Brazilian agricultural exports: Quality matters?

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Abstract:

The general objective of this paper was to verify the relationship between the quality of the products and the Brazilian agricultural exports. In addition, we sought to identify the effects of the exporter's income, distance and SPS and TBT measures on the quality of exported products. For that, Brazilian agricultural export data (HS 4-digit) for the 97 main tradings partners in the period from 1997 to 2016 was used. Among the results obtained for the analyzes related to the trade with new markets, it was identified negative effects of quality both on the probability of accessing new markets and on the share of trade made with them. For the intensive margin, the value exported with existing partners, the estimated coefficients showed that the increase in quality is associated with a higher exported amount. In addition, this research identified a positive effect of income and distance on quality. Finally, the issuance of SPS and TBT measures by Brazilian importers also led to an improvement in the quality of agricultural products exported by the country.

Acknowledegment:

JEL Codes: F14, F12

#1527

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Key-words: product quality; agricultural exports; destination market.

JEL codes: Q17, F1, F12,F14.

1. Introduction

Recent research points to the relevance of the quality of exported products as a determinant of the comparative advantages and the international standard of competition, that is, how differences in quality affect the way in which the products of the countries compete with each other (BASTOS; SILVA, 2010; BRAMBILLA E PORTO, 2016; FLACH, 2016; KHANDELWAL, 2010). As the main results, studies have found that higher quality products are sent to more distant trading partners and to countries with higher income levels.

Countries have different perceptions about quality, where generally developed and higher income economies tend to value higher quality products more than other nations. As consequence, countries that seek to be successful in entering these markets should constantly seek to update the quality of exported goods in order to meet the most demanding demand (BRAMBILLA, PORTO, 2016). As a consequence, countries that seek to be successful in entering these markets should constantly seek to update the quality of exported goods in order to meet the more rigorous demand (BRAMBILLA, PORTO, 2016).

To achieve higher levels of quality, changes in the production process and the use of increasingly skilled labor are required, which in turn require higher wages. However,

these changes are often costly and not always achievable in the least developed countries. On the other hand, according to Leamer (2006), improvements in the quality of goods would have implications on trade, wages and the level of output of the economy. Therefore, exporting higher quality products becomes a fundamental issue, especially for nations that are more dependent on international trade.

In Brazil, the performance of the external sector, especially agricultural exports, exerts a great influence on the economic aggregates. According to data from the MIDC (Ministério do Desenvolvimento, Indústria e Comércio Exterior - Ministry of Development, Industry and Foreign Trade) (2017) in recent years, agricultural exports accounted for 40% of Brazil's total exports, making a major contribution to the good performance of the trade balance. Therefore, deepening the analysis regarding the export quality of agricultural products contributes to the better understanding of this sector that is so important for the Brazilian economy.

Given the above, the general objective of this paper was to verify the relationship between the quality of the products and the Brazilian agricultural exports. Specifically, it was intended to analyze the effect of the exports quality on access to new markets, on the share marketed with the new market in relation to the total exported and on the value exported to existing partners. In addition, we sought to identify the effects of the exporter's income, distance and SPS and TBT measures on the quality of exported products.

The analysis of the Brazilian export market from the point of view of the quality of the products sent abroad is relevant since, transacting higher quality products is a necessary condition for the successful insertion of such goods in importing countries (Khandelwal, 2010). Given that quality is due to the perception of these importers and considering that more advanced countries tend to consume higher quality products, a more detailed analysis of the implications of quality on the dynamics of international trade is crucial. These questions become even more important in developing countries, since they do not always have a satisfactory credit market, a quality institutional environment, investments in technology and other conditions that facilitate the production and export of higher quality goods.

Differently from other papers on this theme (BASTOS; SILVA, 2016; FLACH, 2016; BRAMBILLA; PORTO, 2016)[1] the present research focuses on the agricultural sector.

[1] These and other papers are presented in more detail in section 2.

In the case of Brazil, an analysis of the export quality becomes even more appropriate given the emphasis placed by the foreign sector on the generation of foreign exchange, especially in agriculture, which has been responsible for the positive balance of trade in recent years. Together with this fact, Brazilian farming has always played a fundamental role in economic growth and in the generation of employment and income.

Another contribution of the paper was to consider separately the effect that the quality of exports can have on entry into new markets and on existing markets. In addition, the influence of sanitary and phytosanitary (SPS) and technicals (TBT)[2] measures on product quality was investigated. Several researchs on international trade address the effect of these measures on the trade flow of countries, and ambiguous results are found depending on their restrictive nature[3]. However, in addition to the standard analysis on these notifications, another hypothesis raised in this paper is that when a country imposes SPS and / or TBT measures and the exporter is able to adapt to the requirements, the result may be the sending of higher quality products.

A greater understanding of the effects of the quality of agricultural exports on Brazil's trade relations can help in the elaboration and improvement of policies applied to the sector, so that the country can maintain and increase the value of its exports, as well as raise the dynamism of its sales to the foreign market.

This study is structured in five sections, in addition to this introduction. In the second section is presented a brief review of the literature on the topic in question. The third presents the methodology used. Section 4 presents the data. The results are presented and discussed in the fifth section, and finally, the sixth section presents the final considerations.

[2] According to World Trade Organization (WTO, 2017), the SPS agreement aims to prevent justified measures for the protection of human, animal and plant health from being barriers to trade. As for the TBT agreement, this seeks to prevent technical measures such as standards, regulations for production, labeling and conformity assessment procedures from acting in the same direction (FREITAS, *et al.*, 2015).

[3] The positive consequences of the imposition of SPS and TBT measures involve increasing product quality, human, animal and plant safety, harmonization of international regulations and standards. These advantages will be achieved if the cost for the adaptation to such requirements is not so high and that it is compensated by the greater flow marketed. On the other hand, measures can be interpreted as barriers to trade if the adjustment generates significant costs in the production process and in the commercialization of the product.

2. Literature Review

Bastos and Silva (2010) analyzed the factors that influenced the export quality of Portuguese firms, considering different product categories and destination markets for the year 2005. The authors used panel data for 16541 exporting firms, 7591 product categories exported and 220 trading partners. The results indicated that unit values FOB (proxy for export quality) increased with distance and tended to be higher when trade was carried out with richer countries. It was also verified that the productivity of the company extended the positive effect of the distance, suggesting that the companies of high productivity and of high quality were able to serve commercial partners potentially more difficult.

Brambilla and Porto (2016) when dealing with the income level of destination countries, quality of exports and wages, sought to verify whether industries that exported products to high-income trading partners paid higher average wages. The authors used panel data for 82 countries from 1990 to 2000, and estimated an instrumental variable model. The first evidence found in the results showed that industries that export products to higher income markets tend to send higher quality products. This means that richer countries require higher quality products. The second evidence from the study indicated that providing quality products is costly and requires more intensive use of skilled labor with higher wages. In this way, higher quality products tend to create higher wages.

Flach (2016) using data on Brazilian exporting firms between 1997 and 2000, sought to verify if the companies segment the markets and if the characteristics of the destination country affected the quality of the product and the price. The main results indicated the market segmentation based on quality, in which the firms increased the quality and the prices to the high income partners. Robustness analyzes have confirmed the hypothesis that price differences in all export destinations can be driven by investments in product quality and high quality demand.

Fan, Li and Yeaple (2015) sought to verify the effect of tariff reductions on the quality of goods exported by Chinese firms from 2001 to 2006. The results suggested that a decrease in import tariffs, which may facilitate access to intermediate inputs, tends to induce producers to improve the quality of products and raise their prices in foreign markets.

Verhoogen (2008) proposed a new approach linking trade and wage inequality in developing countries through the quality improvement mechanism and verified its empirical implications for manufacturing firms in Mexico. The results indicated that the most productive firms produce higher quality goods and pay higher wages. Only the most productive firms are able to enter the export market, and tend to produce higher quality goods for the external market than for the domestic market. In addition, it was found that a devaluation of the exchange rate led the more productive firms to increase exports, improve the quality of their products and pay higher wages compared to the less productive firms within the same industry. Evidence indicated that the quality improvement, induced by a currency shock (Mexican peso crisis in 1994) increased wage inequality.

Filho, Medeiros and Albuquerquemello (2017) verified the quality of Brazilian exports between 1997 and 2014, at interstate, sectoral level and according to the degree of technological content. The authors considered the processing industry exports from Brazil to 193 commercial partners. In the aggregate analysis, it was found that the quality of products exported by the country was practically constant over time. For the disaggregated analysis, the authors found that for the technology-intensive sectors (medium and high technological intensity), that in 17 of the 27 units of the federation and in 17 of the 23 classes of products considered, there was an improvement in the quality of exported goods. In addition, the authors found evidence that richer Brazilian states exported higher quality products.

Hallack (2006) conducted an empirical analysis to see if product quality plays a relevant role in determining trade patterns. The author used data on bilateral flows at sectoral level for 60 countries in 1995. Overall, the results have confirmed the theoretical prediction that higher income countries import more from trading partners producing higher quality goods. Manova and Zhang (2012) analyzed China's exporting firms from 2003 to 2005, considering 243 trading partners and 7526 product. It was observed that the most successful exporters used higher quality inputs to produce higher quality goods. In addition, firms have varied the quality of their products in all target markets, using inputs of different quality levels.

3. Methodology

3.1.Export Quality

The quality indicator of the exported products used in this study was based on the approach of Khandelwal (2010) and Kandelwal, Schott and Wei (2013). The model specified by the authors supposes a utility function of the type CES considering that the preferences of the consumers incorporate quality (δ):

$$U = \int_{g \in G} [\delta(g)q(g)]^{\sigma-1/\sigma} \quad (1)$$

By maximizing the utility function (1) subject to the budget constraint, we arrive at the following demand equation:

$$U = (\delta_{kj}^{\sigma-1})(p_{kj})P_{kj}^{\sigma-1}Y_j \quad (2)$$

Applying the logarithm in (2), the quality for each observation related to the sectors that compose the Brazilian agriculture, can be obtained as the residue of the expression:

$$lnq_{kj} + \sigma * lnp_{kj} = \alpha_j + \alpha_k + \varepsilon_{kj} \quad (3)$$

where q_{kj} refers to the quantity exported (kg) in each sector for j-th country, p_{kj} is the exported value of agricultural products and σ is the elasticity of substitution. α_j and α_k represents the fixed effects of importing country and sector[4], respectively. Equation (3) was estimated by Ordinary Least Squares, after assuming a given value for σ. As in the case of Filho, Medeiros and Albuquerquemello (2017), the median elasticity of

[4] The sectors considered in this study refer to the agricultural product groups for the 2-digit codes of the Harmonized System (HS): 01 - Live animals; 02 - Meat and edible meat offal; 03 - Fish and crustaceans, mollusc and other aquatic invertebrate; 04 - Dairy produce; birds' eggs; natural honey; edible products of animal origin, not else where specified or included; 05 - Products of animal origin, not elsewhere specified or included; 06 - Live tree and other plant; bulb, root; cut flowers etc; 07 - Edible vegetables and certain roots and tubers; 08 - Edible fruit and nuts; peel of citrus fruit or melos; 09 - Coffee, tea, mate and spices; 10 – Cereals; 11 – Products of the milling industry; malt; starches; inulin; wheat gluten; 12 - Oil seeds and oleaginous fruits, miscellaneous grains, seeds and fruit, industrial or medicine plants, straw and fodder; 13 - Lac; gums, resins and other vegetable saps and extracts.; 14 - Vegetable plaiting materials; vegetable products not elsewhere specified or included; 15 – Animal or vegetable fats and oils and their cleavage products; etc; 16 - Preparations of meat, fish or crustaceans, molluscs etc; 17 - Sugars and sugar confectionery; 18 - Cocoa and cocoa preparations.; 19 – Preparations of cereal, flour, starch or milk; pastrycooks' prod; 20 - Preparations of vegetable, fruit, nuts or other parts of plants; 24 – Tobacco; 52 – Cotton.

substitution estimated by Broda, Greenfield and Weinstein (2006) for each country was used in this study.

The quality of agricultural products exported by Brazil to each sector in j-th country (δ_{kj}) can be obtained by divinding the residue obtained in (3) and the elasticity of substitution minus one:

$$quality = \ \hat{\sigma} \equiv \ \hat{\varepsilon}_{kj}/\sigma - 1 \tag{4}$$

Thus, the measure of the quality of the Brazilian exports of agricultural products obtained in (4) was incorporated in the estimated equations of the model.

3.2. Empirical specification

In order to meet the different objectives proposed in this study, after obtaining the export quality indicator, it was possible to estimate the following empirical models:

$$Y_{ijkt} = \ \beta_0 + \ \beta_1 \ln(\text{qual.}_{ijk}) + \ \beta_2 \ln(\text{GDP}_{it}) + \beta_3 \ln(\text{GDP}_{jt}) + \beta_4 \ln(dist._{ij}) + \beta_5 \ln(\text{cont.}_{ij}) + \beta_6(TBT_{jkt}) + \ \beta_7(SPS_{jkt}) + \ \alpha_t + \ \mu_k + \gamma_j + \ \varepsilon_{ijkt} \tag{5}$$

The dependent variables were defined as: (i) New Market: dummy variable that receives a value of 1 if a particular commercial transaction between Brazil and the *j-th* country occurred after three consecutive years without negotiations between such countries, and 0 otherwise[5]; (ii) Share: share of the volume marketed by country *i* (Brazil) of product k with the new market j on the total volume traded (US $), in year *t*; (iii) value of exports from country *i* of product *k* to *j-th* country, with which Brazil already trades (already existing market), in year *t* - intensive trade margin measure. Where *j* representes the 97 main Brazilian trading partners of agricultural products from 1997 to 2016; *k* corresponds to all 4-digit HS products from the 22 2-digit HS sectors, representing the agricultural products considered in the sample. It is important to highlight that the export data (US $ and Kg) refers to the 8-digit Mercosul Common Nomenclature (NCM) products, with the first six digits of that nomenclature corresponding to the first six digits of the HS.

[5] Situations in which Brazil did not trade with the importing country in the interval of 1 or 2 years were not considered as a new market, since very short periods may not be considered as a total exit of Brazil from that market.

qual.$_{ijk}$ refers to the quality indicator of exports from country *i* (Brazil) to the *j-th* country in sector *k*, according to section 3.1; GDP_{it} and GDP_{jt} are the respective GDP's of country *i* and *j* in year *t* (nominal GDP – US$), used to indicate the income of Brazil and the importing countries; *dist.*$_{ij}$ indicates the distance between country *i* and country *j*, measured by the distance (km) between the most populous city of each country. As these cities represent a great participation in the economic and export activity of the country, the studies use this *proxy* to measure the distance between the countries (BASTOS, SILVA, 2010, BITTENCOURT, MATTOS, LIMA, 2016); *contig.*$_{ij}$ is a *dummy* that assumes 1 if country j is bordered by Brazil, and 0 otherwise; TBT_{jkt} and SPS_{jkt} are the notifications to the TBT and SPS agreements issued by Brazil's main trading partners of agricultural products in the year t; α_t, μ_k and γ_j refers to the fixed effects of time, product and importing country, respectively. Finally, ε_{ijkt} is the error term.

For the estimation of the first dependent variable (i), although its dichotomous nature, the Ordinary Least Squares (OLS) method was used, instead of non-linear probability models (probit or logit). The reason for this choice was due to the inclusion of a significant number of fixed effects, which can generate the problem of incidental parameter (BEENSTLOCK; FELSENSTEIN, 2007). For the estimations considering the variables specified in (ii) and (iii), the OLS and Pseudo Poisson-Maximum-Likelihood (PPML) methods were used in the context of gravitational equations. The presence of null flows in the dependent variables of the respective models and the heterogeneity of trade patterns can lead to biased estimates when obtained by Ordinary Least Squares. Thus, the PPML method was used in order to deal with these limitations, and to obtain consistent estimates (SANTOS SILVA; TENREYRO, 2006). However, both methods were estimated to test robustness.

The second group of estimated models, based on equation (6), aims to analyze the effect of variables exporter income, distance between countries and the imposition of SPS and TBT measures on the quality of agricultural products exported by Brazil, and may be expressed as follows:

$$\ln(quali._{ijkt}) = \beta_0 + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(dist._{ij}) + \beta_3(TBT_{jkt}) + \beta_4(SPS_{jkt}) + \alpha_t + \mu_k + \gamma_j + \varepsilon_{ijkt} \quad (6)$$

The dependent variable as well as the independent variables of model (6) were defined and explained as previously presented in the specification of equation (5). To obtain the estimates of this model, the OLS method was used with the inclusion of fixed effects of time, product and importing country.

The problem of the endogeneity of the variables is constantly pointed out in the literature that deals with international trade (SILVA, et al., 2016; FONTAGNÉ, et al. 2015; FLACH, 2016; BASTOS; SILVA, 2010). Thus, it is important to recognize that the explanatory variables related to the quality of exports, GDP and SPS and TBT measures may be potentially endogenous, due to their simultaneity with the dependent variable. The use of instrumental variables would be the appropriate procedure to correct this endogeneity. However, since it is difficult to find suitable instruments, it should be considered that the results found in this research may contain this possible bias of endogeneity.

4. Data

The data used in this research are annual and cover the years 1997 to 2016.

Exports: information on the values of Brazilian exports (US $) and quantity exported (kg) were collected from SECEX / MDIC (Secretariat of Foreign Trade – Secretaria do Comércio Exterior / Ministry of Development, Industry and Foreign Trade – Ministério do Desenvolvimento, Indústria e Comércio Exterior, 2017). In this database the classification of products follows the Mercosur Common Nomenclature (NCM), with its first digits corresponding to the first digits of the Harmonized System (SH), which makes it possible to use SECEX data.

Gross Domestic Product (GDP): the indicative variable of income of Brazil (exporter) and the main trading partners were obtained from the World Bank (*World Development Indicators, 2017).*

Distance (dist) and contingence (contig): the geographic distance between the most populous city of the selected importing countries in the sample and São Paulo (measured in Km), as well as the existence of a common border between Brazil and the partners, were obtained from the *Centre D'Estudes Prospective et d'Informations Internationales* (CEPII, 2017).

SPS and TBT: notifications to the SPS and TBT measures issued by Brazilian importers were collected from the WTO Documents online page (2017), taking into account notifications to agricultural products from the 2-digit HS.

5. Results

In this section the results of this study were presented and discussed. Firstly, a brief description of the data was made and the quality indicator of the agricultural sector exports was analyzed for each HS code of 2 digits considered, from 1997 to 2016. Next, the estimates of the quality effect on the Brazilian comercial relations were presented.

5.1.Descriptive analysis

Before presenting the results of the estimates made in the research, a descriptive analysis of the data is done initially to identify some characteristics of the selected sample. According to Table 1, the average value exported by Brazil in the agricultural sector to the main trading partners between 1997 and 2016 was approximately US$ 200,000, with the average exported volume being 378 tons.

Table 1 – Descriptive analysis of the variables used in the research

Variable	Mean	Sd	Min.	Max.
Exported Value (US$)	200217	1513826	0	1.380e+08
Exported Quantity (Kg)	378027	3649855	0	2.240e+08
GDPi (US$ billion)	1452	731.4	508.0	2616
GDPj (US$ billion)	1407	3253	0.487	18625
Distance (Km)	7917	4622	1135	18550
Contig.	0.235	0.424	0	1
TBT	0.0172	0.130	0	1
SPS	0.0966	0.295	0	1
New Market	0.216	0.412	0	1
Quality	5.200	1.487	-2.654	14.91
Nº Obs.		143381		

Source: Research results.

The average of the representative variable of Brazil's income (GDPi) in the period considered was US $ 1.45 trillion. For commercial partners, the average value of GDP was US $ 1.41 trillion. In addition, 23% of the trade relations between Brazil and the main

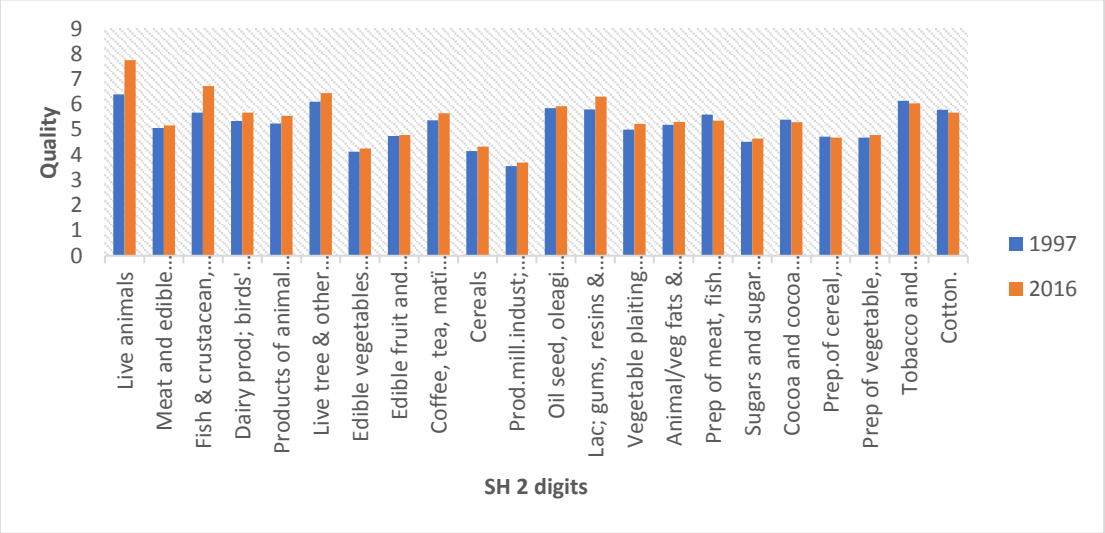
destination markets for agricultural exports between 1997 and 2016 occurred with countries with a common border. The average distance between the most populous Brazilian city and those of the other partners was 7917 Km.

Regarding the variables representative of the non-tariff measures used in the present study, it was verified that only 1.7% of the exports received some technical notification (TBT). For sanitary and phytosanitary notifications (SPS), about 10% of commercial relations occur under the issuance of such measures. It is also worth noting that 21.6% of the transactions take place with a new market, that is, exports were made with partners that did not import the Brazilian product three years ago.

The indicator referring to the quality of exported agricultural products (Quality), as specified in section 3.1., presented an average value of 5.2, with the maximum value (14.91) observed for exports of "live animals and other animal products "(SH 01). The lowest value of the indicator was verified for "cereals" (SH 10), whose exports are usually characterized by products with lower added value.

Figure 1 shows the mean quality by sectors considered in the study (SH 02) for the years 1997 and 2016, in order to analyze the evolution of the indicator in this period. Overall, there were no substantial changes in the quality of agricultural exports. For most of the sectors, the indicator increased, with emphasis on exports of "live animals and other animal products" (SH 01), where the average quality increased from 6.4 to 7.8, and for exports of "fish and crustaceans, molluscs and other aquatic invertebrates "(SH 03), where the average quality increased from 5.7 to 6.7. This increase in quality was expected given the perishability of these products, which require greater investments in quality in order to ensure that the goods arrive at the destination in adequate consumption conditions. On the other hand, the sectors "preparations of meat, fish or crustaceans, molluscs or other aquatic invertebrates" (SH 16), "tobacco" (SH 24) and "cotton" (SH 52) had a small reduction in the average export quality.

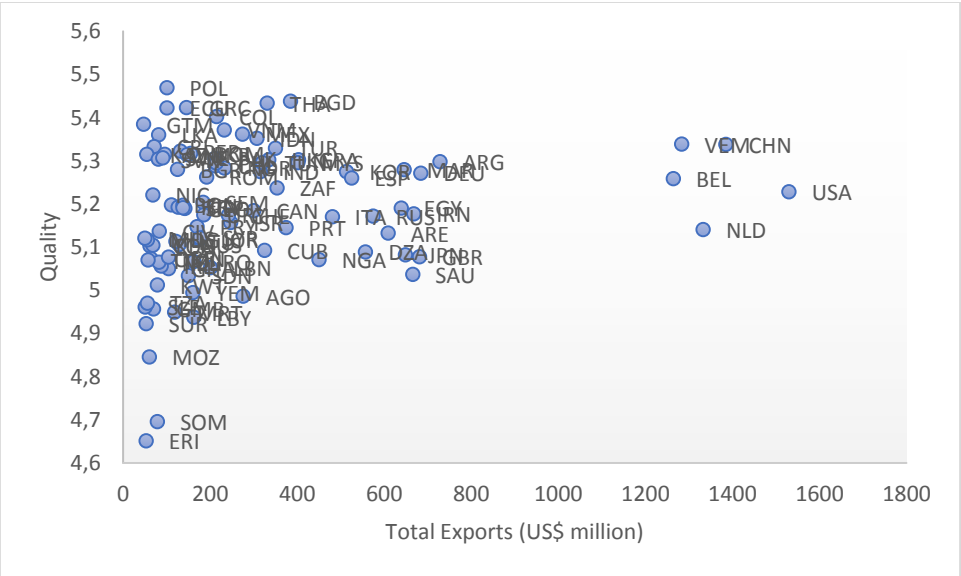
Figure 1 – Average quality by product, 1997 and 2016



Source: Research results.

Still on product quality, Figure 2 shows the relationship between the average quality of products and the total amount exported to Brazil's main trading partners in the period from 1997 to 2016. Based on this figure, it is observed that countries that represent consilidated markets, such as China and the United States, imported products with quality above average quality (Table 1), as expected. However, on average, higher quality products have also been directed to countries with less relative participation in total Brazilian exports, such as Poland, Greece, Thailand and others.

Figure 2 - Average quality and total volume exported (US$ million) by destination – 1997 to 2016.



Source: Own elaboration.

5.2.Effects of the quality of agricultural exports on Brazilian international trade

In order to verify the effect of the quality of agricultural exports on the Brazilian trade relations between 1997 and 2016, three main models were estimated considering the following questions: (i) what is the effect of export quality on access to new markets? (model 1); (ii) what is the effect of the quality on the shared traded with the new market in relation to the total exported? (models 2 and 3); (iii) what is the effect of quality on the value exported to existing partners (intensive margin measure)? (models 4 and 5). The results of the different estimates are presented in Table 2.

Table 2 – Effects of the quality of agricultural exports on Brazil's international trade

	(1)	(2)	(3)	(4)	(5)	(6)
	New Market	Share (OLS)	Share (PPML)	Exported Value (ln) (OLS)	Exported Value (ln) (PPML)	Exported Value (ln) (PPML)
Lnquali.ijk	-0.127***	-0.0227***	-0.135***	3.151***	0.347***	0.3471***
	(0.0258)	(0.00327)	(0.0206)	(0.353)	(0.0397)	(0.039)
LnGDPi	-0.795***	-0.00540***	-0.958***	0.836***	0.1000***	-
	(0.00954)	(0.00115)	(0.196)	(0.0973)	(0.0111)	
LnGDPj	-0.0119**	-0.00114	-0.141	0.133***	0.0160***	-
	(0.00480)	(0.000699)	(0.102)	(0.0493)	(0.00564)	
Lndistij	-0.0703	-0.00196	-1.852**	3.010***	0.243***	0.367***
	(0.0635)	(0.00265)	(0.917)	(0.699)	(0.0706)	(0.0522)
Contig.ij	-0.134*	-0.00902**	-0.307	0.447	-0.00616	0.0466
	(0.0790)	(0.00457)	(0.850)	(0.411)	(0.0448)	(0.0408)
TBTjk	-0.00230	-0.000186	0.0411	0.00468	0.00171	0.00202
	(0.00835)	(0.00144)	(0.189)	(0.0725)	(0.00760)	(0.00759)
SPSjk	0.0168***	0.00208***	0.141	-0.0357	-0.00410	-0.00412
	(0.00496)	(0.000683)	(0.0942)	(0.0397)	(0.00430)	(0.00430)
Constant	24.32***	0.263***	43.74***	-48.06***	-3.594***	-1.435***
	(0.631)	(0.0382)	-9.668	-6.585	(0.666)	(0.460)
Observations	142341	142341	142341	111537	111537	111537
Country effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Products effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.174	0.033	0.023	0.242	0.245	0.244
Loglikelihood	-62044	237483	-3397	-255441	-261916	-261923
r-squared	0.174	0.0327	0.0226	0.242	0.245	0.244
ajusted r-squared	0.174	0.0317		0.241		
F statistic	605.8	3.193		61.32		

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

The results presented in Table 2 indicated good adjustment of the estimated models, in which the null hypothesis of joint insignificance of the variables was statistically rejected according to the values of the F statistic obtained. In addition, it is emphasized that the cluster procedure (at the product level) was performed to obtain robust standard errors, thus solving the possible bias caused by heteroscedasticity. All estimates were

made considering fixed effects for country, year and product, as Flach (2016), Bastos and Silva (2010), Martin and Mejean (2014) and others.

The estimated model (1) shows that the increase in the quality of agricultural exports is associated with a reduction in the probability of Brazil accessing a new market. This is not surprising given that, despite having access to a significant number of partners, a small and consolidated group of countries absorbs the largest share of brazilian exports, such as the United States, China, the Netherlands and others. In this way, higher quality products can be directed to these countries, to the detriment of new markets, with the aim of intensifying the existing trade relations. In addition, higher quality may also imply higher price of the good, which may hinder the acquisition of these products by new commercial partners, explaining the negative sign of the variable representing the quality of Brazilian agricultural exports.

With regard to the income of the exporting country (GDPi) it was found that the increase in GDP is related to less access to new trading partners. Literature commonly points to a positive effect of the country's income on exported value (BASTOS; SILVA, 2010). According to the information in section 5.1., about 77% of the commercial relations carried out in the period occurred with existing partners. Thus, even if higher income generates higher exported volume, in the Brazilian case it is probable that this larger volume will be directed to already consolidated markets, which may explain the negative effect of income on access to new destinations. A similar result was found for the indicative GDP variable of the importing countries considered in the sample.

The estimated coefficient for the distance variable between Brazil and the main commercials had no statistically significant effect on the probability of accessing a new market. For the border variable (*contig*), the signal found indicated that the fact that the country has a common border reduces access to new markets. It should be noted that the variable for access to new markets refers to those situations where a country has not traded with Brazil for at least 3 consecutive years. However, the sample countries to which Brazil borders are not classified as new partners, since they were frequent importers during the period considered (that is, they did not stay for 3 consecutive years without commercializing with Brazil). As a consequence, the border implies a lower probability that the commercial transaction performed represents a new market.

Regarding the effect of the imposition of TBT notifications on the probability of Brazil accessing new markets, the coefficient of the variable did not present statistical significance. In the case of SPS notifications, the result found indicated that the

application of a sanitary and phytosanitary measure by the sample importers increased the probability of Brazil entering new markets. It is important to emphasize that these measures can act as reducers in trade if the costs involved in the adequacy of such requirements hinder exports and therefore, faced with the imposition of an SPS, Brazil would have the incentive to access the new markets that may have less measures restrictive (FREITAS, *et al*., 2016; BURNQUIST; SOUZA, 2010).

For the remaining models (columns 2-5), the estimates were obtained by OLS and PPML. As argued in section 3.2, due to the presence of null flows and heteroskedasticity the use of PPML is more appropriate to obtain consistent estimates. Therefore, the results generated by this approach were discussed, and the OLS estimates are presented only to test the robustness.

In the model (3), we tried to estimate the effect of quality on the share of the volume traded with new markets. The coefficient of the indicator of the quality of agricultural products indicated that the increase in quality is related to a smaller share marketed with new partners, confirming the result obtained in the model (1). In the same way, the variable representative of Brazilian income affected negatively the proportion of the volume traded with new markets in comparison with that traded with the others. Income from importing countries, unlike model (1), was not statistically significant.

The distance between Brazil and the main trading partners showed a negative and significant coefficient, indicating that the more distant the importers, the less the share of trade with new markets. For the other variables, the coefficients obtained were not statistically different from zero, and can not make inferences about their effects on the share of trade relative to new destinations.

The third estimated model (column 4-6) deals with the relationship between the quality of agricultural products and the value exported (US $) for the partners that Brazil regularly trades[6]. Regarding the variable of interest, the results show that the higher the quality of the product, the value exported to these markets tends to increase. This result was expected, since higher quality may imply higher product prices, which may increase the value transacted even in situations where the quantity traded is maintained or reduced, since the variation in price is higher.

The income variables of the selected countries also positively affected the value exported to existing Brazilian trading partners, as commonly found in the literature on the

[6] It should be noted that even if a country fails to trade with Brazil for up to 2 consecutive years, it is still considered a regular partner and is not classified as a new market.

subject (BASTOS; SILVA, 2010; BITTENCOURT; MATTOS; LIMA, 2016). It should be noted that a recent literature points to the non-use of GDP in the estimation of gravitational equations (FIGUEIREDO, LIMA, SCHAUR, 2016; BALTAGI et al., 2014; ANDERSON, 2011). The rationale for this is that GDP is measured on the basis of value added, that is, it does not take intermediate consumer goods into account, however, trade variables are given on a gross basis of sales (SILVA, et al. 2016). Thus, the results of the column (6) are presented withdrawing the income countries of the estimated models. It can be verified that there were no changes in the signs and statistical significance of the variables considered. Regarding the border, TBT and SPS variables, the estimated coefficients indicated that these variables did not affect the value exported to existing markets.

For the variable indicative of the distance between countries (*lndist*) the estimated coefficient pointed to a direct relation with the value exported. Although this result is not expected, it is known that the largest volumes traded occurred with relatively more distant trading partners from Brazil, such as China, the United States, the Netherlands, among others (see section 5.1). Therefore, in this case it is expected that the distance does not negatively affect the export value. In addition, it is important to note that, as argued by Novy (2009), caution should be exercised when using distance as the only variable to represent transport costs between countries. According to Bastos and Silva (2016), Kugler and Verhoogen (2008), higher quality products are directed to more distant markets[7], in this sense, the higher price obtained (consonant with the highest quality) can compensate the transport cost, and thus, the distance coefficient would not negatively affect the volume of Brazilian agricultural exports.

5.3.Export quality, income, distance and SPS and TBT measures

This section presents the results of the estimated models to analyze the relationship between the quality of agricultural products exported by Brazil, the income of the exporting country, the distance between the partners and the issuance of SPS and TBT notifications by the main importers. As a way of testing the robustness, different empirical models were estimated, as shown in Table 3 (columns 1-7). In general, the results were satisfactory, in which the estimated coefficients presented statistical significance and

[7] These issues were best discussed in section 4.3.

signs as presented by other studies that deal with the theme (BALDWIN; HARRIGAN, 2011; JOHNSON, 2012; BASTOS; SILVA, 2010; HALLACK, 2006).

Table 3 – Effects of income, distance and SPS and TBT measures on the quality of Brazilian agricultural exports.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LnGDPi	0.00716**	-	-	0.00716**	0.00672**	-	0.00672**
	(0.00292)	-	-	(0.00292)	(0.00292)	-	(0.00292)
Lndistij	-	0.0620***	-	0.0620***	-	0.0623***	0.0623***
		(0.00287)	-	(0.00287)	-	(0.00287)	(0.00287)
TBTjk	-	-	0.0197***		0.0197***	0.0197***	0.0197***
		-	(0.00523)	-	(0.00523)	(0.00523)	(0.00523)
SPSjk	-	-	0.0134***	-	0.0134***	0.0134***	0.0134***
	-	-	(0.00268)	-	(0.00268)	(0.00268)	(0.00268)
Constant	1.710***	1.346***	1.903***	1.148***	1.718***	1.339***	1.154***
	(0.0828)	(0.0218)	(0.00823)	(0.0849)	(0.0827)	(0.0219)	(0.0848)
Obs.	142341	142341	142341	142341	142341	142341	142341
Country Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yeareffects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Productseffects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.475	0.475	0.475	0.475	0.475	0.475	0.475
loglikelihood	3776	3776	3797	3776	3797	3797	3797
r-squared	0.475	0.475	0.475	0.475	0.475	0.475	0.475
ajusted r-squared	0.474	0.474	0.474	0.474	0.474	0.474	0.474
F statistic	1661	1661	1649	1661	1649	1649	1649

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

According to all the estimated models, the Brazilian GDP coefficient was positive and statistically significant at 5%. It was verified that positive changes in the income of the exporting country positively affected the quality of the Brazilian exports of agricultural products. Thus, the results were consistent with the hypothesis that the higher the income of the countries, the greater the quality of their exported products, since they will be able to make better investments in products, processes, human capital and so on. In this context, Filho, Medeiros and Albuquerquemello (2017), using data on exports from the Brazilian manufacturing industry to 193 commercial partners in the period from 1997 to 2014, also found results that showed the positive effect of GDP on the quality of exported products.

Regarding the distance variable, the estimated coefficients were statistically significant and were positively related to the quality of agricultural products exported by Brazil. Therefore, these results are corroborated by Baldwin and Harrigan (2011),

Johnson (2012) and Bastos and Silva (2010) and indicated that higher quality agricultural products were allocated to more distant trading partners.

For the SPS and TBT notifications issued by the main trading partners to agricultural products, the estimated coefficients were positive and statistically significant. The results showed that countries that impose such measures import higher quality agricultural products. The positive effect may be related to the fact that Brazilian exporters were able to receive the information about the requirements and their benefits related to the safety and quality of products when they were notified with SPS and TBT measures and thus were able to adapt to such resulting in the export of higher quality products.

6. Concluding remarks

The main objective of this research was to analyze the quality of Brazilian agricultural exports considering three issues: (i) what is the effect of export quality on access to new markets?; (ii) what is the effect of quality on the share marketed with the new market in relation to the total exported ?; (iii) what is the effect of quality on the value exported to existing partners (intensive margin measure)?

Among the results obtained for the analyzes related to the trade with new markets, it was identified negative effects of quality both on the probability of accessing new markets and on the share of trade made with them. For the intensive margin, the value exported with existing partners, the estimated coefficients showed that the increase in quality is associated with a higher exported amount. Confirming the hypotheses raised by studies that analyzed the relationship between quality and international trade, this research identified a positive effect of income and distance on quality. In addition, the issuance of SPS and TBT measures by Brazilian importers also led to an improvement in the quality of agricultural products exported by the country.

According to the present study, the relevance of investment in the quality of agricultural products is highlighted so that Brazil can maintain and increase the value of its exports to those countries that are consolidated partners and responsible for absorbing most of the volume directed to the international market. However, while the results have shown that product quality reduces entry into new markets, it is also important to develop policies to help these products, possibly at better prices, to access different markets, making the Brazilian export agenda more dynamic.

As a suggestion for future work it is suggested the sample disaggregation at the Brazilian exporting firms level, which can contribute to obtaining more plausible

estimates, eliminating the possible bias caused by the aggregation of information at the product level. Other measures of product quality can also be considered as a way of analyzing the robustness of the results.

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Appendix A

List of Brazilian importers included in the sample: Angola; United Arab Emirates; Argentina; Australia; Belgium; Bangladesh; Bulgaria; Bolivia; Canada; Switzerland; Chile; China; Cote d'Ivoire; Congo, Rep.; Colombia; Costa Rica; Cuba; Germany; Denmark; Dominican Republic; Algeria; Ecuador; Egypt, Arab Rep.; Eritrea; Spain; Finland; France; United Kingdom; Georgia; Ghana; Gambia; Greece; Guatemala; Hong Kong; Croatia; Indonesia; India; Ireland; Iran; Iraq; Israel; Italy; Jordan; Japan; Kazakhstan; Kenya; Korea; Kuwait; Lebanon; Libya; Sri Lanka; Lithuania; Morocco; Madagascar; Mexico; Mozambique; Mauritania; Mauritius; Malaysia; Nigeria; Nicaragua; Netherlands; Norway; New Zealand; Oman; Pakistan; Peru; Philippines; Poland; Puerto Rico; Korea ; Portugal; Paraguay; Romania; Russian Federation; Saudi Arabia; Sudan; Senegal; Singapore; Sierra Leone; Somalia; Suriname; Slovenia; Sweden; Syrian Arab Republic; Thailand; Trinidad and Tobago; Tunisia; Turkey; Tanzania; Ukraine; Uruguay; United States; Venezuela; Vietnam; Yemen, Rep.; South Africa.