for the subsample for which data on other covariates are available. See main text for exact definitions of the variables.

Table 3

## Institutions, comparative advantage and export performance

	Export Value Industry level				Export Value Product level			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Institutional quality interaction: <math>z_i l_c</math></i>	0.210*** (0.038)	0.250*** (0.051)	0.255*** (0.058)	0.290*** (0.063)	0.122*** (0.040)	0.178*** (0.065)	0.169** (0.071)	0.279*** (0.068)
<i>Skill interaction: <math>h_i H_c</math></i>			-0.011 (0.053)	0.032 (0.067)			-0.027 (0.043)	0.048 (0.057)
<i>Capital interaction: <math>k_i K_c</math></i>			0.016 (0.097)	-0.112 (0.108)			-0.023 (0.066)	-0.079 (0.057)
<i>Ln credit/GDP* capital: <math>k_i CR_c</math></i>				0.097 (0.059)				0.014 (0.034)
<i>Ln income * value added: <math>va_{i,c}(\ln)y_c</math></i>				-0.363** (0.175)				0.672*** (0.205)
<i>Ln income * intra-industry trade: <math>iit_i * (\ln)y_c</math></i>				0.307* (0.174)				1.016*** (0.235)
<i>Ln income * TFP growth: <math>TFP_i * (\ln)y_c</math></i>				0.080 (0.176)				0.281 (0.219)
<i>Ln income * input variety: <math>(1 - hi_i) * \ln y_c</math></i>				0.318 (0.304)				-1.209*** (0.334)
Exporter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	No	No	No	No	No
Importer FE	No	No	No	Yes	Yes	Yes	Yes	Yes
Product FE	No	No	No	Yes	Yes	Yes	Yes	Yes
Observations	2,880	1,705	1,705	1,682	91,436	52,489	52,489	52,382
R-squared	0.645	0.638	0.638	0.642	0.242	0.249	0.249	0.252

*Note:* The table reports beta standardised coefficients. Robust standard errors in parentheses are clustered at the exporting country level. \* Significant at 10% level. \*\* Significant at 5% level. \*\*\* Significant at 1% level.

Table 4

## Institutions, comparative advantage and quality of exported products

	<i>Quality of exported products</i>			
	(1)	(2)	(3)	(4)
<i>Institutional quality interaction: <math>z_i l c</math></i>	0.031*** (0.006)	0.036*** (0.006)	0.033*** (0.007)	0.040*** (0.008)
<i>Skill interaction: <math>h_i H c</math></i>			0.007 (0.006)	0.006 (0.006)
<i>Capital interaction: <math>k_i K c</math></i>			-0.007 (0.005)	-0.001 (0.007)
<i>Ln credit/GDP* capital: <math>kiCRc</math></i>				-0.005 (0.004)
<i>Ln income * value added: <math>vai*(ln)yc</math></i>				0.120*** (0.027)
<i>Ln income * intra-industry trade: <math>iiti*(ln) yc</math></i>				0.026 (0.029)
<i>Ln income * TFP growth: <math>TFPi * (ln) yc</math></i>				0.026 (0.024)
<i>Ln income * input variety: <math>(1- hii) * ln yc</math></i>				-0.114*** (0.040)
Observations	91,436	52,489	52,489	52,382
R-squared	0.174	0.179	0.179	0.180

*Note:* The table reports beta standardised coefficients. Robust standard errors in parentheses are clustered at the exporting country level. All regressions include importer, exporter and product fixed effects. \* Significant at 10% level. \*\* Significant at 5% level. \*\*\* Significant at 1%.

Table 5  
Institutions and quality upgrading

	(1)	(2)	(3)	(4)
	$\Delta Q$	$\Delta Q$	$\Delta Q$	$\Delta Q$
<i>Product Quality (t-5): <math>Q_{cj}</math></i>	-0.615*** (0.047)	-0.704*** (0.054)	-0.704*** (0.054)	-0.704*** (0.054)
<i>Institutional quality interaction (t-5): <math>z_{i/c}</math></i>	-0.049** (0.022)	0.004 (0.004)	0.000 (0.004)	-0.001 (0.005)
<i>Institutional quality interaction * Product quality (t-5): <math>z_{i/c} Q_{cj}</math></i>	0.215*** (0.053)	0.318*** (0.053)	0.317*** (0.053)	0.318*** (0.053)
<i>Skill interaction (t-5): <math>h_{i/c}</math></i>			-0.041*** (0.014)	-0.062*** (0.020)
<i>Capital interaction (t-5): <math>k_{i/c}</math></i>			0.006 (0.005)	0.009 (0.006)
<i>Ln credit/GDP* capital (t-5): <math>k_{i/c} CR_c</math></i>				-0.010 (0.012)
<i>Ln income * value added (t-5): <math>va_{i/c} (\ln) y_c</math></i>				0.003 (0.005)
<i>Ln income * intra-industry trade (t-5): <math>iit_i (\ln) y_c</math></i>				0.015** (0.006)
<i>Ln income * TFP growth (t-5): <math>TFP_i (\ln) y_c</math></i>				-0.005 (0.003)
<i>Ln income * input variety (t-5): <math>(1 - hi_i) * \ln y_c</math></i>				0.001 (0.006)
Observations	75,328	46,199	46,199	46,091
R-squared	0.246	0.209	0.209	0.210

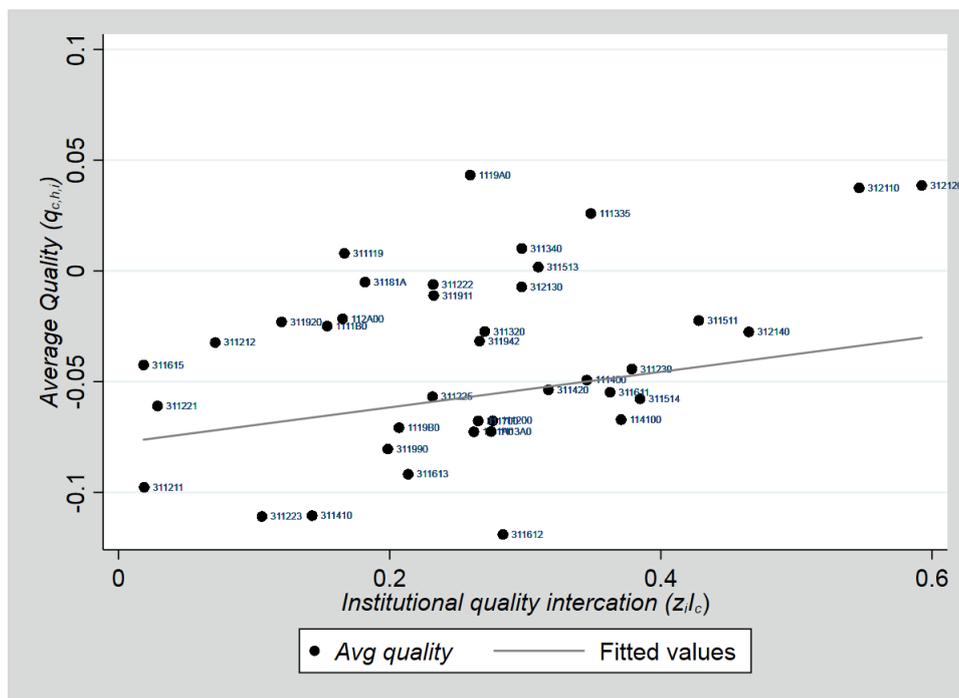
*Note:* The table reports beta standardised coefficients. Robust standard errors always clustered at the exporting country level in parentheses. All regressions include importer, exporter and product fixed effects. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

# Contracting Institutions, Agro-food Trade and Product Quality

Jan Falkowski, Daniele Curzi and Alessandro Olper

## Online Appendix

Figure A1. Product quality and institutional quality interaction



*Note:* The figure is based on data reported in Table 1 and described in the main text.

Table A1. Institutions, export performance and products quality – Year 2002

	(1)	(2)	(3)	(4)	(5)	(6)
	<i>log Exp. Val. Product level (2002)</i>			<i>Quality (2002)</i>		
<i>Institutional quality interaction: <math>z_i l_c</math></i>	0.075** (0.037)	0.093 (0.056)	0.103* (0.060)	0.018*** (0.005)	0.027*** (0.006)	0.022*** (0.006)
<i>Skill interaction: <math>h_i H_c</math></i>			0.037 (0.035)			0.006 (0.008)
<i>Capital interaction: <math>k_i K_c</math></i>			0.028 (0.044)			-0.015** (0.007)
Observations	96,840	57,946	57,946	96,840	57,946	57,946
R-squared	0.252	0.261	0.261	0.156	0.150	0.150

*Note:* The table reports beta standardised coefficients. Robust standard errors in parentheses are clustered at the exporting country level. All regressions include importer, exporter and product fixed effects. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

Table A2. Institutions, comparative advantage and quality of exported products – IV Regressions

	<i>Quality of exported products</i>			
	(1)	(2)	(3)	(4)
<b>First stage</b>				
<i>Contract intensity * log settler mortality</i>	-0.792*** (0.095)	-0.859*** (0.076)	-0.848*** (0.094)	-0.901*** (0.096)
<i>Contract intensity * log population density 1500</i>		-0.212*** (0.048)		-0.187*** (0.094)
<i>Contract intensity * log urbanization rate 1500</i>			-0.113*** (0.030)	-0.027*** (0.054)
F-statistics	69.44	72.43	44.82	37.36
Over-id (p-value)		0.124	0.268	0.183
<b>Second stage</b>				
<i>Institutional quality interaction: <math>z_{ilc}</math></i>	0.041*** (0.012)	0.036*** (0.010)	0.036*** (0.011)	0.029*** (0.007)
Observations	38,588	38,390	34,095	34,095

*Note:* The table reports results of estimating our main equation (1) using instrumental variables approach. At the top the table reports the results of the first stage, and the Kleibergen-Paap F-statistic value, while at the bottom the results of the second stage, as well as the results of the overidentification tests are shown. All regressions include importer, exporter and product fixed effects. \* Significant at 10% level. \*\* Significant at 5% level. \*\*\* Significant at 1%

Table A3. Institutions, comparative advantage and product quality: Robustness checks to various measures of contract intensity of institutional quality

<i>Dep. Variable: Quality</i>	Herfindal Index			Bernards z index			Inst. Quality from Kuncic		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>Institutional quality interaction: <math>z_i/c</math></i>	0.068*** (0.013)	0.050*** (0.017)	0.039** (0.019)	0.065*** (0.009)	0.077*** (0.015)	0.065*** (0.015)	0.018*** (0.005)	0.023*** (0.005)	0.021*** (0.006)
<i>Skill interaction: <math>h_i/H_c</math></i>			0.006 (0.006)			-0.012* (0.007)			0.007 (0.006)
<i>Capital interaction: <math>k_i/K_c</math></i>			-0.013*** (0.005)			0.025** (0.010)			-0.007 (0.006)
Observations	91,436	52,489	52,489	68,979	36,324	36,324	89,889	51,983	51,983
R-squared	0.174	0.179	0.179	0.177	0.166	0.166	0.174	0.180	0.180

**Note:** The table reports beta standardised coefficients. Robust standard errors in parentheses are clustered at the exporting country level. All regressions include importer, exporter and product fixed effects. \* Significant at 10% level. \*\* Significant at 5% level. \*\*\* Significant at 1% level

Table A4. Institutions and quality upgrading - robustness checks to various measures of contract intensity and institutional quality

	Herfindal Index			Bernards z index			Inst. Quality from Kuncic		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$\Delta Q$	$\Delta Q$	$\Delta Q$						
<i>Product Quality (t-5): <math>Q_{cj}</math></i>	-0.367*** (0.018)	-0.350*** (0.022)	-0.328*** (0.022)	-0.472*** (0.064)	-0.503*** (0.073)	-0.503*** (0.073)	-0.484*** (0.025)	-0.545*** (0.039)	-0.545*** (0.039)
<i>Institutional quality interaction (t-5): <math>z_{ilc}</math></i>	-0.092*** (0.026)	0.008* (0.005)	0.019*** (0.005)	0.019*** (0.004)	0.016 (0.040)	-0.017 (0.041)	-0.030* (0.016)	-0.046* (0.025)	-0.052* (0.028)
<i>Institutional quality interaction * Product quality (t-5): <math>z_{ilc}Q_{cj}</math></i>	0.047*** (0.010)	0.049*** (0.011)	0.057*** (0.012)	0.066 (0.063)	0.146** (0.073)	0.146** (0.073)	0.079*** (0.028)	0.166*** (0.044)	0.166*** (0.044)
<i>Skill interaction (t-5): <math>h_{iHc}</math></i>			-0.034** (0.014)			-0.061** (0.024)			-0.068** (0.026)
<i>Capital interaction (t-5): <math>k_{iKc}</math></i>			-0.001 (0.004)			-0.002 (0.022)			-0.024 (0.021)
Observations	75,385	68,071	46,232	60,128	32,546	32,544	74,302	45,843	45,842
R-squared	0.234	0.182	0.171	0.202	0.207	0.207	0.242	0.224	0.224

*Note:* The table reports beta standardised coefficients. Robust standard errors in parentheses are clustered at the exporting country level. All regressions include importer, exporter and product fixed effects. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$