Quality Upgrading, Competition and Trade Policy:

Evidence from the Agri-Food Sector

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Abstract. This paper analyzes the extent to which the reduction of import tariffs – as a measure of import competition – affects the quality upgrading of the food products exported to the EU. This relationship is studied within a 'distance to the frontier' model (Aghion et al., 2005) who predicts a non-monotonic relation between competition and innovation. Quality is inferred from trade data using the Khandelwal (2010) method. The results show strong support for the existence of an non-monotonic relationship between competition and quality upgrading, with varieties close to the world frontier more likely to upgrade quality in response to an increase in import competition.

Keywords: Quality Upgrading, Trade policy, Competition, Distance to the frontier, Food Industry

1. Introduction

In the last decades food quality and safety issues have been considered among the main topics in the agri-food markets of rich countries. This trend has been driven by a variety of factors exacerbated by several food scares which triggered growing consumer concerns about the attributes of foods, the way of producing them and increased attention about the relationship between diet and health (Caswell and Mojduszka, 1996; Grunert, 2005; Bontemps et al., 2013). As a consequence, vertical and horizontal quality differentiation of food products has become a necessary condition to satisfy consumers' demand (Grunert, 2005). In this setting, competition in agri-food markets switches from price-based to quality-based since consumers look for quality and safety differentiated food products (Jouanjean, 2012).

This increased attention on food safety and quality and the growing set of regulations in the developed countries puts increasing pressure on producers from developing countries to adapt their processes and make goods eligible to be exported (Jouanjean, 2012). As a result, the last decades have witnessed a growth of contractual and technology transfers to transmit advanced production capabilities from high to low income economies, with the aim of increasing both productivity and product quality (Swinnen, 2007; Swinnen and Vandeplas, 2007; Goldberg and Pavcnik, 2007).

According to Sutton (2001), product quality is the most important element that allows firms to have success in the international market, since low productivity can be offset by lower wage

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rates, but firms producing low quality products cannot achieve any sales in global markets, no matter how low the income level. (Swinnen and Vandeplas, 2007). Thus, especially for developing countries, which often have a comparative advantage in the agri-food sector, improving the quality of exported products represents a necessary condition for economic growth and development.

In this paper we analyze the extent to which a growth in competition, triggered by trade liberalization in the origin country, affects the rate of quality upgrading in the exported products. This relation is investigated using highly disaggregated import data to the EU-15 in the 1995-2007, from more than 70 countries in thousands of food products. Quality has been inferred from trade data using the Berry's (1994) nested logit demand system along the line recently proposed by Khandelwal (2010). This approach has a straightforward intuition: conditional on price, imports with higher market shares are assigned higher quality.

Our conceptual framework is in the spirit of a growing literature that tests the so called 'distance to the frontier' model (see Aghion et al. 2005; 2009; Amable et al. 2010; Bourles et al. 2012; Amiti and Khandelwal, 2013). This class of models suggests that an increase in competition induces firms (sectors) that are initially close to the technology frontier to innovate more, while it reduces the expected rents from innovation for firms (sectors) further away from the frontier. The interplay between these two forces induces a relationship between competition and innovation which is non-monotonic, and conditional to the firm/product distance from the (world) technology frontier.

Empirically we borrow the strategy of Amiti and Khandelwal (2013), who studied the relationship between quality upgrading and competition in the manufacturing sector. However, we depart from this study in several respects. First, we work in a different destination market – the EU-15 instead of the US market – and with a specific sector – the food industry – which has not been covered by Amiti and Khandelwal (2013) analysis. This is a sector where quality attributes play a critical role, since they represent a key prerequisite for market access in developed countries. Second, we make use of data on the FDI sector targeting and Preferential Trade Agreements (PTAs) with the EU, in order to test for the heterogeneity of the escape-competition and discouragement effects to different trade policies. Third, we test the sensitivity of our results to alternative methods of measuring products quality, as well as alternative methods of measuring import competition, and we also control for the diffusion of the EU voluntary standards.

Main results support the prediction of the distance to the frontier model. First, we find strong evidence for a non-monotonic relationship between competition and quality upgrading. Varieties close to the world frontier are more likely to upgrade quality in response to an increase in competition, while the opposite effect holds for varieties far from the frontier. Moreover, varieties far from the frontier display, on average, faster quality upgrading, confirming a clear convergence in quality. Second, these results hold true overall, considering sub-samples of OECD and non-OECD countries, and are stronger for country-sectors that are target of specific FDI policies and for countries *without* preferential trade agreement with the EU.

The remainder of the paper is organized as follows: the second section presents some theoretical considerations, summarizing the main intuition of the distance to the frontier model. The third section briefly presents the Khandelwal (2010) method, on which we rely to infer the quality of the exported products, and the data used in the empirical part. In the fourth section our main results are presented and discussed. Finally, in the last section, we draw the main conclusions.

2. Theoretical and empirical considerations

2.1 Theoretical background

How does an increase in competition affects firms' incentive to innovate? According to the economic theory such relation is ambiguous. Aghion and Howitt (2005), following Schumpeterian

growth theory, argue that the relation between competition and innovation is critically dependent on the incumbents' position relative to the world technology frontier. In this model, the entry cost is an exogenous parameter, that determines the level of competition faced by the incumbents (Amiti and Khandelwal, 2013). In this setting, higher competition lowers the cost of entry of potential new entrants, which, in case of entrance, would replace incumbent firms.

According to this class of model, an increase in competition lead firms (sectors) that are initially close to the technology frontier to innovate more, while it reduces the expected rents from innovation for firms (sectors) further away from the technology frontier. These two effects are respectively called the *escape-competition* and *discouragement* effects of competition on innovation. These and other authors (see, e.g., Acemoglu et al., 2006; 2010) argue that the interplay between these two forces induces a relationship between competition and innovation that is non-monotonic, and conditional on the firm (product) distance from the world technology frontier. More formally:

$$Y = f(C, D, X)$$

where *Y* is a firm-sector output performance, *C* is a measure of market competition, *D* represents the distance to the technological frontier, while *X* is a vector of other covariates.

Aghion et al. (2009) found considerable empirical support for this relation by studying how firms' entry affects innovation incentives in incumbent firms using a detailed micro data panel for the United Kingdom.[2] More recently, Amiti and Khandelwal (2013) used a similar logic to study the relationship between the rate of growth of quality upgrading (as a measure of innovation) and the reduction of tariffs (as proxy for import competition). They show that the growth of quality upgrading is positively affected by the reduction of tariffs, but the magnitude of the effect is indeed conditional to the product distance from the (world) quality frontier.

In what follows, we keep the logic of distance to the frontier model of Aghion and Howitt (2005) as our basic framework. This strategy offers the possibility to test whether the findings of Amiti and Khandelwal (2013) hold true in a different market – the EU-15 instead of the US market – and with a specific sector – the food industry – which is only marginally covered by their analysis but where quality attributes represent a fundamental prerequisite for firms' export success (see Crozet et al. 2012; Altomonte et al. 2010; Curzi and Olper 2012).

2.2 The empirical model

The empirical strategy is in the spirit of the growing literature that tests the distance to the frontier model, where an output variable is regressed on a proxy for competition and its interaction with the distance to the frontier term (e.g. Aghion et al. 2009; Amable et al., 2010; Bourles et al. 2012; Amiti and Khandelwal, 2013). In particular, we test the relation between competition (here expressed as tariffs reduction) and quality upgrading, which represents our country-product output variable. Let D_{icht} be the distance to the frontier of product *h* (at the CN 8-digit level), exported by country *c*, at time *t*, to country *i*, namely, the ratio of its quality to the highest quality within the same product category (see section 3.1 for details). Formally, our strategy is aimed at testing the following empirical model: ,

$$\Delta ln\phi^{F}_{icht} = \alpha_{iht} + \alpha_{ct} + \beta_1 D_{ich,t-5} + \beta_2 tariff_{chs6,t-5} + \beta_3 \left(D_{ich,t-5} * tariff_{ch6,t-5}\right) + \varepsilon_{icht} \qquad (1)$$

The dependent variable, $\Delta ln\phi^{F}_{icht}$, represents the change in a variety's (country *c* – product *h* combination) quality between period t and $t-5$. All the explanatory variables are in level for the period $t-5$ to reduce any potential endogeneity problem. Thus, quality growth is explained by the

[2] Other evidence supporting the interaction between innovation activities and firms/countries distance to the technology frontier, can be found in Acemolgu et al. (2006) and Bourlès et al. (2012). By contrast, in Amable et al. (2010) and Alder (2010) the evidence in support of the distance to the frontier models is mixed, and often not in line with theoretical predictions.

lagged distance to the frontier ($D_{ich,t-5}$), the lagged import tariff ($tariff_{chs6,t-5}$) and the interaction term of the these two variables $\left(D_{ich,t-5} * tariff_{chs6,t-5}\right)$.[3] This interaction term should allow for the non-monotonic relationship stressed by the distance to the frontier models of Aghion et al. (2005; 2009).

The presence of importer country-product-year fixed effects, α_{iht}, allows us to explore the variability between products' quality estimates that are comparable with each other, and moreover, within the same importing country. Differently, the exporter country-year fixed effects, α_{ct}, control for the potential concern that some country-level shocks (such as technological shocks, changes in relative endowments or changes in institutions) may affect the competitive environment.

In accordance with Aghion et al. (2009), we expect that $\beta_2 > 0$ and $\beta_3 < 0$, so that the non-linear effect of an increase in competition on the rate of quality upgrading is confirmed. Hence, the positive and negative signs of β_2 and β_3, respectively, suggest that for varieties close to the world quality frontier – i.e. when the distance to the frontier variable is close to 1 – a fall in tariffs would stimulate a variety's quality growth in the subsequent period. By contrast, for varieties far from the frontier – i.e. when the distance to the frontier variable is close to zero – tougher competition may reduce the rate of quality upgrading due to the discouragement effect. This is because varieties far from the frontier need higher tariffs to protect their rents and to promote investment in quality upgrading. Moreover, a value of $\beta_1 < 0$ would suggest that varieties far from the frontier experienced a faster quality upgrading during the considered period, namely that there is convergence in quality.

3. Quality estimates, data and measures

3.1 Quality estimates

In order to measure quality, we follow the approach proposed by Khandelwal (2010). Khandelwal (2010) develops a method to infer product quality using price and quantity information from trade data., based on the nested logit demand function of Berry (1994) The demand for an imported variety (product *h* from country *c*), at the time *t*, depends on the following demand function:

$$\ln(s_{cht}) - \ln(s_{0t}) = \phi_{1,ch} + \phi_{2,t} + \alpha p_{cht} + \sigma \ln(ns_{cht}) + \gamma \ln pop_{ct} + \phi_{3,cht} \qquad (2)$$

where s_{0t} is the outside variety, representing the domestic alternative to the imported variety and computed as one minus the industry's import penetration. s_{cht} represents the variety *ch*'s overall market share and is defined as $s_{cht} = q_{cht}/MKT_t$, where q_{cht} is the imported quantity of such variety and $MKT_t = \sum_{ch \neq 0} q_{cht}/(1 - s_{0t})$ is the industry size. ns_{cht} is the nest share, that is the variety *ch*'s market share within product *h*. $\phi_{1,ch}$ are the variety fixed effects and represent the time invariant component of quality, while the year fixed effects $\phi_{2,t}$ account for the common quality component. Finally, $\phi_{3,cht}$ is a variety-time specific deviation (residual). The term pop_{ct}, differently, represents the population of country *c*, and accounts for the so-called hidden varieties.[4] Within this framework, the quality of variety *ch* at time *t*, ϕ_{cht}, is defined as the sum of the estimated parameters, *quality* $\equiv \phi_{cht} = \hat{\phi}_{1,ch} + \hat{\phi}_{2,t} + \hat{\phi}_{3,cht}$.[5]

We estimate two different versions of equation (2), separately for each NACE 4-digit industries in each of the considered EU importing countries (the EU-15 Member States). The first

[3] The variable "*tariff*" is indexed with *hs6* (instead of *h* as for the variable *D*), since data on tariffs are only available at the HS 6-digit level of disaggregation (instead of the CN 8-digit as for the trade data). For more details on this regard, see section 3.2.

[4] According to Khandelwal (2010), a large country size can lead such country to have a greater market share, due to the fact that it exports more unobserved or hidden varieties within a product. Thus, population controls for country size. Population data are taken from World Bank.

5 Note that, the terms in equation (2) do not include the importing country subscpript *i* as in equation (1), since equation (2), like in Khandelwal (2010), refers to a generic quality estimation for a given country. In the reminder of the paper, the estimated quality term, ϕ_{icht} , includes the subscript *i*, as it refers to any EU importing country *i*.

version is based on simple OLS estimator, while the second one, by using 2SLS, accounts for the potential correlation of the error term, $\phi_{3,cht}$, with both the nest share and the variety's price. Indeed, both variables are clearly endogenous to the market share. Following Khandelwal (2010) and, especially, Colantone and Crinò (2014), we use the following variables as instruments for nest share and price in the 2SLS: the interaction between unit transportation costs and the distance of *c* from the respective EU destination; the interaction between the oil price and the distance from *c*; the number of varieties within each product *p*; the number of varieties exported by each trading partner.[6]

With the quality estimates ϕ_{icht} in hand we can measure the distance to the frontier (D_{icht}). This is measured by first taking a monotonic transformation of the quality estimates to ensure that all estimates are non-negative, $\phi_{icht}^{F} = exp[\phi_{icht}]$. Then we define a variety's distance to the frontier as the ratio of its transformed quality to the highest quality within each CN 8-digit product: $D_{icht} = \frac{\phi_{icht}^{F}}{max_{c \in iht}(\phi_{icht}^{F})}$, where the max operator selects the maximum value of ϕ_{icht}^{F} within a product-year, and $D_{icht} \in (0,1]$. Thus for varieties close to the frontier, D_{icht} will be close to 1. Differently, for varieties far from the frontier, D_{icht} will be close to 0.

3.2 Data and other variables

In order to infer product quality in each of the EU-15 countries, treated as destination markets, we rely on trade data from the EUROSTAT-Comext database. We make use of yearly import data in value and in volume for all the EU-15 countries (except Luxembourg, for which we do not have production data) and from all trading partners in the World with data. We work at the maximum level of disaggregation (CN 8-digit) over the period 1995-2007.

Data on domestic production for the EU-15 importing countries are drawn from the EUROSTAT Prodcom database, which contains yearly information on the value and volume of domestic production. This classification is directly linked to the NACE 4-digit classification, since the first four digits of the Prodcom code identify the 4-digit NACE industry, enabling us to easily map products into industries. The Prodcom classification is also easily linked to the CN 8-digit classification through appropriate correspondence tables provided by EUROSTAT.

In order to study the level of competition that exporters face in their own country and industry, we use ad valorem tariffs for all the exporting countries with data. We collect these data from WITS (World Bank), at the HS 6-digit level and over time. Note that we do not need to aggregate the tariff rate, thus avoiding any bias linked to choice of the aggregation method. All tariffs are expressed as ad valorem equivalent. For products where there are also specific duties, we transform them in ad valorem equivalents using the world unit values.[7] The final database has more than 700,000 observations and contains information on the quality of more than 1,500 CN 8-digit food products exported by more than 70 countries to the European Union, and on their respective import tariffs at the HS 6-digit level.

An important innovation of our analysis is related to investigating how FDI policies affect the link between competition and quality upgrading. To that purpose, we use data on industry-level targeting, coming from the 2005 Census of Investment Promotion Agencies (IPAs), conducted by the World Bank.[8] Sector targeting is considered one of the most effective ways of attracting FDI.

[6] Oil prices are from Brent. Bilateral distance is the population-weighted number of kilometers between the two countries' largest cities, provided by CEPII. Since Eurostat does not provide data on unit transportation costs, following Colantone and Crinò (2014), we compute product-level transport costs, starting from variety-specific unit transportation costs for the U.S., using data from Feenstra et al. (2002). Then, these transportation costs are regressed on partner fixed effects, in order to remove the influence of the U.S. From this regression we take the average of the residual across all partners within each 6-digit product code.

[7] For further details, see the documentary research about the 'calculation of ad valorem equivalents' in the WITS web site at http://wits.worldbank.org/wits/.

[8] Data on direct FDI inflows does not exist at detailed level of disaggregation.

Recently, Harding and Javorcik (2011) found empirical evidence that targeting a particular sector by a national IPA can lead to attract more than the double of FDI inflows. Thus, as argued by Harding and Javorcik (2012), data on sector targeting can be considered a good proxy for FDI inflows, and moreover they are less susceptible to the possible simultaneous relationship between FDI and quality upgrading. In fact, FDI can improve the quality of the exported products, but they could also be attracted by those countries-sectors that already produce and export high quality products. Clearly, this possible endogeneity bias is strongly attenuated by using the IPA data.

The IPA data set covers 105 countries over the period 1984-2000. For our purpose, we use IPA data from 1995 to 2000, covering about 50 countries of our sample. The data set includes time-varying information on which SITC 4-digit agri-food sectors were targeted by the national IPAs in their investment promotion efforts. This allows us to test whether an increase in competition due to a fall in tariffs, exerts a heterogeneous effect on the rate of product quality upgrading according to whether countries-sectors are targeted as more attractive for FDI inflows, and thus, where it is more likely to find a better business environment.

Another relevant issue from a developing countries perspective is to understand the extent to which the recent development of PTAs played some role in affecting the rate of quality upgrading. Recent assessment of the EU PTAs effect through gravity model clearly suggests that PTAs have a positive and significant impact on trade flows (see Jean and Bureau, 2012). However, to the best of our knowledge, there is no evidence on their effect on quality upgrading. This relationship is tested by using a PTA dummy following Scoppola et al. (2013). In particular, the PTA dummy has been built by considering for each year the presence of a PTA with the EU already in force. Hence, in addition to the GSP preferential schemes, we have included the PTA signed with the ACP, South Africa, the Mediterranean countries, Chile and Mexico and the initiative Everything but Arms.

Moreover, in order to control the extent to which the properties of our quality estimates are consistent with the previous findings, we make use of UNIDO data to measure countries-sectors' factor endowments and total factor productivity. [9] The UNIDO database provides data on nominal value added at factor cost, capital labor ratio, number of employees and gross fixed capital formation for 34 exporting countries and five processed food industries, defined according to the 3-digit ISIC (Revision 3) classification, over the period 1995-2007. Moreover, data on countries' GDP per capita to proxy for country' endowment are taken from the World Bank.

4. Results

4.1 A preliminary look at the quality estimates

Before analyzing the relationship between competition and quality upgrading, we study whether our quality estimates are consistent with the expectations. In particular, we are interested in how countries' productivity and factor endowment measures are correlated to our quality estimates. Note that we are simply interested in robust correlation and not in the causality relation. Indeed, to some extent, this correlation should be tautological because total factor productivity (TFP) rises as a result of innovation, either reducing costs, or, indeed, increasing the quality of the input or the final products (Helpman, 2011).

9 TFP is estimated from a value-added function which allows for country, industry and time-specific effects and assumes variable returns to scale (see Harrigan, 1999; Gopinath and Ruan, 2008; Olper et al., 2013). Data on gross fixed capital formation are used to calculate capital stock, following the perpetual inventory method (see Hall et al., 1988; Crego et al., 1998). The estimated TFP is then linked to the NACE 4-digit classification through appropriate correspondence tables provided by the United Nations Statistical Division.

Table 3. Product quality and countries' factor endowments

	Ln Quality$_{cht}$			
	(1)	(2)	(3)	(4)
Ln TFP	0.270***			
	(0.0854)			
Ln labour productivity		0.134***		
		(0.0436)		
Ln capital labour ratio			0.105**	
			(0.0516)	
Ln per capita GDP				0.0887***
				(0.0241)
Country-Year fixed effects	YES	YES	YES	YES
Importer-Product-Year fixed effects	YES	YES	YES	YES
No. of obs.	536,519	554,785	617,271	1,016,582
R-squared	0.90	0.89	0.89	0.84

Notes: Table shows results of regressing the estimated quality on (log) total factor productivity, (log) value added per employee, (log) capital-labor ratios and (log) per capita GDP. All regressions include country-year and importer country-product-year fixed effects. Standard errors are clustered by exporting country. Significance levels: * 0.10 **0.05 *** 0.01.

Columns 3 and 4 of Table 1 show that a positive correlation exists also between the quality of the exported products and two standard measures of factor endowment, namely the countries-industry capital-labor ratio and GDP per-capita. Thus, more capital intensive and richer countries export higher quality products, a result that again supports previous findings based on unit values as proxy for quality (e.g. Schott, 2004; Hallak, 2010).

The above correlations corroborate the expectations, giving credence to the properties of our quality estimates. However, our main focus is on the relation between competition and quality upgrading, an issue addressed in the next section.

4.2 Baseline results

In this section we present our main results of estimating equation (1) by OLS. In all specifications, the estimated standard errors are clustered within exporting countries, with EU countries treated as one country because of their common trade policy. Column 1 of Table 2 reports our baseline results, that allow to test whether the effect of tariffs on quality upgrading is indeed conditional to the distance to the world quality frontier. Results strongly support this conclusion. First, in line with the expectations, a negative coefficient on the lagged distance to the frontier variable suggests that varieties far from the frontier, on average, display a faster rate of quality upgrading. Namely, there is clear evidence of convergence in quality among varieties.

Second, a significant negative coefficient on the interaction between tariffs and the distance to the frontier variable implies that varieties close to the world frontier are more likely to upgrade products in response to an increase of competition (tariffs reduction). By contrast, the significant positive coefficient on the linear tariff implies that tariffs are likely to have the opposite effect for varieties far from the frontier. Quantitatively, our results show that a 10 percentage points reduction in tariffs induces a decrease in the rate of quality upgrading of –2.1% for varieties far from the world quality frontier and an increase of 2.5% for varieties close to the frontier.

Table 2. Quality, distance to the frontier and competition: baseline results

Dependent variable: Δ Quality	(1)	(2)	(3)
	ALL	OECD	NON OECD
Lagged distance to the frontier (*t - 5*)	-0.831***	-0.881***	-0.551***
	(0.0956)	(0.0357)	(0.0621)
Lagged tariffs (*t - 5*)	0.217***	0.264***	0.129
	(0.0776)	(0.0913)	(0.126)
Lagged tariffs * distance to the frontier (*t - 5*)	-0.463**	-0.384***	-0.607***
	(0.184)	(0.135)	(0.234)
Country-Year fixed effects	YES	YES	
Importer-Product-Year fixed effects	YES	YES	
No. of obs.	239,332	239,332	
R-squared	0.54	0.54	

Notes: All regressions include importer country-product (CN-8)-year and exporter country-year fixed effects. Standard errors are clustered by exporting country (with EU countries treated as one country because of its common trade policy). Significance levels: * 0.10 ** 0.05 *** 0.01.

Since countries in our sample vary strongly in terms of the level of development, it is important to study the heterogeneity of the escape-competition and discouragement effects according to different country characteristics. In columns 2 and 3 we present the results of estimating equation (1) giving the possibility to have separate coefficients for OECD and non-OECD countries. The non-linear relation between quality upgrading and competition is statistically significant in both the OECD and non-OECD sample, although in the latter case the estimated coefficient of the (linear) tariffs term is not statistically significant, but the two terms are jointly significant. [10]

4.3 FDI sector targeting, PTAs and quality upgrading

An important element of globalization that more often affects the competitive environment, especially of the developing countries, is represented by the FDI inflows. A large body of literature points out that attracting foreign investors can lead to faster economic growth, thanks to increasing capital inflows, transfers of new technologies and know-how and, as a consequence, positive productivity spillovers to local firms (Görg and Strobl, 2001; Görg and Greenaway, 2004; Javorcik, 2004; Javorcik and Spatareanu, 2011).[11] For our purpose, an interesting issue to address is whether there exists a heterogeneous effect of an increase in the level of competition on the rate of quality upgrading, depending on different policies on the attraction of FDI inflows.

[10] The main results hold even controlling for different measures of product quality (e.g. estimating product quality with the method of Khandelwal, Schott and Wei (2013) or using unit value as proxy for quality) or different proxy for the level of competition (e.g. EU sector-country import penetration or the diffusion of the EU voluntary standards). The results are not shown cause the space but are available upon request.

[11] The FDI spillover effect, however, is conditional on different elements. Javorcik (2004), using a firm-level panel data set from Lithuania, provides evidence that the productivity spillover is positively linked to the foreign presence in the downstream sectors (backward linkage channel) and with a partially and thus not fully owned foreign projects. However, she does not find evidence of spillovers due to either the horizontal or the forward linkage channel. Rojas-Romagosa (2006) argued that the spillover effects are conditional on the absorptive capacity of the firms and/or the host country. He pointed out that, counter intuitively, the spillover effect is higher for developed countries than for emerging economies and that it depends also on the technological gap (i.e. the lower is the technological gap, the larger is the spillover).

Table 3. FDI sector targeting, PTAs and quality upgrading

Dependent variable: Δ Quality	(1)	(2)	(3)	(4)
	FDI Sector target	No FDI Sector target	PTAs	no-PTAs
Lagged distance to the frontier (*t - 5*)	-0.856***	-0.785***	-0.756***	-0.826***
	(0.0826)	(0.219)	(0.110)	(0.101)
Lagged tariffs (*t - 5*)	0.385***	0.0612	0.160	0.223**
	(0.0991)	(0.0740)	(0.0978)	(0.0916)
Lagged tariffs * distance to the frontier (*t - 5*)	-1.586***	-0.731**	-0.130	-0.513**
	(0.160)	(0.321)	(0.282)	(0.220)
Country-Year fixed effects	YES		YES	
Importer-Product-Year fixed effects	YES		YES	
No. of obs.	70,386		239,332	
R-squared	0.67		0.54	

Notes: All regressions include importer country-product (CN-8)-year and exporter country-year fixed effects. Standard errors are clustered by exporting country (with EU countries treated as one country because of its common trade policy). Significance levels: * 0.10 ** 0.05 *** 0.01.

Columns 1 and 2 of Table 3 show results obtained by interacting the variables used in specification (1) with a dummy variable that takes the value of 1 if a country's IPA at time *t* considered the sector as a priority target for attracting FDI inflows, and zero otherwise. Thus, we are estimating separate coefficients for countries-sectors that are considered a priority by national investment promotion agencies and those which are not. The results show that the escape-competition and discouragement effects hold for both groups. However, the effect is more pronounced for those countries-sectors considered as a priority target. Broadly speaking, these results are in line with the literature on the effects of FDI which shows that FDI inflows improve the quality of the products exported by the hosting countries. Thus, we find evidence that the entry of multinationals in the economy increases the ability of those countries to upgrade the quality of their production and, consequently, of their export basket (Wang and Wei 2008; Iacovone and Javorcik 2008; Harding and Javorcik, 2012).[12]

Next, a second relevant issue especially from a developing countries perspective, is to understand the extent to which the recent development of PTAs played some role in affecting the rate of quality upgrading. Trade preferences have been applied with aim of increasing developing countries' export earnings, as they can charge higher price than before and increase export quantity. Moreover, PTAs can also have a positive impact on export products diversification, that is more often viewed as a key determinant of economic growth (Cadot et al., 2013).

Columns 3 and 4 of Table 3 test the relation between competition and quality upgrading by splitting the sample into countries with and without a PTA with the EU. Results show that the non-monotonic relation is confirmed only for countries without a PTA. Instead, for countries granting a PTA, although some non-linearity is apparent from the data, the estimated relationship is not statistically significant. Thus, we do not find any evidence that granting preferential access to

[12] Wang and Wei (2008) provide evidence that products exported by Chinese foreign-invested firms tend to have systematically higher unit values than the other domestic firms, suggesting that they produce higher quality products. Iacovone and Javorcik (2008) reached a similar conclusion comparing the unit value of the new products introduced by foreign and domestic firms in Mexico, finding that foreign establishments tend to export higher quality products. Finally, Harding and Javorcik (2012), using data on IPAs sector targeting, provide evidence that attracting FDI inflows can boost the ability of a country to upgrade the quality of its export basket.

developing countries in the food sectors, *per se*, contributed to increase the rate of their products quality upgrading, *ceteris paribus*.

5. Summary and conclusions

In this study we empirically investigated the extent to which the trade liberalization wave of the last decades affected the rate of quality upgrading in the exported food products. We use a distance to the frontier framework (Aghion et al., 2005; 2009), according to which firms' innovation activities – like quality upgrading – are a non-monotonic function of the level of competition and the firms' distance to the technological frontier. To test this prediction, we inferred products quality following Khandelwal (2010), considering imported agri-food products in the EU-15 from more than 70 exporters in 1500 CN 8-digit agri-food products.

We find strong evidence that an increase in the level of competition leads to faster quality upgrading only for products close to the world quality frontier. These results are consistent with the main predictions of the Aghion et al. (2005; 2009) model and they hold true when we split the sample into OECD and non-OECD countries. Interestingly, we showed that in countries-sectors considered as a priority target for the FDI inflows, the escape-entry and discouragement effects are much more pronounced. This result is in line with recent findings, showing that FDI inflows can boost the rate of quality upgrading in the hosting countries.

Our results support the notion that the initial distance to the world quality frontier should be considered an important element to be taken into account in valuing the subsequent effect of trade liberalization policies. Our findings also suggest that policies oriented to attracting FDI inflows should be considered a viable strategy, in particular for developing countries wishing to climb up the quality ladder, in order to increase their presence in the international markets. From the results of this paper it clearly emerges that policies aimed at promoting domestic competition can trigger the quality upgrading of the exported products. As a consequence of such products' quality upgrading, countries could export more, and thus their welfare could improve.

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