

THE QUALITY OF BRAZILIAN EXPORTS: A CROSS STATE, SECTORAL AND TECHNOLOGICAL CONTENT ANALYSIS

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Abstract

This paper aimed to analyze the evolution of Brazilian exports' quality in an interstate (regional), sectoral and by degree of technological content. The data used correspond to the products exported by Brazilian manufacture industry to 193 countries, between 1997 and 2014. The results showed an increase in the exports' quality of South and Southeast regions of Brazil; in sectors of high and medium technological intensity; in 17 industrial sectors. Although the augment in the quality of these segments, aggregated analysis pointed out no improvement in general exports' quality during the period of study.

Keywords: Brazilian exports. Product quality. Manufacture industry.

JEL Classification: C25, F14, L15.

Resumo

Este artigo objetiva analisar a evolução da qualidade das exportações brasileiras em nível inter-estadual (e regional), setorial e por grau de conteúdo tecnológico. Os dados utilizados correspondem aos produtos exportados pela indústria de transformação brasileira para 193 países, entre 1997 e 2014. Os resultados mostram que houve aumento na qualidade dos produtos exportados pelas regiões Sul e Sudeste do Brasil; nos setores de alto e médio conteúdo tecnológico; e, em 17 setores industriais. Apesar do crescimento da qualidade nesses segmentos, a análise agregada aponta que não houve melhorias na qualidade geral das exportações durante os 17 anos investigados.

Palavras-chave: Exportações brasileiras. Qualidade do produto. Indústria de transformação.

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1 Introduction

Recent studies investigate the importance of product quality in creating comparative advantages and in the direction of trade (HALLAK; SCHOTT, 2011; KHANDELWAL; SCHOTT; WEI, 2013). As a result, rich countries tend to import relatively more from countries that produce high quality goods (SCHOTT, 2004; HALLAK, 2006). Therefore, it is a precondition for the success of exports and economic growth.

Nevertheless, only a few countries are capable of producing and exporting high quality goods. This fact occurs because its production requires the use of quality inputs (MANOVA; ZHANG, 2012; KUGLER; VERHOOGEN, 2012), good institutional background (LEVCHENKO, 2007; FALKOWSKI; CURZI; OLPER, 2015) and a favorable credit market (FAN; LAI; LI, 2015; CIANI; BARTOLI et al., 2015). Factors not always abundant or which detain poor quality in developing countries.

When it comes to Brazil, empirical evidence regarding the quality of exported products and their conditioners remains scarce, even though Brazil remarkable position among the world's largest exporters and importers (IMF, 2012). In addition, it is necessary to explore external market perception of the quality of Brazilian exports, as a way to improve the performance of Brazilian trade balance, especially in industrialized goods.

In this sense, this paper analyzes the evolution of the quality of products exported by the Brazilian processing industry in the period between 1997 and 2014. The main objectives are: i) Investigate if the products' quality has changed; ii) Study the exports' quality standard by degree of technological content and sector; iii) analyze the evolution of exports' quality in each Brazilian state and region.

The approach we used in this study assumes that the quality of exported products is attributed by the foreign consumer, hence, it will seek to measure Brazilian products quality from the importer perception. We hope that this study will contribute to the later incipient literature by establishing commercial and industrial policy suggestions.

Besides this introduction, the present study is structured in five sections. The second section is reserved for a review of empirical literature, and has the purpose of introducing some evidences about the commercialized products quality. The third section shows off the main methodological tools used to analyze Brazilian products quality. The fourth section is dedicated to the presentation of research results and discussions. Finally, a fifth section is devoted to the conclusions.

2 The quality of exports: a brief review

Economists have long been trying to understand what are the cross-country transactions determinants. From the existing literature, it is predominantly cited the existence of comparative advantages, production scales, technology, etc. (HELPMAN, 2011). Recently, a new factor has been focused: the quality of exported goods and services. But what is a quality? How to estimate it? What is its role in determining the volume of goods and services commercialized?

According to Pinheiro, Markwald and Pereira (2002), quality is a multidimensional concept, determined by measurable and immeasurable characteristics. In the first group, we can mention: performance, conformity, durability, appearance, etc. In

the second, we have: tradition, reputation, cultural factors, etc. These aspects are taken into account by economic agents when buying a commodity, thus people around the world are trying to define international acceptance standards for consumer markets, for example through the implementation of ISO certifications.

Data on the quality of internationally traded goods and services are not readily available, this is in part due to the subjective nature of quality, which is difficult to measure. In addition, this information involves different countries, each with its specifics, making this determination even harder. Thus, economists have tried to infer the quality of exports and imports indirectly, by observing other economic variables such as unit prices (HALLAK, 2006; HALLAK; SCHOTT, 2011), market share (KHANDELWAL, 2010) and ISO certification (VERHOOGEN, 2008).

As aforementioned, a commonly used way to measure exports quality is to use unit prices as proxy variables for quality. These unit prices are calculated by dividing the value of exports by the measured quantity. So, the higher the unit prices, the higher is the product quality. According to Helpman (2011), if we also take into account the fact that exports with higher unit prices are generally sold by developed countries, we will found that nations' level of income per capita is positively correlated with exports quality.

However, the use of unit price analysis was contested by several authors, among them, Hallak (2006), who stated that unit prices are very imprecise measures of exports quality, since they may reflect: fluctuations in the costs of production factors, tariffs and taxes; variations in the horizontal products differentiation (in this case, indicating brands diversity rather than variations in quality, in this sense, countries with more diversified exports would have exports with lower unit prices); currency fluctuations.

Given this fact, Hallak and Schott (2011) have developed a methodology that can purge the effects of product diversification from quality measures by conducting a study on exports quality from 43 countries to the United States between 1989 and 2003. However, this analysis is still subject to the other errors aforementioned.

Another way of analyzing the quality of exports has been done by Verhoogen (2008), who, instead of using unit prices, applied quality certifications as proxy variables, to investigate whether there has been an improvement in the quality of products and services exported by Mexico after a currency shock. However, this study has also received considerable criticism because of the assumptions about quality measures which were undertaken.

Last but not least, it is necessary to cite Khandelwal (2010), who applied the model developed by Berry (1994) on American foreign trade data. In his approach, the author was able to improve the estimation of exports quality, considering sectoral aspects and technological levels through the use of a Nested Logit Demand System. Thus, given the occurrence of increases in prices, for example, products that maintain the largest market shares are revealed as the ones with higher quality.

Certainly, this incessant search for a better understanding of products quality and their effects on foreign trade will allow the shaping of trade policies and sectoral incentives, hence, augmenting exports and aiding the economic development of the nation.

3 Methodological procedures

As mentioned in the previous sections, this paper is concerned in inferring products quality from the demand pattern. In this sense, the empirical model was developed from the simple model proposed by [Khandelwal, Schott and Wei \(2013\)](#), which is capable of measuring quality as a demand shock. These disturbances include relevant features which are not observable to the product and/or the market. The model description is presented below.

3.1 Empirical model

Let [Equation 1](#) be a CES utility function, which defines the consumer utility for variety h (product j for exporting country k):

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

where $\sigma(h)$ and $q(h)$ correspond to the quantity and quality level of the variety h sold to country k , while sigma represents the elasticity of substitution. The maximization of utility subject to the budget constraint results in [Equation 2](#) and [Equation 3](#) of demand:

$$U = (\varphi_{jik}^{\sigma-1})(p_{jk})^{\sigma} P_{jk}^{\sigma-1} Y_k. \quad (2)$$

where p_{jik} is the price of the good j sold by state i to country k ; P_{jk} and Y_{jk} represents the price index and income in sector g of country k , respectively. When Applying ln to [Equation 2](#), we obtain [Equation 3](#):

$$\ln q_{jk} + \sigma * \ln p_{jk} = \alpha_j + \alpha_k + e_{jk}. \quad (3)$$

where on the left side α_k and α_j refer to the fixed effects of the product and buyer country, respectively. In turn, the disturbance term is represented by e_{jk} . Thus, the quality of the exported product is inferred dividing the residuals of [Equation 3](#) by product j elasticity of substitution in country k minus one, as presented in [Equation 4](#):

$$quality = \hat{\sigma} \equiv \frac{\hat{e}_{jk}}{(\sigma - 1)}. \quad (4)$$

We estimate [Equation 3](#) separately to each pair of countries (importer-industry) through Ordinary Least Squares (OLS).

[Schott \(2004\)](#), [Hallak \(2006\)](#) and [Khandelwal \(2010\)](#) encontraram evidências que a qualidade das exportações depende do nível de desenvolvimento econômico do país exportador, we use the specification that relates quality and exporter's GDP per capita:

$$quality_{ht} = \alpha_{ht} + \beta * \ln Y_{it} + \nu_{ht}. \quad (5)$$

where $quality_{ht}$ is the estimated quality of state i 's export in product j (variety h) at time t and Y_{it} is state c 's GDP per capita. The inclusion of a product-year dummy, α_{ht} , indicates that the regression considers the cross-sectional relationship between quality and income within products. We run the regression for [Equation 5](#) to prove that rich state, on average, export higher quality varieties within products.

3.2 Data

Data collected from the Foreign Trade Secretary (SECEX) of the Ministry of Industry, Commerce and Services (MDIC) correspond to the period from 1997 to 2014 and are disaggregated to 8 digits, according to the Mercosul Common Nomenclature (NCM). The database has more than 600,000 observations and contains information on 2410 products exported by Brazil to 193 countries. The products under 8-digit NCM classification were mapped in 25 industries according to the International Standard Industrial Classification of All Economic Activities (ISIC), revision 4, through correspondence tables provided by the Brazilian Institute of Geography and Statistics (IBGE).

Then, we estimate [Equation 3](#) using the elasticities of substitution provided by [Broda, Greenfield and Weinstein \(2006\)](#), available at 3 digits under Harmonized System (HS). The correspondence between the elasticities and export databases was carried out using the 3-digit classification, since the first 6 digits of the NCM belong to the HS classification.

Finally, after inferred the levels of quality, it was undertaken an analysis disaggregated by states (regions), types of industry and technological intensity of the exported product. The latter typifies the degree of technological content of the products exported in four classes: high, medium-high, medium-low and low. This distinction comes from the Organization for Economic Cooperation and Development (OECD), which ranked industrial sectors according to their relative level of expenditure on research and technological development (R & D).

4 Results

This section is dedicated to presenting and discussing the quality of Brazilian exports from 1997 to 2014. In this sense, [subsection 4.1](#) brings an analysis of the temporal behavior of Brazilian exports quality. In [subsection 4.2](#) is carried out a discussion about the quality of Brazilian exports by technological intensity. [subsection 4.3](#) presents the results for the products exported by each Brazilian state. Finally, [subsection 4.4](#) deals with the stratification of the quality of Brazilian exports by industrial sector.

4.1 The quality of Brazilian exports (1997-2014)

Figure 1 presents a box plot¹ which shows the distribution of the quality of Brazilian exports from 1997 to 2014. Three phases can be identified: decline (1997-2003), recovery (2004-2008) and stabilization (2009-2014).

The first phase, 1997 to 2003, is marked by the reduction of the quality of products exported by Brazil. A number of factors may explain this phenomenon: adverse

¹ In this box plot, the square height express the quality differential between the exported products (Quality Ladder) – so that, a bigger box demonstrate that the exports quality varies a lot among themselves –, the line within each box represents the median of quality and the little diamonds express the quality average for every year of the study. The points above and below each box denotes the outliers and inliers of the historical series, respectively.

external conditions (Russian, Mexican and Argentine crises)²; decrease in indicators of human capital; lack of industrial and technological policies.

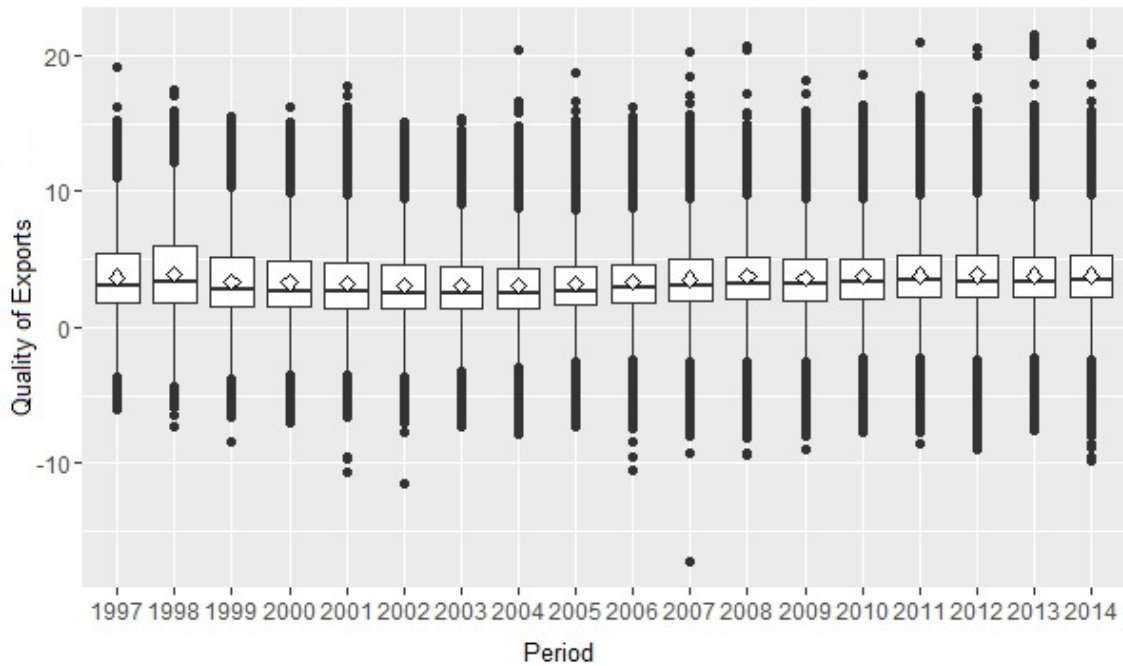


Figure 1: Brazilian manufacturing industry exports quality.
Source: authors' elaboration.

In the second phase, 2004 to 2008, the results suggest an augment of products quality. This fact may be related to the growth of productivity and human capital indicators, exchange rate appreciation (what reduces the cost for importing inputs) and the implementation of Industrial Policy and Foreign Trade (PITCE), in 2004. The latter aimed to strengthen and expand industrial base through innovation and value added to Brazilian processes, products and services. In addition, in this phase the taxation of product innovation grew in relation to the first phase (1997-2003), moving from 18.96% to 35.73%, on average (CAVALCANTE; NEGRI, 2011).

In the third and last phase, from 2009 to 2014, was perceived a stagnation of quality levels. This fact is perhaps due to: the US Financial Crisis in 2008 (which negatively affected some relevant factors to the growth of Brazilian products quality, such as the exchange rate); reduction in the rate of product innovation (36.5%) and decrease of productivity; creation of the Productive Development Policy (PDP), launched in May 2008, and the Plano Brasil Maior, launched in August 2011³.

In general, Brazilian exports did not show any signs of quality upgrading during the period analyzed. This result highlights the need for new trade, industrial and technological policies. However, when it comes to quality ladders (the degree of quality differentiation among products), we have that after 1998 a reduction in the heterogeneity have been found. This fact instigates an investigation of the quality behavior by technological content, helping to comprehend if that bigger homogeneity is devoted to

² During external crises, dollar depreciates, hence increases the costs of acquiring inputs and/or stimulates their substitution for poor quality inputs, which are cheaper.

³ These plans were sought to combat the negative effects of the crisis by adopting measures of protectionism or sectoral incentive, as mentioned by Almeida (2011) and Morais (2008).

production and exportation of a higher percentage of primary products or industrialized goods, which have technology added to its value.

4.2 Technological content and product quality

Figure 2 shows the behavior of the quality of Brazilian exports by technological content. The results point out an increase in the exports quality of high and medium-high technology goods, between 1998 and 2014, only decreasing in 2002⁴. However, low and medium-low-tech goods fell in quality in 2014 compared to 1998.

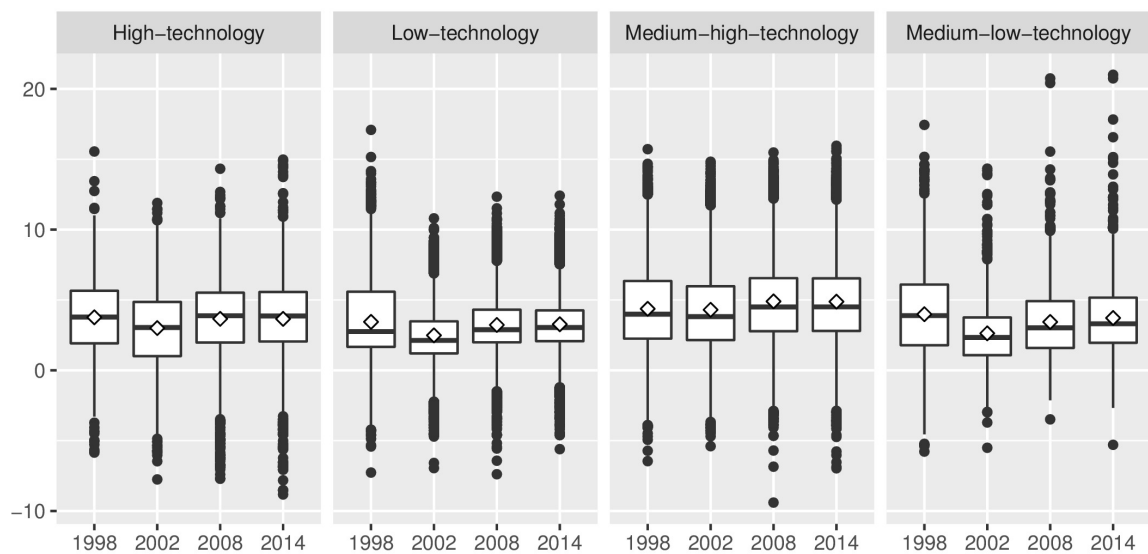


Figure 2: Brazilian exports quality by technological intensity.
Source: authors' elaboration.

According to [Curzi, Raimondi and Olper \(2014\)](#), that increment in the quality of high-tech products may have relation to the productivity gains of bigger commerce. For [Henn, Papageorgiou and Spatafora \(2013\)](#), this quality upgrading stems from the fact that in these sectors occurs a flow of knowledge whenever a quality improvement happens. Thus, development and enhancement of techniques and inputs, for example, is rapidly disseminated among firms in the industry.

When it comes to the quality reduction in products of Low and Medium-low technology, [Henn, Papageorgiou and Spatafora \(2013\)](#) say that exist a lot of exogenous influence in these sectors, for example, climatic variations, or the degree of availability of minerals. Moreover, the mere fact of the low value-added of these goods discourages the search for productivity gains in these sectors. The authors suggest that countries suffering from this problem should diversify their export agenda.

⁴ According to [Negri et al. \(2005\)](#), this is due to the fact that between 2000 and 2003 Brazilian exports of high technology products seem not to be influenced by product innovations. Thus, the Brazilian industry with high technological content faced difficulties or lacked interest in improving products quality.

4.3 Cross-states and regional differences

Among the 27 federated units of Brazil (including the Federal District, Brasília), it is observed that only seventeen exhibited quality upgrading over the years of the study (1998-2014), namely: Acre, Alagoas, Amapá, Ceará, Distrito Federal, Mato Grosso, Minas Gerais, Pará, Pernambuco, Rio de Janeiro, Rio Grande do Norte, Rio Grande do Sul, Rondônia, Roraima, Santa Catarina, São Paulo, Sergipe and Tocantins. This result can be observed in the table 1.

Table 1: Exports quality by Brazilian states.

State	1998			2014			Situation
	Average	Median	Ladder	Average	Median	Ladder	
Acre	5,26	6,15	2,27	5,77	6,58	2,78	+
Alagoas	5,47	5,28	0,62	5,23	6,15	0,20	+
Amapá	3,56	3,78	0,69	6,26	6,83	1,63	+
Amazonas	3,23	3,07	4,54	1,88	1,73	5,18	-
Bahia	5,55	6,20	1,71	3,58	2,89	2,71	-
Ceará	2,89	2,06	1,68	2,29	2,22	1,35	+
Distrito Federal	3,70	2,83	2,34	3,34	3,13	2,14	+
Espírito Santo	4,38	4,65	4,25	4,05	3,80	2,01	-
Goiás	4,62	5,18	5,01	3,80	3,16	5,55	-
Maranhão	5,62	5,08	2,85	4,60	2,91	5,06	-
Mato Grosso	5,49	5,80	1,72	5,98	6,64	1,23	+
Mato Grosso do Sul	4,57	5,27	3,94	3,68	3,05	3,45	-
Minas Gerais	3,96	3,62	3,64	3,93	3,78	2,62	+
Pará	5,90	6,13	1,02	5,75	6,59	3,37	+
Paraíba	2,69	2,16	1,70	2,01	1,73	1,44	-
Paraná	4,47	4,48	3,59	4,26	3,85	3,15	-
Pernambuco	2,48	1,82	2,18	2,89	2,34	2,58	+
Piauí	5,03	4,14	5,54	3,97	3,28	2,53	-
Rio de Janeiro	3,51	2,70	4,34	3,92	3,78	2,13	+
Rio Grande do Norte	2,48	1,92	1,96	3,05	2,63	2,69	+
Rio Grande do Sul	3,56	3,11	3,19	3,78	3,53	2,41	+
Rondônia	3,89	6,07	0,85	5,15	6,53	4,47	+
Roraima	5,64	5,57	0,66	5,05	6,86	4,10	+
Santa Catarina	3,41	2,63	4,02	3,52	2,95	2,66	+
São Paulo	3,90	3,36	4,18	3,96	3,54	3,29	+
Sergipe	4,51	4,87	4,49	3,48	2,81	3,46	-
Tocantins	2,97	2,29	0,22	3,20	2,84	0,25	+
BRASIL	3,87	3,37		3,82	3,43		+

Source: authors' elaboration. Note: Ladder means the quality variation in a given year. In this sense, it means the quality differentiation between the higher and the lower quality indicator. Situation indicates a variation of the median quality between the last and the first year of study. The plus sign represents an increase in quality whilst minus sign means the opposite.

In North, the states of Acre, Amapá, Pará, Rondônia, Roraima and Tocantins presented an improvement in the quality of their exported products (table 1). When it comes to the Northeast region, four of the nine states showed quality upgrading, namely: Alagoas, Ceará, Pernambuco and Rio Grande do Norte. In the Middle-West, only the Brasília and Mato Grosso demonstrated quality upgrading. In the most developed regions of the country, South and Southeast, only Paraná and Espírito Santo did not present quality upgrading, in the last seventeen years. Appendix A presents a boxplot with the analysis of Brazilian exports quality by federated unit (similarly to subsection 4.1 and subsection 4.2).

With the results presented previously, it can be seen that the states with higher GDP (São Paulo, Rio de Janeiro and Minas Gerais, respectively) obtained a greater improvement in the quality of their exports. The Appendix C shows the Federated

Units GDP per capita variation. To test this hypothesis we estimate Equation 4. 2 presents the results of this estimation.

Table 2: Export quality and GDP per capita: OLS estimates

Variables	Coefficient	Std.Dev
Ln(GDP)	0.2450***	(0.0000)
Constant	1.0966***	(0.0000)
N	424673	
R^2	0.7075	
Product-year FE	YES	

Source: authors elaboration. *** indicates significance at 1% level or higher.

It shows that the coefficient on the exporting state's GDP per capita is positive and statistically significant. Richer states, on an average, export higher quality varieties, within products. Thus, these results are consistent with the hypothesis that more advanced states (or countries) will manufacture higher quality products (SCHOTT, 2004; HALLAK, 2006; KHANDELWAL, 2010).

4.4 Sectoral differences

According to table 3, among the twenty-three group of products exported by Brazilian industrial sector, seventeen showed quality upgrading, namely: Aircraft, Beverages, Leather artifacts, Computer accessories, Timber, Equipments, Electrical machines, Metallurgy, Furniture, Other, Rubber products, Metal products, Tobacco products, Minerals, Automobiles, Railway vehicles and Clothing.

In particular, we highlight Aircraft exports, once these not only presented quality upgrading, but it also had the highest average and median among all industrial products in 2014. In addition, this group of products is very representative on Brazilian exports agenda. On the other hand, Maritime Vessels showed a decrease in quality, once in 1998 it had a greater average and median than in 2014. These results can be seen on table 3. Appendix B presents a boxplot with the analysis of Brazilian exports quality by industrial sectors.

Also according to table 3, it is observed that the beverage class has the lowest average and median in 1998, as well as in the last year of analysis, 2014.

Therefore, although Brazil is considered a developing country, having in its export agenda a great representative less of primary products, we observe that its industrial sector has shown improvement. In this sense, as suggested by Khandelwal (2010), one of the ways to gain productivity on commerce and increase the export revenues, is the diversification of products. Still according to this author, the potential for quality upgrading tends to be higher in manufactured products when compared to primary products.

Table 3: Exports quality by industrial sector.

Industry	1998			2014			Situation
	Average	Median	Ladder	Average	Median	Ladder	
Aircraft	7,01	7,27	3,66	10,96	11,11	4,75	+
Beverages	0,85	0,33	1,28	0,96	0,82	1,24	+
Cellulose, paper	4,63	5,88	2,66	3,97	3,97	0,84	-
Leather artifacts	2,24	2,36	1,12	2,88	2,90	1,50	+
Crude oil derivatives	5,15	5,80	2,60	3,13	1,36	6,82	-
Maritime Vessels	10,05	8,52	7,50	9,19	8,51	4,34	-
Computer accessories	3,70	3,79	3,97	3,69	3,94	3,76	+
Timber	5,74	5,96	1,01	6,04	6,25	1,63	+
Equipments	5,13	4,77	4,68	5,82	5,49	4,31	+
Electrical machines	2,87	2,65	3,59	3,53	3,41	3,71	+
Metallurgy	5,75	6,17	1,35	9,37	10,14	0,09	+
Furniture	3,99	4,02	1,39	4,29	4,28	1,30	+
Other	2,28	1,89	4,15	2,42	2,19	2,86	+
Foods	6,44	6,89	2,43	6,87	6,37	1,16	-
Rubber products	3,22	3,05	3,19	3,91	4,14	1,91	+
Metal products	3,88	3,89	3,44	4,32	4,67	3,65	+
Tobacco products	3,04	2,50	0,50	2,79	3,20	1,51	+
Minerals	2,68	1,79	2,36	2,31	2,27	1,46	+
Chemicals	5,52	6,16	2,90	1,93	2,25	2,31	-
Textile	3,46	2,95	3,14	3,27	2,93	2,16	-
Automobiles	3,46	3,13	2,08	4,28	4,07	2,79	+
Railway vehicles	4,16	3,69	4,20	5,90	5,53	4,78	+
Clothing	1,95	1,96	1,30	2,95	2,86	1,56	+

Source: authors' elaboration. Note: Ladder means the quality variation in a given year. In this sense, it means the quality differentiation between higher and lower quality indicator. Situation indicates a variation of the median quality between last and first year of study. The plus sign represents an increase in quality whilst minus sign means the opposite.

In the empirical literature, other studies give support to the idea of diversifying the export agenda. [Baldwin and Robert-Nicoud \(2014\)](#), for example, mention that once China is one of the top exporters in the segment of Electronics, one way to improve its exports quality with low cost is investing in other sectors.

5 Conclusions

This paper analyzed the quality of Brazilian exports from 1997 to 2014. In a more aggregated way, it can be concluded that the quality of goods exported by Brazil remained practically unchanged during the study period, with exceptions for the years 2002 and 2008, when a reduction in it was found. However, these declines should not be taken into account, since they are probably correlated with the international macroeconomic situation, for example, the Subprime crisis in 2008.

It is also important to point out that, although the general quality of exports remained at the same level, the amount exported in that period more than tripled. According to SECEX (2016), in 1997 Brazil exported approximately US\$ 48,448 billion whilst in 2014 US\$ 207,610 billion. This fact is very relevant as maintaining the level of quality while strongly intensifying foreign trade is often problematic.

When it comes to the disaggregated analysis by degree of technological intensity employed in the production of the exports, we have two situations. On one hand, sectors technology-intensive (High and Medium-High) showed quality upgrading between 1997 and 2014. On the other hand, sectors of Low technological content (Low and Medium-Low) presented a reduction in the quality of their products. These facts were expected, given the review of the empirical literature, but they need to be investigated more

deeply, to discover its reasons. The quality ladder did not vary very much in high-tech sectors, but it decreased in low-tech ones. This evidence is probably related to the death of commercial relations involving poor quality products, what results in a greater homogeneity in the exports quality of these sectors.

Regarding the quality of exports by Brazilian states and regions, the study pointed out that only seventeen of all the Brazilian federated units presented quality upgrading throughout the period 1998-2014. The states that presented improvements in quality are: Acre, Amapá, Pará, Rondônia, Roraima and Tocantins (North Region); Alagoas, Ceará, Pernambuco and Rio Grande do Norte (Northeast Region); Distrito Federal, Goiás and Mato Grosso (Middle-West Region); Minas Gerais, Rio de Janeiro and São Paulo (Southeast Region); Rio Grande do Sul and Santa Catarina (South Region).

This increase in quality is due to the fact that localities with high GDP per capita are more susceptible to improvements in the standard quality of their products, since they have high capital-labor, high innovation tax and high capital human level. This evidence is very important, once an increase in the product quality implies an increase the inter-regional inequalities. Thus, it is necessary directing resources and public policies in favor of advances in the quality of exports in less developed regions of the country have greater efficiency.

In relation to the quality of Brazilian exports by industrial sector, it is verified that seventeen of the 23 classes of products exported showed improvement in their quality. They were: Aircraft, Beverages, Leather artifacts, Computer accessories, Timber, Equipments, Electrical machines, Metallurgy, Furniture, Other, Rubber products, Metal products, Tobacco products, Minerals, Automobiles, Railway vehicles and Clothing. Aircraft was the class that presented the highest quality upgrading. It also had the highest average and median quality among all classes.

In summary, although the aggregate analysis did not detect high standards of quality upgrading in Brazilian exports, relative improvement was found in terms of technological content, regional and sectoral production. This fact corroborates the intensification of public policies, specially those which encourage the diversification of production or offer an incentive to less developed regions.

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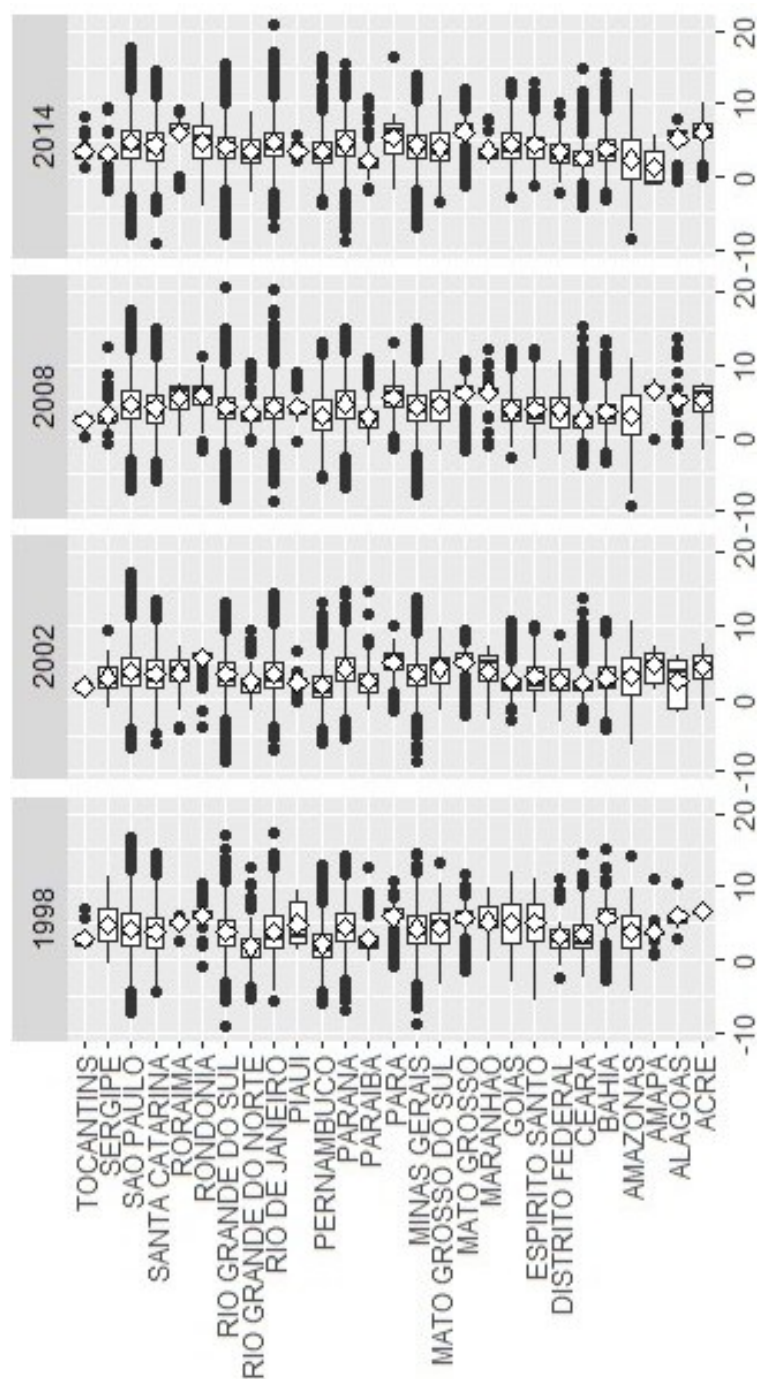
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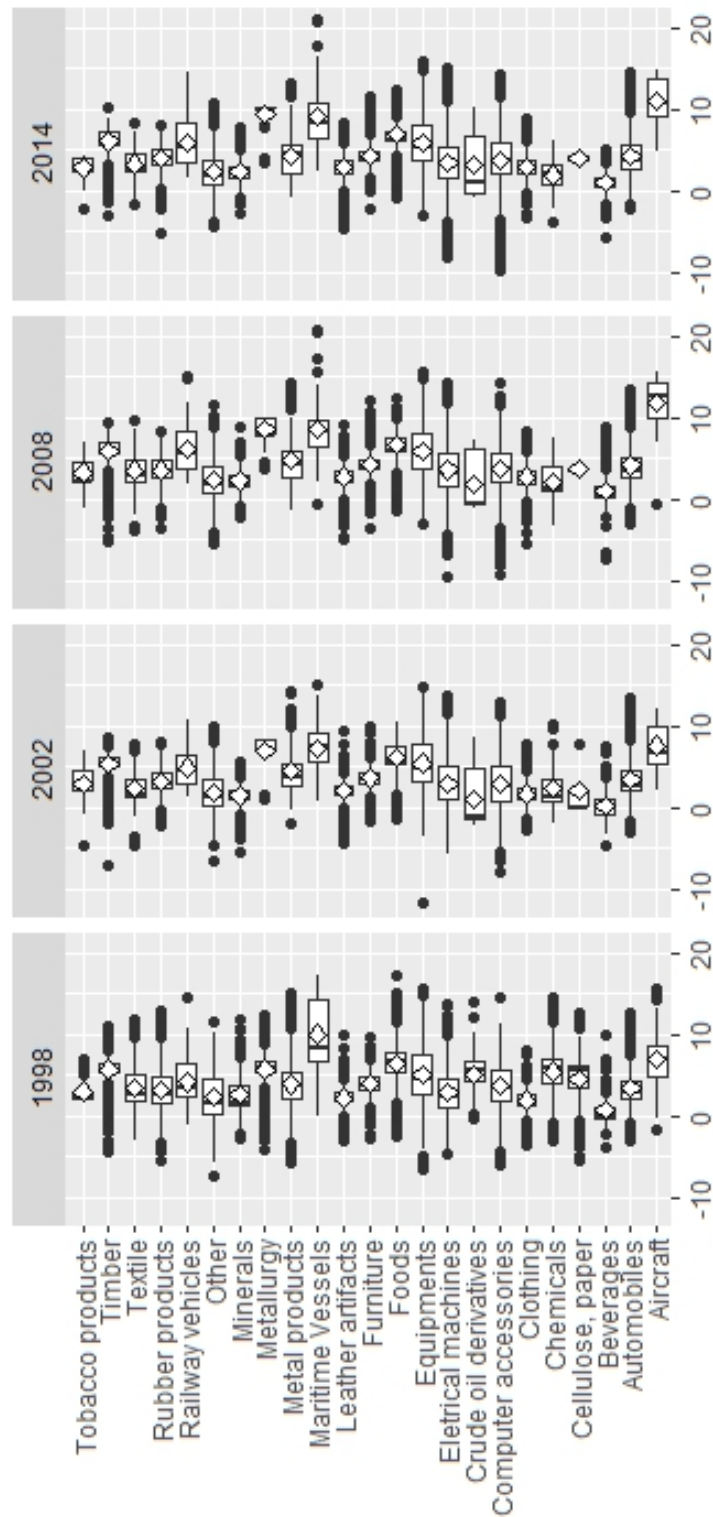
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APPENDIX A – Brazilian exports quality by Federated Unit.



Source: authors' elaboration.

APPENDIX B – Brazilian exports quality by Industrial sectors.



Source: authors' elaboration.

APPENDIX C – GDP per capita variation of Brazilian states:
1998-2011 (%).

Region/State	1998	2011	Variation (%)
Brazil	339,07	465,97	37,43
Northeast	61,21	85,42	39,55
Maranhão	4,68	7,34	56,84
Piauí	4,75	7,33	54,32
Ceará	6,97	9,64	38,31
Rio Grande do Norte	7,93	10,55	33,04
Paraíba	5,71	8,74	53,06
Pernambuco	7,91	11,01	39,19
Alagoas	6,45	8,49	31,63
Sergipe	8,86	11,72	32,28
Bahia	7,95	10,6	33,33
North	65,81	93,75	42,46
Rondônia	8,74	16,51	88,90
Acre	8,39	11,02	31,35
Amazonas	12,36	17,06	38,03
Roraima	10,66	14,12	32,46
Pará	7,99	10,74	34,42
Amapá	9,59	12,25	27,74
Tocantins	8,08	12,05	49,13
South	53,96	69,27	28,37
Paraná	15,31	21,29	39,06
Santa Catarina	20,14	25,02	24,23
Rio Grande do Sul	18,51	22,96	24,04
Middle-West	83,65	116,31	39,04
Mato Grosso do Sul	12,98	18,58	43,14
Mato Grosso	11,68	21,71	85,87
Goiás	11,80	17,11	45,00
Distrito Federal	47,19	58,91	24,84
Southeast	74,44	101,22	35,98
Minas Gerais	13,67	18,3	33,87
Espírito Santo	15,57	25,75	65,38
Rio de Janeiro	21,30	26,83	25,96
São Paulo	23,90	30,34	26,95

Source: adapted from IBGE.