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PRODUCTION EVOLUTION AND EXPORT PERFORMANCE OF BRAZIL NUT IN THE BRAZILIAN AMAZON

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Abstract

The Brazil nut is an important Brazilian socio-biodiversity commodity. This article analyzes production behavior and exports in the Brazilian Amazon, identifying factors that have conditioned this market behavior. Brazil nut production is concentrated in Acre, Amazonas, Pará and Rondônia states, which together account for 93.5% of Brazilian production. There is evidence of the exhaustion of native Brazil nut tree exploitation, since the extractive supply did not respond to price stimuli in recent decades. Export revenues declined, due to a reduction in quantities exported and to real exchange rate appreciation. Public funding policies and price guarantee had a limited effect on care of the Brazil nut extractivist population. This study shows that changes in sanitary regulation and Brazil nut quality control in the main trading partners had a negative effect on export performance, mainly from 2003.
Keywords: *Commodity, marketplace, public policy, socio-biodiversity, vegetal extractivism*
JEL Codes: *F14, Q17, Q23*

1. Introduction

The Brazil nut is one of the most traditional export products of the Amazonian extractive economy. Until 1998, Brazil was the world's largest producer, with 52% of the total. However, this participation had already reduced, since in the early 1970s it reached 89%. Since then, production has been declining and in 2011 represented only 39% of the world total. Currently, Bolivia ranks first in terms of production and exports, accounting for 47% and 37%, respectively, of the world total (Food and Agriculture Organization of the United Nations (FAO), 2013).

In Brazil, Brazil nut extraction is concentrated in the Amazon states, where Acre, Amazonas, Pará and Rondônia are the most representative today, accounting for 93.5% of national production in 2011; 6.5% is distributed among Amapá, Mato Grosso and Roraima states (Instituto Brasileiro de Geografia e Estatística (IBGE), 2013). In all these states, it is a product of great socioeconomic importance, as it sustains a value chain involving traditional

communities, commercial agents, companies, and governmental and non-governmental institutions.

The Brazil nut market has undergone profound transformations, mainly during the last two decades. The factors involved are economic, environmental, social, legal and public policy. But the results are mainly reflected in market performance in terms of production and exports that define the income of different actors in the value chain.

From this perspective, the objective of this work was to evaluate Brazil nut production behavior and exports in the last two decades, in order to identify the factors that are conditioning this market performance in terms of production, exports and the instrumental effects of public funding policies and price guarantee.

The paper is structured in four sections, including this introduction. The work methodology is described below. The Results and Discussion section evaluates the historical behavior of national production and prices in the last eight decades and spatial distribution in the last two decades. Exports are also evaluated, identifying the factors that define their performance. This section also includes an analysis of financing and price guarantee policies for Brazil nuts. In the last section, the conclusion of the work is presented.

2. Method

The information used was obtained from the FAO – FAOSTAT (2013); the Brazilian Institute of Geography and Statistics (IBGE) – IBGE Automatic Recovery System – SIDRA (2013); the Ministry of Development, Industry and Foreign Trade (MDIC) – Aliceweb Foreign Trade System (2013b); the Getúlio Vargas Foundation (FGV) – FGVDados (2013); and the Institute for Applied Economic Research (IPEA) – IPEADATA (2013).

To analyze production and price behavior, we used: growth rate estimation using semi-logarithmic linear regression models; correlation analysis between production and Brazil nut prices; and Student's t-test to measure the significance level of growth rates and correlation coefficients between variables. Nominal Brazil nut prices were deflated by FGV's General Prices Index – Internal Availability (IGP-DI) (base: December 2012 = 100).

Evaluation of export performance was carried out using the shift-share method, using the methods of Silva and Carvalho (1995); Pires, Gomes, Alves and Rosado (2005); Zugaib (2008); and Ferreira, Teixeira and Souza (2009), who analyzed the export revenue performance of various agricultural commodities in Brazil. This method allows evaluation of the export performance and identification of the influence of international prices, exchange rates and export quantities.

This work analyzed the period from 1989 to 2012. Brazil nut exports with and without bark were analyzed, according to the specifications of Mercosul Common Nomenclature (MDIC, 2013a). Data on export quantities, prices and export revenue were obtained from the MDIC Aliceweb System (MDIC, 2013b). The following is a brief description of the method.

The Brazil nut export revenue in the initial (0) and end (t) periods are given by the following equations.

$$R_0 = Q_0.(P_{US\$0}.\lambda_0) \quad (1)$$

$$R_t = Q_t.(P_{US\$t}.\lambda_t) \quad (2)$$

where R_0 and R_t are Brazil nut export revenue, in R$, in periods 0 and t; Q_0 and Q_t are the quantities of Brazil nut exported in tons during periods 0 and t; $P_{US\$0}$ and $P_{US\$t}$ are prices received by Brazil nut exporters, in US$ per ton, in periods 0 and t; and λ_0 and λ_t are the real exchange rates, in R$/US$, in periods 0 and t.

The real exchange rate was calculated using equation 3.

$$\lambda = e.\frac{IPC_{USA}}{IGP_{BR}} \quad (3)$$

where e is the nominal exchange rate (R$/US$); IPC_{USA} is the United States Consumer Price Index and IGP_{BR} is the Prices General Index – Internal Availability. The nominal exchange rate and price indices of the United States (IPC_{USA}) and Brazil (IGP_{BR}) were obtained from IPEA (2013) and FGV (2013).

The price effect captures the variation in export revenue that occurred due to variation in the international Brazil nut price in US$. The exchange rate effect evaluates the effect of exchange rate variation on revenue. The equations used in this calculation are specified below:

$$R_t^P = Q_0.(P_{US\$t}.\lambda_0) \quad (4)$$
$$R_t^\lambda = Q_0.(P_{US\$t}.\lambda_t) \quad (5)$$

The total effect or total variation in Brazil nut export revenue between periods t and 0 is given by equation 6.

$$R_t - R_0 = (R_t^P - R_0) + \left(R_t^\lambda - R_t^P\right) + \left(R_t - R_t^\lambda\right) \quad (6)$$

wherein:

$(R_t - R_0)$ is the total variation in Brazil nut export revenue, in R$, between periods 0 and t;

$(R_t^P - R_0)$ evaluates the contribution of international price to the variation in Brazil nut export revenue (price effect);

$\left(R_t^\lambda - R_t^P\right)$ evaluates the contribution of real exchange rate to the variation in Brazil nut export revenue (exchange rate effect); and

$\left(R_t - R_t^\lambda\right)$ evaluates the contribution of variation in export quantities to Brazil nut revenue.

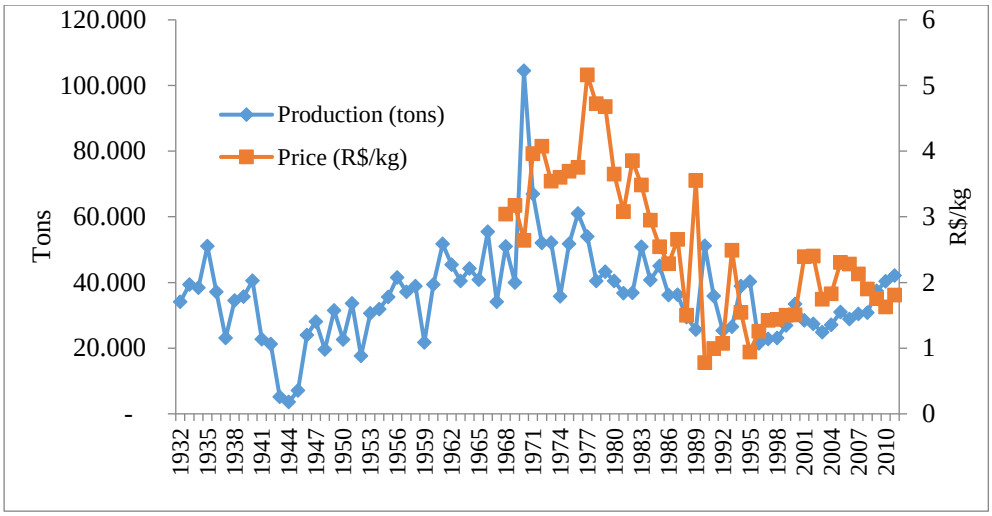
3. Results and Discussion

3.1. Evolution and Spatial Distribution of Brazilian Production of Brazil Nuts

3.1.1. Historical Behavior of Production and Prices

Brazil nut production behavior, which has been influenced by several factors, can be observed in Figure 1. Analyzing the data available for the last 80 years (1932–2011), four distinct sub-periods are observed. The first marked a sharp fall in production beginning in the early 1930s and extending into the mid-1940s. At this stage, production declined at a rate of 14.6% per year. Production in 1945 represented only 13.95% of the total in 1935, the greatest volume-producing year in this sub-period. This fall was mainly motivated by displacement of the extractive labor force due to the war effort, aiming to increase the rubber supply (Carvalho, Ferreira, & Homma, 1994; Homma, Carvalho, Ferreira, & Nascimento, 2000).

The second phase began in 1945 and lasted until the early 1970s. During this period, the production growth rate was 4.9% per year; the peak occurred in 1970, when 104,400 tons were produced, the highest value observed in history. This was a phase of Brazil nut extraction recovery after World War II, and also marks a period in which large population contingents were mobilized to the Amazon because of directed colonization programs and infrastructure works.



Source: IBGE (2013).

Figure 1. Behavior of Brazil Nut Production and Real Prices, 1932–2011

In 1970, a prolonged phase of decline in production began, extending to 1990. During this period, production and prices showed the same declining trend. It is the phase with the greatest impact on Brazil nut tree stocks due to the progress of deforestation for timber extraction, planting and pasture formation, as well as mining, road construction and hydroelectric projects. According to Santana and Khan (1992), this period was the peak of deforestation, burning, logging, road opening and large agricultural and livestock projects; price and quantity fluctuations are well accentuated.

The fourth phase began in 1990 and extends to the present and marks the stagnation of production. Between 1990 and 2011, real Brazil nut prices grew at a rate of 3.18% per year; however, production did not respond to this stimulus, since its growth rate was only 0.28% per year and was not statistically significant (Table 1). This situation characterizes Brazil nuts as a supply product perfectly inelastic to prices, which leads to the possible occurrence of native Brazil nut tree stock depletion (Homma, 1993), due to deforestation in the southeast and part of the west of Pará state, and in Acre and Rondônia states, or the remaining stocks not being in areas accessible for collection by extractive communities.

3.1.2. Spatial Concentration of Production

Currently, Brazil nut production is concentrated in Acre, Amazonas, Pará and Rondônia states, which in 2011 accounted for 93.5% of national production. Until 1983, Pará state stood out as the largest national producer. In that year, it accounted for 45.12% of national production. From this year onwards, production in Pará state began to show a strong decline and during the last two decades, production decreased at a rate of 2.64% per year (Table 1). In 2011, state production represented only a third of the total in 1983 (IBGE, 2013).

Table 1. Brazil Nut Growth Rates and Correlation Coefficients between Price and Quantity, 1990–2011

State	Production growth rate (%aa)	Price growth rate (%aa)	Correlation coefficient between price and quantity
Rondônia	6.26*	−1.05^{ns}	−0.2746^{ns}
Acre	0.26^{ns}	1.79^{ns}	0.3678^{ns}
Amazonas	5.51^{ns}	6.26*	−0.3202^{ns}
Roraima	8.57*	−2.9*	−0.6940*
Pará	−2.64*	2.18*	−0.1981^{ns}
Amapá	−7.38*	−3.47*	0.4280**
Mato Grosso	6.05*	−0.10^{ns}	−0.0248^{ns}
Brazil	0.28^{ns}	3.18*	−0.3278^{ns}

Source: Prepared by the authors based on IBGE data (2013).
Note: (*) and (**) indicate significance at the 1% and 5% error probability levels according to Student's t-test. (ns) indicates not significant.

Nowadays, Acre and Amazonas states are the largest producers of Brazil nuts. In the last two decades, each accounted for about 30% of the total produced in Brazil. Other states that also produce Brazil nuts are Amapá, Rondônia, Roraima and Mato Grosso. In the early 1990s, these four states accounted for 8.6% of the total and currently account for 14%. This performance is due to the increase in production observed in Rondônia and Mato Grosso, which showed growth rates of approximately 6% per year, since production in Amapá decreased by an average of 7.38% per year (Table 1).

In the period 1990–2011, the real prices received by Brazil nut extractors showed an average growth of 3.18% per year. However, production did not respond to price stimuli, since total production in 2011 was 18% lower than in 1990. Table 1 also shows the correlation coefficients between the price and quantity of nuts produced per state. According to microeconomic theory, the expectation is that correlations between price and quantity produced are positive *ceteris paribus*. To measure the coefficient's statistical significance level, Student's t-test was used, considering significance levels of 1% and 5% error probability.

Table 2. Evolution of Production and Number of Specialized Municipalities in Brazil Nut Extractivism, 1990–2011

States	1990		1995		2000		2005		2011		Variation (%)	
	N[1]	Quant.[2]	N	Quant.	N	Quant.	N	Quant.	N	Quant.	1990-2011	
Acre	6	17,483	10	8,818	8	8,139	12	11,141	12	14,036	100.00	-19.72
Amapá	1	2,250	1	1,858	3	1,639	3	860	3	400	200.00	-82.22
Amazonas	27	12,445	21	15,381	26	7,746	24	8,763	32	14,272	18.52	14.68
Mato Grosso	4	634	1	87	0	0	2	161	10	1,707	150.00	169.24
Pará	20	15,617	22	11,161	21	7,716	14	5,112	19	6,042	-5.00	-61.31
Rondônia	7	1,276	1	401	3	6,356	4	2,571	3	3,379	-57.14	164.81
Roraima	1	7	0	0	0	0	0	0	0	0	-100.00	-100.00
Total	66	49,712	56	37,706	61	31,596	59	28,608	79	39,836	19.70	-19.87

Source: Prepared by the authors based on IBGE data (2013).
Note: ([1]) indicates the number of specialized municipalities and ([2]) indicates quantity produced (tons).

The results show that in regional terms the correlation coefficients are not significant, that is, price and quantity are not related. This means that Brazil nut production is perfectly inelastic to prices. In economic terms, it means that even if prices increase, there will be no response in terms of increasing the volume produced. This situation occurs when the natural resource is close to stock exhaustion, a situation that is valid for the Brazil nut case.

The spatial concentration of Brazil nut production (Table 2) was measured using the standard concentration index (ICN) calculated for 1990, 1995, 2000, 2005 and 2011, according to the methodology described by Haddad (1989) and Santana (2004). The selection criterion adopted was that municipalities specializing in Brazil nut production have a higher than average ICN.

In 1990, 66 municipalities specializing in Brazil nut extraction were identified, accounting for 97.1% of national production. These municipalities were concentrated in Amazonas (27), Pará (20) and Acre (6). In 2011, there was a 19.7% increase in the number of specialized municipalities, which increased from 66 in 1990 to 79 in 2011. The largest increases were observed in Amazonas, which went from 27 to 32 municipalities, and in Acre, from 6 to 12 municipalities. Increases were also observed in Mato Grosso and Amapá states. And in Pará state, there was a reduction in the number of municipalities.

Although there was an increase in the number of municipalities, there was no response in terms of increased production. In fact, there was a fall of 19.87% in the quantity produced by these specialized municipalities, corroborating the affirmation that the limit of native Brazil nut tree stocks is being reached.

3.2. Brazilian Export Performance of Brazil Nuts

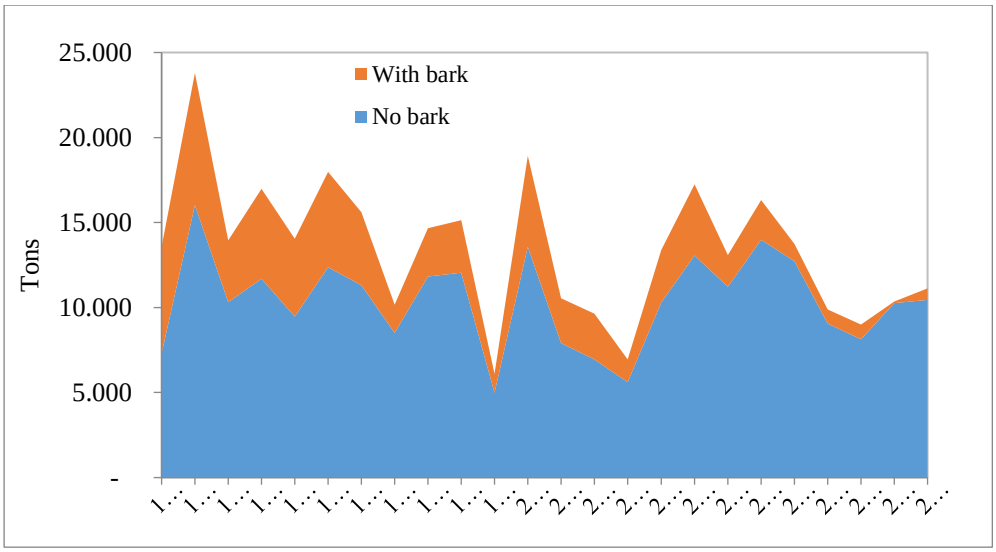
3.2.1. Export Evolution

Brazil nuts are exported from Brazil in two forms (with and without bark). The predominant export is nuts with bark, that in the period analyzed (1989–2012) represented 77.32% of export quantity. Export of nuts without bark had previously been more prevalent. In 1989, for example, it accounted for 46.15% of exported volume. But, currently, it represents only 6.05% of the total (Figure 2).

To analyze quantity distribution and export value by state (Table 3), the period 1989–2012 was divided into two sub-periods (1989–2000 and 2001–2012). Pará state still occupies the first place as exporter: considering the complete period, it accounted for 55.65% of export quantity and 67.34% of value. But there was performance loss over the period. In the sub-period 1989–2000, it accounted for 72.62% and 76.07%, respectively, of the quantity and value of Brazilian exports, while in the sub-period 2001–2012 the share in terms of quantity fell to 33.92% and of value to 56.73%.

Acre state has substantially increased its export share. In the sub-period 1989–2000, it accounted for less than 2% of export quantity, which in terms of value represented less than 1% of the total for the country. The following sub-period (2001–2012) marked a strong expansion of Acre's share in this market, accounting for 39.76% of export quantity and 13.52% of value.

Amazonas state maintained its market share, accounting for approximately a quarter of export quantity and value in the full period. The participation of other states is residual, since it represented less than 2% of the export quantity and value in the period (Table 3).



Source: Prepared by the authors based on MDIC data (2013b).

Figure 2. Evolution of Brazil Nut Export Quantity, 1989–2012

Table 3. Quantity (Tons) and Value (1,000 US$) of Brazil Nut Exports by State in the Sub-Periods 1989–2000 and 2001–2012

	1989–2000				2001–2012				Total (1989–2012)			
State	**Quantity**		**Value**		**Quantity**		**Value**		**Quantity**		**Value**	
	Ton	%	Thousand US$	%	Ton	%	Thousand US$	%	Ton	%	Thousand US$	%
Acre	3,465	.92	2,259	0.84	56,169	9.76	29,781	3.52	59,634	8.51	32,040	.56
Amazonas	44,432	4.56	60,037	22.42	32,588	3.07	62,317	8.29	77,020	3.91	122,354	5.07
Pará	131,371	2.62	203,731	76.07	47,924	3.92	124,959	6.73	179,296	5.65	328,689	7.34
Rondônia	154	.08	115	0.04	3,923	.78	2,256	.02	4,077	.27	2,371	.49
Others*	1,484	.82	1,674	0.63	661	.47	958	.44	2,145	.67	2,633	.54
Total	180,906	0.00	267,815	100.00	141,266	00.00	220,271	00.00	322,172	00.00	488,087	00.00

Source: Prepared by the authors based on MDIC data (2013b).
Note: (*) includes exports from 23 other municipalities.

From 1999, data from the Aliceweb system (MDIC, 2013b) has allowed identification of the municipal origin of exported Brazil nuts. In the period 1999–2012, exports were registered in 38 municipalities. Table 4 shows the data of the 15 largest exporters, responsible for almost all exports.

Table 4. Quantity (Tons) and Value of Brazil Nut Exports (US$ thousand), according to the Municipality of Origin, 1999–2012

State	Municipality	Quantity		Value	
		Ton	%	Thousand US$	%
Pará	Belém	51,281.76	30.84	114,382.96	44.15
Acre	Brasiléia	49,394.62	29.70	23,690.23	9.14
Amazonas	Manaus	39,004.92	23.45	71,349.44	27.54
Pará	Oriximiná	8,159.35	4.91	24,015.68	9.27
Pará	Óbidos	5,744.63	3.45	15,423.08	5.95
Acre	Rio Branco	5,019.87	3.02	4,646.19	1.79
Rondônia	Guajará-Mirim	4,281.63	2.57	2,660.69	1.03
Acre	Epitaciolândia	2,496.20	1.50	1,164.36	0.45
Mato Grosso	Juína	377.61	0.23	159.79	0.06
Rio de Janeiro	Rio de Janeiro	115.02	0.07	258.60	0.10
Rio de Janeiro	Niterói	111.83	0.07	343.02	0.13
São Paulo	Itu	95.40	0.06	95.66	0.04
São Paulo	Botucatu	63.87	0.04	332.99	0.13
Espírito Santo	São Mateus	48.00	0.03	182.86	0.07
Acre	Sena Madureira	32.00	0.02	137.23	0.05
-	Others*	72.65	0.04	209.47	0.08
Total		166,299.35	100.00	259,052.24	100.00

Source: Prepared by the authors based on MDIC data (2013b).
Note: (*) includes exports from 23 other municipalities.

The most important municipalities are Belém (Pará), Brasiléia (Acre) and Manaus (Amazonas), which together accounted for 83.99% of the quantity and 80.84% of the value of Brazilian exports. Table 4 also shows records of Brazil nut exports in several municipalities located in other regions of the country. The participation of these municipalities is residual and represents less than 1% of the total exported in the period. These exports are made by companies that process other types of nut and which also buy Brazil nuts sporadically from states of the Amazon region due to availability of the product.

In the period 1989–2012, the Brazil nuts produced in Brazil were exported to a total of 56 countries. However, there was a strong concentration of these exports in a few countries. The main importer, the United States, acquired 33.97% of the quantity exported by Brazil in the period 1989–2012, which represented 37.87% of the export value. Despite the decline in export quantity in this period, these percentages remained relatively stable, signaling that the United States is a traditional market (Table 5).

During this period, Brazil lost competitiveness in the European Union market. In the sub-period 1989–2000, German, United Kingdom, Italian, Dutch, Spanish and French markets absorbed 52.14% of Brazilian exports. In the following sub-period (2001–2012), this share fell to only 10.40%, which meant a decrease of 49.76% in the quantity exported to these markets. The main cause of this decline in performance was the establishment in the European Union of sanitary standards for the export of nuts with bark (EURLEX, 2013).

Table 5. Main Brazil Nut Importer Countries, 1989–2012

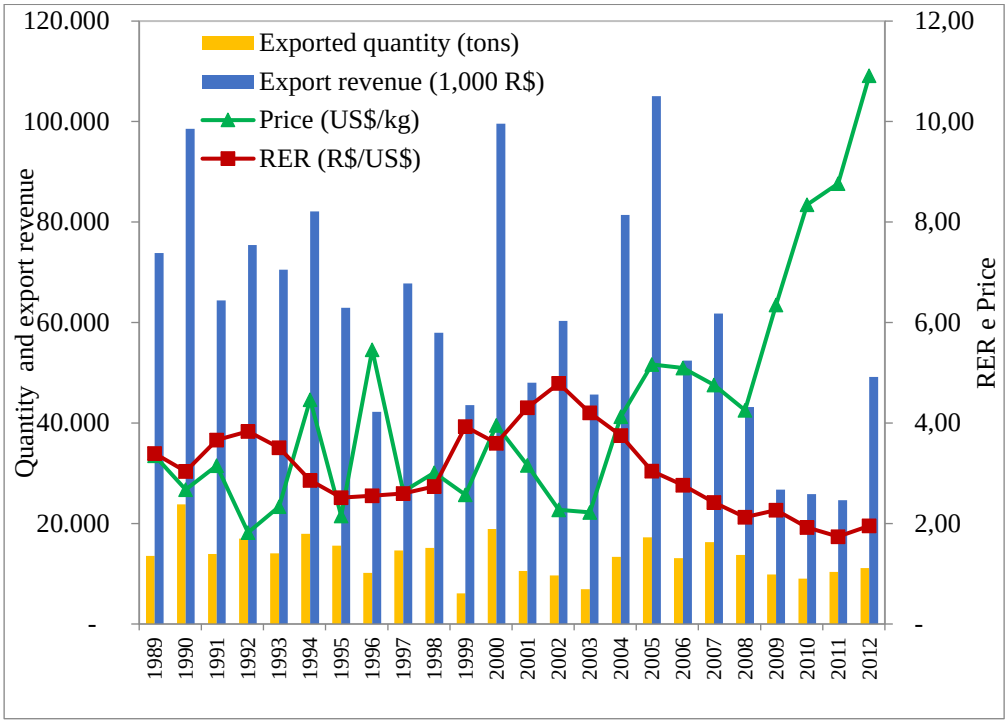
	1989–2000				2001–2012				Total (1989–2012)			
Country	**Quantity**		**Value**		**Quantity**		**Value**		**Quantity**		**Value**	
	Ton	**%**	**Thousand US$**	**%**	**Ton**	**%**	**Thousand US$**	**%**	**Ton**	**%**	**Thousand US$**	**%**
United States	72,476	40.06	103,300	38.57	36,964	26.17	81,556	37.03	109,440	33.97	184,856	37.87
Bolivia	2,575	1.42	675	0.25	55,997	39.64	28,559	12.97	58,571	18.18	29,234	5.99
Germany	32,835	18.15	44,131	16.48	3,570	2.53	5,466	2.48	36,405	11.30	49,597	10.16
UK	30,112	16.64	52,778	19.71	2,615	1.85	4,395	2.00	32,727	10.16	57,173	11.71
Italy	21,285	11.77	23,097	8.62	4,819	3.41	8,195	3.72	26,104	8.10	31,292	6.41
Hong Kong	-	-	-	-	13,836	9.79	31,622	14.36	13,836	4.29	31,622	6.48
Australia	5,571	3.08	12,176	4.55	4,258	3.01	15,613	7.09	9,829	3.05	27,789	5.69
Netherlands	4,938	2.73	11,369	4.25	2,070	1.47	6,510	2.96	7,007	2.17	17,879	3.66
Peru	-	-	-	-	4,961	3.51	3,091	1.40	4,961	1.54	3,091	0.63
Span	2,845	1.57	6,461	2.41	1,242	0.88	4,279	1.94	4,086	1.27	10,740	2.20
France	2,314	1.28	2,408	0.90	376	0.27	405	0.18	2,689	0.83	2,813	0.58
South Africa	1,353	0.75	3,413	1.27	832	0.59	3,976	1.80	2,185	0.68	7,389	1.51
China	88	0.05	97	0.04	1,814	1.28	4,053	1.84	1,902	0.59	4,150	0.85
Belgium	808	0.45	1,038	0.39	936	0.66	2,885	1.31	1,744	0.54	3,924	0.80
New Zealand	645	0.36	1,490	0.56	946	0.67	4,444	2.02	1,591	0.49	5,935	1.22
Others*	3,062	1.69	5,381	2.01	6,032	4.27	15,224	6.91	9,095	2.82	20,605	4.22
Total	180,906	100.00	267,815	100.00	141,266	100.00	220,271	100.00	322,172	100.00	488,087	100.00

Source: Prepared by the authors based on MDIC data (2013b).
Note: (*) includes 23 importer countries.

With this market loss, the product was destined for other countries that also produce and export Brazil nuts. Bolivia, which absorbed only 1.42% of Brazilian exports between 1989 and 2000, imported 39.64% of the total exported by Brazil, becoming the largest importer in Brazil, in the sub-period 2001–2012. Peru, which in the first sub-period was not included in the list of importing countries, represented 3.41% of the quantity exported by Brazil in the sub-period 2001–2012.

3.2.2. Variation in Source Decomposition of Brazil Nut Exports

In this section, the shift-share method is used to decompose the variation in the sources of Brazil nut export revenues, with analysis of the behavior of the key variables that determine export revenues (Figure 3). International prices for Brazil nuts grew at a rate of 4.97% per year, and this growth pattern remained unchanged in the period analyzed, since it was the variable with the lowest coefficient of variation (Table 6).



Source: Prepared by the authors based on IPEA (2013) and MDIC data (2013b).

Figure 3. Evolution of Real Exchange Rate (RER) and Brazil Nut Price, Quantity and Export Revenue, 1989–2012

Despite the rise in international product prices, Brazil's export revenues showed a large fluctuation, with a coefficient of variation around 36%, and declined at a rate of 3.33% per year in the period, with the sharpest fall occurring from 2005 (Figure 3). This result was strongly influenced by exchange appreciation in the Brazilian economy, which began at the end of 2002 and reached its peak in the last 2 years of the series. This valuation neutralized the increases in international prices and contributed to the reduction of Brazil's export revenues.

Table 6. Descriptive Statistics and Growth Rates of Real Exchange Rate and Brazil Nut International Prices, Export Quantity and Export Revenue, 1989–2012

Variable	Units	Minimum	Mean	Maximum	Standard deviation	CV[1] (%)	Growth ra(%aa)
Real exchange rate	R$/US$	1.74	3.06	4.79	0.81	26.49	−2.03*
International price	US$/kg	1.06	1.52	2.26	0.26	17.15	4.97*
International price	R$/kg	2.38	4.59	7.14	1.20	26.25	−1.54**
Quantity exported	Tons	6,106	13,424	23,794	3,978,216	29.64	−1.81*
Export revenue	Thousand R$	24,658,319	60,966,859	105,072,070	21,945,153	36.00	−3.33

Source: Prepared by the authors based on MDIC data (2013b).
Note: (*) and (**) indicate significance at the 1% and 5% error probability levels according to Student's t-test. (ns) indicates not significant. ([1]) indicates coefficient of variation.

Another variable that contributed decisively to the decline in revenues was the quantity exported, which also showed a strong fluctuation in the period, with a coefficient of variation of 29.64%, registering a negative growth rate of 1.81% per year. Table 7 shows the results of decomposition of price, exchange and quantity effect for each year analyzed.

Table 7. Decomposition of Annual Growth Rate of Brazil Nut Export Revenue, 1990–2012

Year	Price effect	Exchange effect	Quantity effect	Total effect
1990	−14.88	−8.99	57.35	33.48
1991	−7.55	18.99	−46.10	−34.67
1992	−8.16	4.39	20.96	17.19
1993	23.48	−10.40	−19.62	−6.55
1994	11.77	−20.80	25.46	16.43
1995	0.21	−11.93	−11.62	−23.33
1996	1.56	1.49	−35.95	−32.90
1997	9.34	1.87	49.26	60.48
1998	−21.28	4.15	2.64	−14.49
1999	29.79	56.50	−111.10	−24.82
2000	−19.50	−6.74	154.89	128.64
2001	−27.76	14.21	−38.25	−51.81
2002	23.69	13.89	−11.85	25.72
2003	19.72	−14.64	−29.38	−24.30
2004	3.63	−11.20	85.75	78.18
2005	23.44	−23.19	28.82	29.08
2006	−27.48	−6.77	−15.88	−50.12
2007	7.90	−13.35	23.38	17.92
2008	−5.64	−11.41	−13.04	−30.09
2009	−19.27	5.33	−24.19	−38.13
2010	25.26	−19.01	−9.53	−3.27
2011	−8.35	−8.75	12.46	−4.64
2012	65.21	20.43	13.77	99.40

Source: Prepared by the authors based on IPEA (2013) and MDIC data (2013b).

The total effect shows the downward trend in Brazil nut export revenues, since in 13 of the 23 years analyzed, negative variation rates were observed, which predominated as of 2001. The

contribution of exchange rate effect predominated, mainly, from 2003 on when negative real exchange rates prevailed, marking the phase of higher appreciation of the Brazilian currency against the dollar in the period analyzed. This result ended up neutralizing the price effect that exhibited positive variation rates in 13 of the 23 years analyzed.

The quantity effect also exerted a strong influence on the fall in export revenues, since negative variation rates were observed in 12 years, which were motivated by reduced production in the main producing states and also by restructuring of the international market starting from the first decade of the 21st century with the establishment of stricter sanitary and quality control standards by European Union countries.

3.3. Impact of Public Policies on Brazil Nut Extractivism

The fall in performance and structural changes in the Brazil nut market have demanded from the Federal Government support in terms of public policies aimed at extractive communities for which this product is the main income source. In this sense, some initiatives deserve to be analyzed.

Table 8. Evolution of Rural Credit Applications in Brazil Nut Extractivism, 2000–2012

Year	Operations		Contracted value	
	Quantity	Percentage (%)	Thousand R$	Percentage (%)
2000	143	18.36	1,099.26	3.47
2001	109	13.99	283.49	0.90
2002	4	0.51	5,653.95	17.86
2003	9	1.16	4,691.65	14.82
2004	11	1.41	3,525.23	11.14
2005	23	2.95	177.52	0.56
2006	55	7.06	425.78	1.34
2007	126	16.17	1,033.21	3.26
2008	15	1.93	43.17	0.14
2009	163	20.92	3,336.11	10.54
2010	34	4.36	10,776.46	34.04
2011	72	9.24	370.78	1.17
2012	15	1.93	240.45	0.76
Total	779	100.00	31,657.05	100.00
Average	60 operations/year		2,435.16	
CV (%)	91.00%		124.42%	

Source: Prepared by the authors based on data from the Central Bank of Brazil (Banco Central do Brasil, 2013).
Note: Credit operation values corrected to R$/kg using the FGV IGP-DI (base: December 2012 = 100).

One of the policy instruments to encourage Brazil nut extractive communities is rural credit. In Brazil, only 779 credit operations were contracted in the period, which corresponded to an average of 60 operations contracted per year. Total fund volume was R$ 31.7 million, that is, an average of R$ 2.5 million per year (Table 8).

These funds are incipient, since in the period considered they represented only 4.5% of the value of Brazil nut production. Another weakness of the financing policy for extractivists is the

strong instability in resource application, since the coefficients of variation for operations and contracted values were high at 91.00% and 124.42%, respectively. This indicates that there is a strong discontinuity in financing policies for Brazil nut extraction.

A more recent policy instrument is the National Plan for the Promotion of Socio-Biodiversity Product Chains (PNPSB). Created in 2009, its objective is to promote the conservation and sustainable use of socio-biodiversity and to guarantee alternative sources of income for extractive communities. Thus, it seeks to provide access to credit policies, technical assistance and rural extension, in addition to the availability of markets and marketing instruments, according to the minimum price guarantee policy (Ministério da Agricultura, Pecuária e Abastecimento, 2009).

As a result of PNPSB, as of April 2009, the Minimum Price Guarantee for Socio-Biodiversity Products (PGPM-Bio) was created by the national supply company (Companhia Nacional de Abastecimento, CONAB). PGPM-Bio is an economic subsidy instrument in which the extractor receives a bonus when proving that he or she sold the product at a lower price than the minimum set by CONAB.

From its inception until July 2013, subsidy payments totaled R$ 642,781.00, involving only 1,171 tons of Brazil nuts and serving 582 families. It is worth noting that practically all operations were carried out in 2009 and 2010. In 2011 and 2012, no operation was carried out and only one subsidy operation was registered in the period from January to July 2013 (CONAB, 2013).

4. Conclusion

The results of this work suggest that the highest exhaustion level of native Brazilian tree exploitation was reached, since the extractive supply became rigid to the point of not responding to the price stimuli observed in the last two decades; the supply has become perfectly inelastic.

This situation presents strong reduction in the international trade of Brazil nuts, one of the most traditional export products of the Brazilian Amazon. As a result, export revenues showed a strong downward trend, due to a reduction in the quantities exported and appreciation of the real exchange rate, which neutralized the effect of international market price that was positive during most of the period analyzed.

The changes in sanitary regulation and quality control of the main trading partners have also had a strong effect on the export performance of Brazil nuts, especially since 2003. The requirements have led Brazil to direct a significant share of its production to countries such as Bolivia and Peru that are also Brazil nut producers.

It was also evidenced that rural credit and price guarantee policies have not adequately addressed Brazil nut extractors because access is low, and the amounts applied are not very representative. This situation occurs due to limitations of the physical infrastructure and personnel of the institutions responsible for the operationalization of these policies, including those that provide technical assistance and rural extension services. Another limiting factor is the low level of associativism that prevails among extractive communities. Recognition of this context is fundamental for the success of any strategy aimed at developing the Brazil nut value chain in the Brazilian Amazon.

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