Was it Uruguay or Coffee? The causes of the beef jerky industry's decline in southern Brazil (1850 – 1889)

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ABSTRACT

What caused the decline of the beef jerky's production in Brazil? The main sustenance for slaves, beef jerky was the most important industry in southern Brazil. Nevertheless, by 1850, producers were already worried that they could not compete with Uruguayan industry. Traditional interpretations impute the decline to labor markets differences in productivity, since Brazil used slaves while Uruguay had abolished slavery in 1842. Recent research also raises the possibility of a Brazilian "Dutch Disease", resulting from the coffee exports boom. We test both hypothesis and argue that Brazilian production's decline was associated with structural changes in demand for low quality meat. Trade protection policies created disincentives for Brazilian producers to increase productivity and diversify its cattle industry.

Keywords: Beef Jerky, Brazil, Regional Development.
JEL: N46, N56, N96

RESUMO

Qual a causa do declínio da produção do charque no Brasil? Principal alimento dos escravos, o charque foi a mais importante indústria do sul do Brasil. No entanto, em 1850, produtores se preocupavam porque não conseguiam competir com a indústria do Uruguai. Interpretações tradicionais relacionam o declínio a diferenças de produtividade no mercado de trabalho, uma vez que o Brasil utilizava escravos e o Uruguai havia abolido a escravidão em 1842. Pesquisas recentes levantam a possibilidade de uma "doença holandesa" brasileira, resultante do aumento das exportações do café. Ambas as hipóteses são testadas e argumentamos que o declínio da produção brasileira estava associado a mudanças estruturais na demanda por carne de baixa qualidade. Políticas de proteção comercial criaram desincentivos para que os produtores brasileiros aumentassem a produtividade e diversificassem sua produção.

Palavras-chave: Charque, Brasil, Desenvolvimento Regional.

1. INTRODUCTION

Cattle industry was the most important economic activity in southern Brazil during the nineteenth century. Beef jerky (*charque*) provided the main nourishment for the slave labor in coffee and sugar cane plantations and, between 1845 and 1889, along with hides, represented on average 70.5% of Rio Grande do Sul province exports (FEE 2004). Nevertheless, after the 1850's, for the cattle ranchers and beef jerky exporters the local economy couldn't compete with the Uruguayan production (Cardoso 2003, p.204; Bell, 1998, p.79). Having the largest slave population in the Americas after 1850, why did the Brazilian industry was lagging behind?

Traditional interpretations about the lack of competitiveness were attributed to labor markets. Productivities' differences between slave labor in Brazil and wage labor in Uruguay, alongside rising slave prices after the end of the transatlantic slave trade in 1850, were the explanations as why production in Rio Grande do Sul was losing its market share. However, Monasterio (2005) refuted the hypothesis that the use of slave labor was irrational and argued that captives represented a lower cost than wage labor for the beef jerky production. Monasterio also raised an alternative hypothesis, in which the coffee export boom damaged the southern industry through a "Dutch Disease": the real exchange rate appreciation caused by the soaring coffee exports raised Brazilian *charque* prices, making them less competitive against foreign competition.

Rio Grande do Sul is located at the Uruguayan border and both regions have similar geographical endowments. These regions also shared similar transports costs to the Brazilian main markets of Rio de Janeiro and São Paulo. Since Brazil did not have integrated coastal railways, transport had to be made by mules or by coastal ships (Summerhill 2003). This paper argues that production costs, represented by the price of the slave labor, were not responsible for the beef jerky industry's decline. Brazilian exchange rate appreciation had a short term impact on Rio Grande do Sul industry's competitiveness, but quantitative analysis shows that it cannot be use as a long-run explanation for the sector's decline. The answer to understand Brazilian industry's situation is to look at structural changes in meat production at the other side of the border, which resulted from an increase in demand for products with higher quality than beef jerky.

The increased integration of Latin America into the world economy at the second half of the nineteenth century is well known (O'Rourke; Williamson 1999), but

the impact of the first globalization on peripheral industries remains an open topic. Uruguay's growth came not primarily through an increase in beef jerky to Brazil, but through a diversification of its exports. Regional military conflicts, especially the Paraguayan War (1864 – 1870), led to an increased demand for products that could be conditioned, such as canned beef. Also, shifting external demands, especially from European markets, dictated the production of a country that did not have substantial internal markets for its products. Brazilian producers, however, received a different set of incentives. With tariff protection offered by the government and a guaranteed market for their product, the Brazilian southern beef jerky industry did not have incentives to change their production for high quality meats, where they would face global competition. Brazilian low wages would make high quality meat production unprofitable if the producers relied only on internal markets. Another important aspect for the different paths taken by the Uruguayan and the Brazilian cattle industry regards the supply of new technology. Uruguay's modernization was built with British foreign capital. Southern Brazil, in the absence of foreign investments, lacked access to financial institutions that could make a modernization possible.

2. BEEF JERKY EXPORTS IN RIO GRANDE DO SUL

The Pampas, a biome that covers the south of Rio Grande do Sul and all Uruguay, was an appropriate place for cattle herding and beef jerky production. The border proximity between cattle farms in Uruguay and Rio Grande do Sul can be stated from a statistic provided by the Province's Presidential Report from 1858. According to the President Silva Ferraz, in 1857, 81.427 cattle entered the Province from Uruguay, while 103.635 crossed the border on the opposite direction. This represents an intense livestock movement, since for the same year, 40.279 cattle were used for meat consumption (*carne verde*) and 365.508 animals were used to produce beef jerky (Provincial Presidential Report, 1857, p.35).[1] Regarding beef jerky production in Rio Grande do Sul, as can be seen in table 1, the majority of exports went to other ports in Brazil, such as Rio de Janeiro and Pernambuco, to feed slaves that worked at the coffee

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[1] From the same Report, each animal resulted in 4 arrobas of beef jerky.

and sugar cane plantations. Exports to ports in Europe, as Spain, Italy and Portugal, represented a small part of production.[2]

Table 1: Destination of Rio Grande do Sul Beef Jerky Exports (arrobas)

Year	Ports in Brazil	Uruguay	Ports in Europe
1847	2.404.104	336	152.325
1848	2.362.031	3425	80.153
1849	2.093.996	346	25.116
1850	1.838.131	248	2.575
1851	1.907.717	0	0
1852	1.492:744	0	0
1853	1.754.015	0	11
1854	1.397.621	0	5.916
1855	1.170.983	0	0
1856	1.229.089	0	0

Source: Provincial Presidential Reports, Rio Grande do Sul (several years)

Notwithstanding the complaints from local producers quoted by Cardoso (2003) and Bell (1998), two major political conflicts benefited Rio Grande do Sul's beef jerky industry at the beginning of the 1850's. The first came from the end of the *Farroupilha* civil war (1835–1845), which occurred as a result of claims from unfair external competition. The revolutionaries, associated with the Brazilian cattle industry, criticized the high customhouse's taxes applied to their product, while the products from Uruguay and Argentina were exempt from taxes (Padoin 2006). As an agreement to end the conflict, the Imperial government taxed imports of foreign beef jerky at 25 percent (Pesavento 1980).

Despite the raise in taxes, in 1851, the legislative assembly of Rio Grande do Sul urged the Emperor to raise taxes again on foreign beef jerky, to 40 percent. Their argument was that the taxes on salt, used extendedly on beef jerky and tannery production, made the local production uncompetitive (Correio Mercantil… 1851a p.2). Since the tax on salt, of 30 percent, was an important source of revenue, the government was not receptive to the idea. Also, the demand for an increased tax on foreign beef jerky conflicted directly with plantation owners that used slave labor. In an editorial called "the demands of southern friends", published at a Rio de Janeiro's newspaper,

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[2] It should be noted that the discrepancy between data from table 1 and the series in graph 1 is due to the figures in the latter regards the values declared by the tree most important custom houses, Porto Alegre, Rio Grande and São José do Norte, and do not represent all the province production.

beef jerky producers were criticized for the demands that would raise agricultural production costs on other provinces (Correio Mercantil…, 1851b p.1).

Given the conflict of interest between provinces, it's fairly common to find in contemporary southern newspapers texts regarding the need to diversify Rio Grande do Sul's industry. In 1851, the "Rio-Grandense" newspaper called for a change in meat production. Since city of Rio Grande port was frequented by "hundreds of foreign vessels" and foreigners were not "accustomed to beef jerky", the province was losing economic opportunities by focusing in a production that consumed an "insane amount of work", which required a lot of slaves for all the processes required to prepare the product (O Rio-Grandense, 1851, p.3).

While worries increased in Rio Grande do Sul about its main export product, another regional conflict gave a renewed advantage to the Brazilian beef jerky. The conflict that benefited Brazilian exporters was Uruguay's *Guerra Grande* (1839 – 1852), between Blanco and Colorado political parties, which disorganize the Uruguayan industry (Bell 1993). Despite a reduction in Rio Grande do Sul cattle supply during the conflict, due to herds apprehensions from the Uruguayan government and an increase in livestock mortality (Farinatti 2008), Brazilian cattlemen benefited from an almost complete stop in the Uruguayan production.

The end of the war was achieved with Brazilian support, which offered protection against new assaults from the argentine commander J.M de Rosas. Debilitated by several years of conflicts, Uruguay had to accept the Brazilian government demands at the postwar treaty in 1851, including Montevideo's occupation by the Imperial army in 1853 (Souza; Prado, 2002). According to Santos (1987, p.41), to increase Uruguay's dependence to its protectorate, the Imperial government had also the objective to impair the cattle industry from its neighbor. The treaty raised import taxes even more, enhanced property rights for the Brazilian *estancieiros* that had lands across de border and established that Uruguayan cattle would not pay taxes to enter Brazilian territory, offering a cheap cattle supply to the Brazilian beef jerky (Pesavento, 1980a, p. 29). The country's border with Brazil was taken as an "Imperial economic and social appendix", with a great number of Brazilian cattle ranchers, that used slave labor regardless of the Uruguayan abolition in 1842 (Souza; Prado, 2002, p.2).

The beneficiary impact of the Imperial government politics for the beef jerky production in Rio Grande do Sul is clear from Graph 1, which shows a steady increase in exports after 1851. Until the end of the Paraguayan War, in March 1870, the

Brazilian beef jerky benefited from its protectionist advantage over Uruguayan production. It's important to note that the sharp drop in exports shown in 1869, according to the Province's President Israel Rodrigues Barcellos, was due to heavy rains that destroyed major roads leading to places of cattle slaughter (Provincial Presidential Report, 1869, p.5). Since beef jerky production sites were located in cities near the east coast, such as Pelotas, and cattle were raised in cities at the border of Uruguay, a disruption on the roads could paralyze production. Also, in 1870, pastures in Rio Grande do Sul were ravaged by a foreign herb (*epazote*) that had already caused damage in Uruguay and Argentina (Diário do Rio de Janeiro 1870, ed. 167 p.2). From the beef jerky exports data, the industry's stagnation began after 1870. In 1872, the city of Rio Grande Business Association financed some studies to understand the problems of its industry (Cardoso 2003, p.214). Again, taxes were to blame for the lack of competitiveness.

Graph 1: Rio Grande do Sul Beef Jerky Exports (tons)
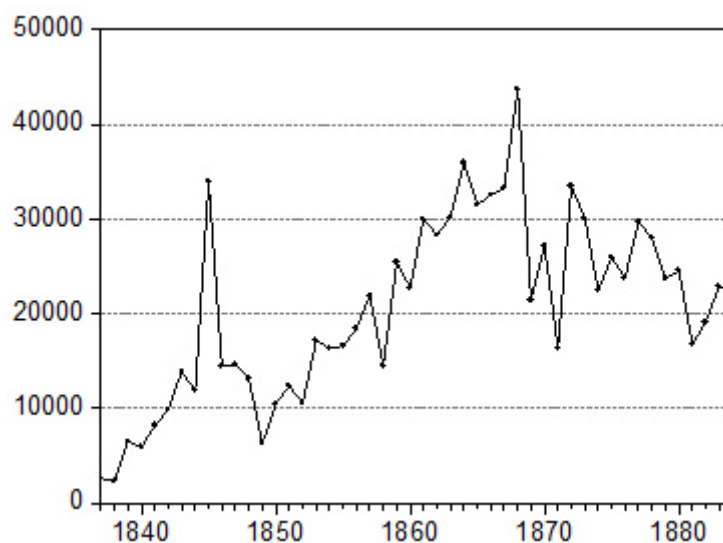
Source: FEE (2004)

However, even in the 1860s, a decade with increasing growth in exports, Rio Grande do Sul production lagged behind when compared to Uruguay. According to a commercial Rio de Janeiro newspaper, in 1865 there was some concern regarding the quality of Rio Grande do Sul beef jerky. The Rio de la Plata product was preferred and had "taken over the markets of Rio de Janeiro" (Diário do Rio de Janeiro 1865, ed.8 p.3). The Brazilian beef jerky still had a better market share in Bahia but the article stated that it was also facing increasing competition from Uruguay. Using data from Rio

de Janeiro newspapers, it's clear that despite similar prices, during the 1860's Uruguay's beef jerky already dominated the most important Brazilian market. The information in Table 2 presents data with prices (réis) and beef jerky stocks (arrobas) from newspapers at the first week of each year presented. This should not be interpreted as an average price for the whole year but gives information to differences in prices from both regions. Using data from the beginning of each year also makes it possible to compare the stocks available for each product at the end of the previous year.

Table 2: Prices and stocks of Beef Jerky in Rio de Janeiro

	Rio Grande do Sul (RS)			Rio de la Plata (URU)			R.Grande Stock	Uruguay Stock
Year	Min	Max	Average	Min	Max	Average		
1860	3.000	4.500	3.750	3.200	4.600	3.900		
1861	1.600	4.500	3.050	3.000	3.200	3.100		
1862	2.000	3.000	2.500	2.500	3.200	2.850		
1863	3.000	3.200	3.100	1.800	3.600	2.700	11.300	120.492
1864	1.000	2.600	1.800	1.500	2.600	2.050	32.120	187.281
1865	800	2.000	1.400	800	3.000	1.900	37.837	231.200
1866	600	2.100	1.350	1.200	2.200	1.700	33.700	208.071
1867	2.800	3.400	3.100	2.800	4.000	3.400	13.800	204.225
1868	1.600	2.400	2.000	1.800	3.200	2.500	19.500	180.500
1869	3.600	3.600	3.600	3.000	4.600	3.800	7.000	53.600
1870	1.500	5.000	3.250	2.000	4.000	3.000		
1871	2.000	5.000	3.500	3.000	4.600	3.800		
1872	3.800	3.800	3.800	3.400	4.000	3.700		

Source: Diário do Rio de Janeiro – Biblioteca Nacional Digital (Several Years)

After the beginning of the 1870's, the Law of Free Birth (*Ventre Livre*) terminated the last source of slave supply and posed a new limit to the increase in beef jerky production (Bethell, 1970). An increase in demand was unlikely with the slave population decline throughout the country, approximately 45 percent in coffee plantation areas between 1872 and 1887 (Luna; Klein, 2010, p.320). Immigrants that were replacing slave labor did not consume dried meat (Holloway 1980). After the end of slavery in Brazil, in 1888, beef jerky production continued its slow decay. However, at the beginning of the twentieth century, the sector remained relevant at the regional level. In 1909, Álvaro Baptista, finance minister of Rio Grande do Sul, deplored the inability of the region to move away from an industry that would inevitably disappear (Fonseca 1983).

3. MEAT EXPORTS IN URUGUAY

The political and economic disorganization of Uruguay, the result of constant wars and bad commercial treatises, came to a halt in 1856 (Rock, 2000). From that period until 1865, Blanco and Colorado's head politicians tried to come together in order to create a national awareness and condemn the perjury from past existing connections between both parties and inimical foreign countries (Casal 2004). However, with or without political conflicts, Uruguay's economy was heavily reliant on international trade (Barran; Nahum, 1984). Different from Rio Grande do Sul, which had a large market in other Brazilian provinces, Uruguay depended on foreign markets.

After 1860, due to the 1851 treaty and changes in global demand, the beef jerky started losing its relevance in Uruguayan exports. Also, as a consequence of the United States Civil war (1861–1865), Uruguayan exporters had the possibility to diversify and increase its wool production, since the country was one of few regions in the world where bovine and ovine cattle shared the same territory. United States was the main cotton supplier to Europe's textile industry and faced an abrupt fall in production during the war years, leading to a rise in cotton demand from other regions and also for substitutes, such as wool (Barran; Nahum 1984).

Within a decade (1860-1870), the wool industry established itself as one of major economic activities in Uruguay, enabling the rise of medium size *estancieiros* and giving ovine's a more important position in cattle raising. Cattle diversification, however, did not happen for Brazilian *estancieiros* located north of the Rio Negro River (Farinatti 2008, p.103). As the treatises guaranteed better gains from selling bovine cattle, they kept extensive breeding for the beef jerky industry in Rio Grande do Sul. The good economic scenario resulting from wool exports lasted until the end of the North American conflict. With markets normalization after the war, and the United States protectionist tariff against foreign wool (Morrill tariff), Uruguayan wool sector lost a great share of its market. In the 1870's, according to a contemporary writer, higher land prices and wages represented the end of easy money for sheep farmers (Burton 1870, p.88).

The profits from Uruguay's prosperity years led to the perception in the literature that, beginning in 1860, *estancias* acquired a modern vision, with innovative technologies coming from social groups with a "clear capitalist project" (Minello 1977, p.578). Nevertheless, that capitalist project seems to have come from a greater

availability of resources from the 1860's economic boom, as the increased need for leather and wool offered incentives to invest in steam machinery to draw grease out of the animals and improve productivity.

An example of the shift in market demand came in 1862, with the first meat extract factory in the Prata Region, established by a Belgian company. Located in the city of Fray Bentos, in a place previously used as a *saladero,* the factory was sold to a British company in 1866, giving birth to the "Liebig's Extract of Meat Company". Anglo-Irish traveler Thomas J. Hutchinson visited the factory in 1867, and his first impression refers to the unlikeness to others *saladeros* he had been to: "the general atmosphere, about the engine-house particularly, being suggestive of rich beef-gravy" (Hutchinson, 1868, p.411). Hutchinson reports that each animal produced 10 pounds (4,5kg) of meat extract and that during his visit in March 1867, the factory had the capacity to produce 250 pounds (114kg) per day. Despite the amount, the production was still insufficient to European demands, which was four times greater (Hutchinson, 1868, p.412).

Another writer who visited Liebig was the Italian Antonio Gallenga. In the book that registered his voyage through South America, he describes the "famous" English company and its £500.000 capital. According to the author, during the summer months, when the cattle was heavier, herds would arrive through great distances, sometimes more than 100 miles, and a thousand would be slaughtered per day on average. With 550 employees, mainly Bascos, the factory slaughtered around 80 animals per hour, and "nothing was wasted". Gallenga mentions estimatives about Liebig's revenue, which had annual profits of £81.000, using 6000 tons of coal and around 128.000 pounds of salt (Gallenga, 1880, p.300). The cleanness at Liebig in comparison to other *saladeros*, also cited by Hutchinson, is clear in Gallengas description of a common *saladero* administered by a Brazilian. According to the description, after visiting the slaughterhouse escorted by his host family – and surprised that no one bothered about the amount of blood and animal remains in the area - "we went back to the breakfast-room, the dwelling-house being so close to the *saladero* that the flies would not have allowed us to eat in peace for one moment" (Gallenga, 1880, p.301).

Infrastructural information shows the importance of meat extract to Uruguay's exports. Not only for its added value and the possibility to be shipped to distant markets, but also because the country had been diversifying its exports products and delegating

beef jerky a smaller role.[3] This trend was reinforced by another regional conflict. Even with the good economic conditions and no political conflicts after the pact between Blancos and Colorados in 1856, confrontation among parties resurged as the result of geopolitical tension in the region that led to Paraguayan War. Once more, Brazil interfered in Uruguayan territory, giving support to Colorado's party president Venancio Flores against the Blanco party, which had the support of the Paraguayan Marshal Solano López. One important reason for the Brazilian intervention was the constant territorial dispute in the region, which had several Brazilian cattle ranchers. With Argentina and Paraguay supporting different parties, Brazil had to make a statement, and sent in terrestrial forces commanded by the Baron of Tamandaré (Casal 2004).

Brazil used border areas as a base for war operations and its monthly subsidy to its Oriental Division caused a rapid economic expansion in Uruguay from 1865 to 1868: "The incoming gold allowed Montevideo entrepreneurs to establish new navigation, railroad, telegraph, and building companies as well as new steam factories, new banks, credit brokers, and even mining operations" (Casal, 2004, p.137). The artificial growth increased livestock and meat extract sales, causing land and cattle prices to rise. The high profit rates led banks to increase credit lines, making possible investments on the first meat refrigerated storages. Growth came to a sudden stop only in 1868, when the inflow of Brazilian gold ended as the war drew to a close (Casal 2004).

Despite the increase in production during the Paraguayan War, Uruguay did not increase its bovine meat supply to external markets because low quality meat had only limited demand internationally. The European consumer, especially the British, rejected beef jerky (Minello, 1977, p. 580). Seen as food for slaves in Brazil and Cuba, accounts report that "its appearance to Europeans [was] absolutely offensive" (Newcastle Courant, Sep, 1866, p.3). According to contemporaneous newspapers:

> "Some five hundred or six hundred different experiments have been made to cure South American beef so as to make it a marketable article in Europe; but no real success has as yet attended the efforts. The meat [charque] as forwarded has been refused by the working classes in England, and rejected by the French navy…" (Dublin Evening Mail, Jun 1869).

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[3] Nevertheless, the meat extract still did not have the same appeal as fresh meat; "[…] except for the war years, when a large demand for this kind of meat (canned and tasajo) for the armies existed, the exports have been small. The canning plants must give way, as the cattle industry improves, to the modern packing plants which turn out the higher grades of meat" (Jones, 1927, p.366).

Before refrigeration, the second half of the nineteenth century witnessed several attempts to transport meat from South America to Europe that didn't involve dried salted beef. Besides Baron Liebig's meat extract, used in military endeavors and in European hospitals, other methods tried to preserve the meat as raw as possible. One of them, called Sloper's process, packet the meat in tins and preserve it by the introduction of "a certain gas the composition of which is kept a profound secret". There were also methods that involved "forced infiltration of brine into all the tissues of the animal immediately after death", from the Liverpool Company based on Uruguay called the Morgan Patent Meat Preserving Company. Also, the Pharmaceutical Society of London developed a process with consisted in the immersion of fresh meat in melted paraffin (Newcastle Courant, Sep 14, 1866 p.3). Using data from the British government ledgers of imports, Graph 2 shows the increase in meat exports after 1870 from Uruguay that didn't involve salting. Millot and Bertino (1996 p.170) also show that meat industry in Uruguay increased steadily after 1875 until the end of the century.

Graph 2: Uruguay's exports of preserved meat otherwise than by salting, 1850-1889 (cwt).
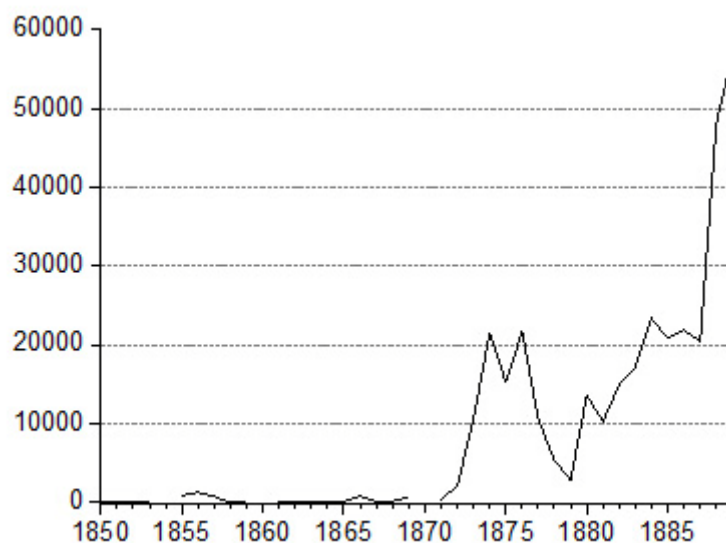
Source: Ledgers of Imports under Countries (CUST 4), British National Archives.

The increase in demand for non salted meat in Europe did not affect only the Plata region. By the end of the 1860's, refrigerated meat was shipped across the United States and had begun to reach European markets (Timmons, 2005; Wade 2003). According to a weekly gazette from 1866, the business of hermetically sealed packing for meats and vegetables was flourishing in states like Maine (Bath Chronicle and

Weekly Gazette, Sep, 1866). The productivity increase in the North American production, achieved through a series of laborsaving devices, sought to take advantage of all the cattle parts. From this, "jerked beef" produced in Chicago was sold to West Indies' slaves from previously disposable parts, such as necks and shanks (Wade 2003 p.8). Just as the United States production, it seems that Brazil after the 1870's became only a destination for Uruguayan low-quality meat, what was left of production to European markets.[4] According to Millot and Bertino (1996 p.169), beef jerky's industry in Uruguay peaked in 1863, when other industries involving cattle began to rise.

Bovine cattle increase in Uruguay between 1852 and 1900 was approximately 370% - a live stock of 1.800.000 to 6.800.000 - whereas the growth in ovine cattle was of 2330%, from 796.000 to 18.608.000 (Jones 1927). The production of low quality meat reduced during the years. From 1921 to 1923, for example, beef jerky represented only 5% of the countries commodities export (Jones 1927), meanwhile for Rio Grande do Sul, the average was 20,8% (FEE 2002). Higher quality meat, such as refrigerated (7%), frozen (14%) and canned (7%) left beef jerky behind as a displaced product in the Uruguayan Republic (Finch 2005). On the other hand, Rio Grande do Sul exported only 0,33% of canned meat and 5,33% of packed meat. The backwardness can be verified by comparing the dates in which packinghouses were established in both regions: Frigorifica Uruguai, in 1905, and the first in Rio Grande do Sul, in 1918 (Jones, 1927).

## 4. INTERPRETATIONS FOR THE BRAZILIAN INDUSTRY'S DECLINE

Despite differences in fiscal incentives and access to foreign capital between Rio Grande do Sul and Uruguay, characterization of slave labor as "noneconomic" remains an important explanation for why Rio Grande do Sul could not compete with Uruguay, which increasingly used free labor after the 1840's (Borucki et al 2004). The use of a less productive labor force, the "irrationality hypothesis", was defended by several authors, such as Corsetti (1983), Cardoso (2003) and Pesavento (1980). Authors such as Décio Freitas (1980, p.35), argued that nothing could be more anti-economic than slave labor. There are two usual reasons for this kind of argument: restricted labor division resulted in lower productivity; and the necessity of constant vigilance represented higher costs than free labor. Also, flexibility in wage labor markets presented the possibility to reduce the workforce in economic slowdowns (Cardoso 2003).

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[4] According to Hutchinson (1868): "Only in Brazil and Cuba, where it is bought on account of its cheapness to feed the slaves, has this charqui ever been a marketable article."

Costs became increasingly important after the 1860's, when according to Pesavento (1980), the *saladero platino* began to modernize its industry. The rising slave prices after the end of the slave trade in 1850 represented an important increment in costs for the Brazilian production, as can be seen in graph 3, with the prices of male slaves, between 20 and 29 years old, that worked at beef jerky production sites in Rio Grande do Sul. With the sudden stop in labor supply, European immigration policies became one of the main concerns for Brazilian politicians (Carvalho, 2003; Skidmore, 1974). Contemporary authors, as the Italian researcher G. B. Marchesini stated that the "recent experience" with foreigner labor in Brazil made clear that the "free labor [was] more productive in any culture" (Marchesini, 1877, p.76).[5]

Graph 3: Average Male Slave Prices (Mil-Reis)
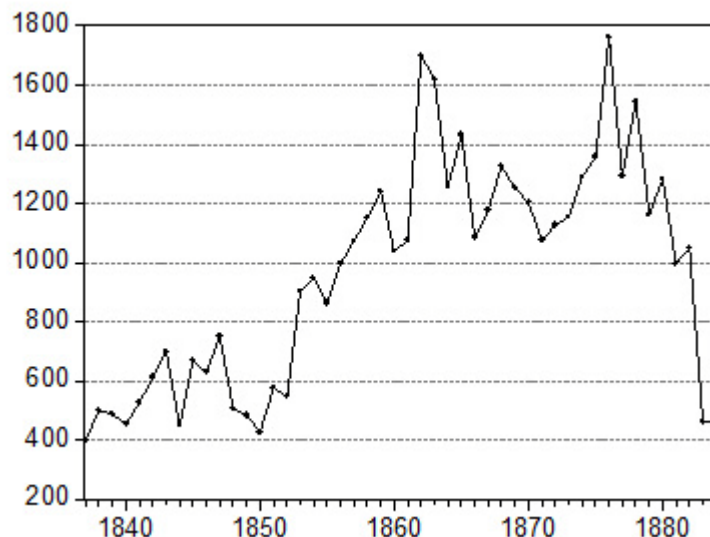
Source: State of Rio Grande do Sul Archive.

The view of slave labor as necessarily less productive than free labor remained practically uncontested until the work of Conrad and Meyers (1958). Afterwards, Fogel and Engerman (1989) also provided evidence that captive labor had been even more productive than wage labor in some circumstances, and that the reason for slave use in the United States southern plantations was economic, not only cultural. For Brazil, Mello (1978) and Versiani (1994) also raised questions about captive labor economic inferiority despite the absence of data to compare all labor costs related to free labor,

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[5] Many contemporary Brazilian authors and politicians quoted European authors such as Adam Smith about the benefits of free labor: "The experience of all ages and nations, I believe, demonstrates that the work done by slaves, though it appears to cost only their maintenance, is in the end the dearest of any. A person who can acquire no property, can have no other interest but to eat as much, and to labour as little as possible" (Smith, 2007, p.252).

mainly represented by immigrants. By the end of the 1870's, Rio Grande do Sul already had a strong presence of foreigners, not only at agricultural colonies but also in urban areas (Trento, 1989). Nevertheless, the only connection they had with the beef jerky's industry was through the production and selling of hides to external markets.[6] Slaves still were largely used on the most prosperous economic regions of Rio Grande do Sul: "the *charqueadores*, which were supposed to be the more ardent defenders of abolition, remained proslavery until the end" (Cardoso, 2003, p.257).

Monasterio (2005) also provides evidence that slave use at the *charqueadas* was rational and represented a lower cost than free labor. He makes reference to attempts to introduce the "*platine* system" in Rio Grande do Sul, without success. During the Paraguayan War, there are records of attempts to send prisoners and Paraguayan children to work at the *saladeros*, to lower industry's wages (Casal, 2004, p.131-35). Another indicative of the high costs of wages in Uruguay's *saladeros* occurred with the end, in 1861, of the Commerce Treaty with Brazil due to protests of unfair competition by President Bernardo Berro. The president prohibited work long term contracts between Brazilian and "citizens of color", because the possibility of slave use, which "represented half of the wages from a Uruguayan rural worker" (Souza; Prado, 2002, p.16).

Another important cost regarding the *charque* industry was the possibility of revolts and runaways, because production sites and the cattle herding region (*campanha*) were near the Uruguayan border, where slavery was illegal. The proximity led authors such as Luiz Targa and Décio Freitas to assert that slave use was not possible at the cattle herd region (Nogu>eról *et al*, 2007, p.13). However, Versiani (1994) showed that slaves responded to a series of positive incentives, which were used to increase productivity and prevent runaways in frontier regions. Nogu>eról *et al* (2007) also presents evidence that slaves used horses on the open fields of Rio Grande do Sul on a regular basis, and some were even horse tamers. One of the negative incentives for runaways was Uruguay's responsibility – from the 1851 treaty – to return any black individual suspect of been a runaway slave. Also, a large part of the Uruguayan border was controlled by Brazilians ranchers (Souza, 2002, p.13).

Despite the focus on the limitations in using slave labor, the literature did not deny the possibility for specialization. Using reports of contemporaries that visited the

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[6] Quadro Estatístico e Geográfico da Província de S. Pedro do Rio Grande do Sul, p.81, 1868. Available at FEE.

charqueadas in the nineteenth century, there were descriptions of labor division (Cardoso, 2003, p.178). Marcondes (2009) recently showed that between 1873 and 1875, in cities related to cattle ranching in Rio Grande do Sul, slaves were used in several occupations, with an ample division of labor.[7] The new database used in this paper also provides evidence that, between 1850 and 1884, there has been labor division at the *charqueadas*. From the 637 male and healthy slaves' sample, half of them (319) had declared an occupation. Also, data from the inventory of businessman José Inácio da Cunha, from 1865, shows that his 115 slaves had seventeen different occupations at the *charqueada*.[8] Women were also divided along different occupations, such as cook, farmhand, laundress, seamstress, among others.

Labor division along a "production line", with slaves that killed the herds, others that cleaned the animals and others that salted the meat, points to a division of labor similar to a free workforce system. Nogueról *et al* (2007) noticed that slaves with declared occupation at *post-mortem* inventories, after 1850, had on average 15 per cent higher selling prices. There was a perception by slave owners about productivity differentials among captives. Brazilian historiography also provides ample evidence that slave labor specialization included even complex tasks, which demanded special training (Schwartz 1988; Luna, Klein 2011).

Another recent hypothesis concerning the Brazilian beef jerky's decline is from Monasterio (2005). He raises the possibility of a "Dutch Disease" phenomenon, where a boom in the export sector affects other sectors subject to international competition. In the *charqueadas'* case, the expansion of coffee production drove demand for non tradable products which resulted in inflation. Hence, the reduction in the competitiveness of Brazilian beef jerky would occur through the appreciation of the real exchange rate. Graph 4, which presents a real exchange rate series for Brazil, provides evidence that there were currency appreciation after 1850, when coffee exports began to growth at a faster rate.

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[7] The cities were Dom Pedrito, Encruzilhada and Rio Pardo.
[8] Inventory nº 600, maço 39. APERS. The activities are: *Campeiro, graxeiro, pedreiro, servente, balieiro, carneador, lavadeiro, tripeiro, carroceiro, sebeiro, tanoeiro, salgador, marinheiro, descarneador, cozinheiro, carpinteiro e roceiro.*

Graph 4: Real Exchange Rate (1850 = 100)
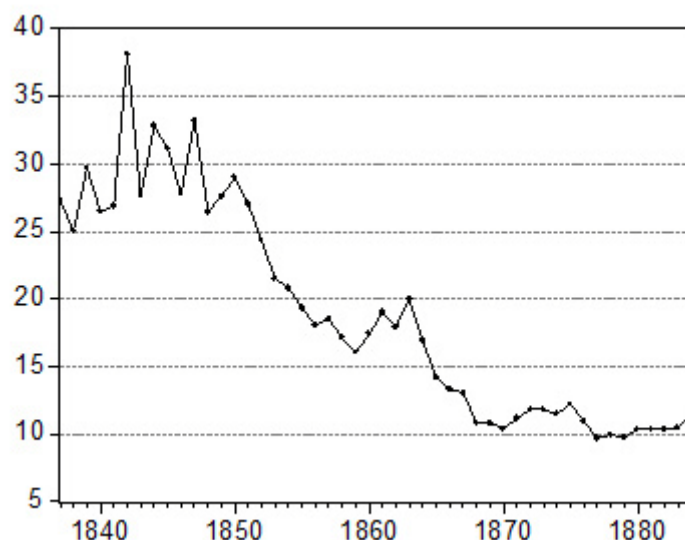
Source: Moura Filho (2006); Twigger (1999); Lobo (1971)

Comparing the literature on the subject for Brazil and Uruguay, it is interesting to note that the beef jerky industry's decline after 1870 appears on both countries, as Finch (2005) and Millot and Bertino (1996) argued for Uruguay. Uruguayan historiography even raises the possibility of a "resource curse" due to its inability to compete in the meat market with countries with similar characteristics, such as New Zealand.[9] According to authors that support this hypothesis, the good pastures from the Pampas promoted inertia. With less risk, investments made in the Uruguayan cattle received smaller profits, but it kept the industry working (Barrán; Nahum 1984, p.670).

On the next section, we provide quantitative analysis on the two hypothesis raised for the Rio Grande do Sul industry. Analyzing the impact of the exchange rate and labor costs on prices and quantity exported can contribute to the debate by changing the variables of interest. The quantity exported, shown in graph 1, presents evidence that exports did not decline, but stagnated after 1870 from an early period of high protection. The industry's decline at the beginning of the twentieth century can only be understood with the end of slavery, which terminated the main consumers. After that, only a fraction of the poorest population continued to consume salted dried meat.

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[9] According to Barrán and Nahum: the British colonists were forced to respond to the challenge presented by the rugged and wooded territory of New Zealand. From the start, in the first half of the nineteenth century, they sowed pastureland. Uruguay, as has already been stated, had the diabolical blessing of ease. Its natural pastures did not necessitate the invention of the soil; it was already there (p.670, 1984).

3. LABOR MARKETS OR DUTCH DISEASE?

In this session we test the different hypothesis presented previously for the causes of the beef jerky industry decline. The sample begins in 1837, right before the beginning of the *Farropilha* civil war, and goes until the *de facto* abolition of slavery in Rio Grande do Sul, in 1884. The variables used are quantity (in tons) and prices (in mil-réis) of beef jerky exported (FEE 2004), slave prices, real exchange rate and salt prices (IPEA). The inclusion of salt prices refers, as previously stated, that at the beginning of the 1850's there was an argument that taxes on salt made local production uncompetitive.

For the labor market hypothesis, we built a series of slaves' prices for the three main cities associated with beef jerky production: Pelotas, with 1463 observations, Rio Grande, with 751, and Porto Alegre, with 1289. These observations refer to slaves registers from postmortem inventories, between 1830 and 1884. From this data, we selected only healthy males, between 20 and 29 years, that represented the most valued and productive labor for the industry. They represent the highest slave prices.[10] We adjust these prices using Feinstein (1995) consumer price index in silver prices. The usual Brazilian price index for the period analyzed is Lobo (1971), which is based on a limited basket of consumer goods in Rio de Janeiro. Since slaves represented a significant investment for the period analyzed, using Lobo's price index would distort the series due to higher fluctuation from non durable consumer goods. Lobo's index, with the 1919 weighting, is used with the price of beef jerky and salt. Concerning the Dutch disease hypothesis, a real exchange rate series, presented in graph 3, is built using data from the nominal exchange rate by Moura Filho (2006), together with the price level for England from Twigger (1999) and the domestic price level of Lobo (1971), which contains beef jerky prices.

Two other series were tested in the empirical analysis but were discarded. The first one is Bértola (1998) estimations of the cattle industry in Uruguay. The first impediment to use the data is that it begins in 1870, at the latter half of the present analysis. The other difficulty is that the estimations do not relate only to beef jerky production and, as will be demonstrated at the next section, Uruguay began to increasingly diversify its exports away from beef jerky after 1870. The other series tested refers to Brazilian coffee exports, whose labor force represented the main market

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[10] The data is from the Public Archive of Rio Grande do Sul.

for beef jerky. The reason this variable was excluded is that is highly correlated with the real exchange rate. Also, since annual data is used, the limited number of observations requires a certain restrain in the number of parameters to be estimated. Other information that should be noted comes from graph 5. As previously stated, both beef jerky and salt prices were deflated using Lobo's price index. However, as the real exchange rate graph also shows, the price index probably distorts the real prices before 1855.

Graph 5: Beef Jerky and Salt Prices (Mil-Réis)
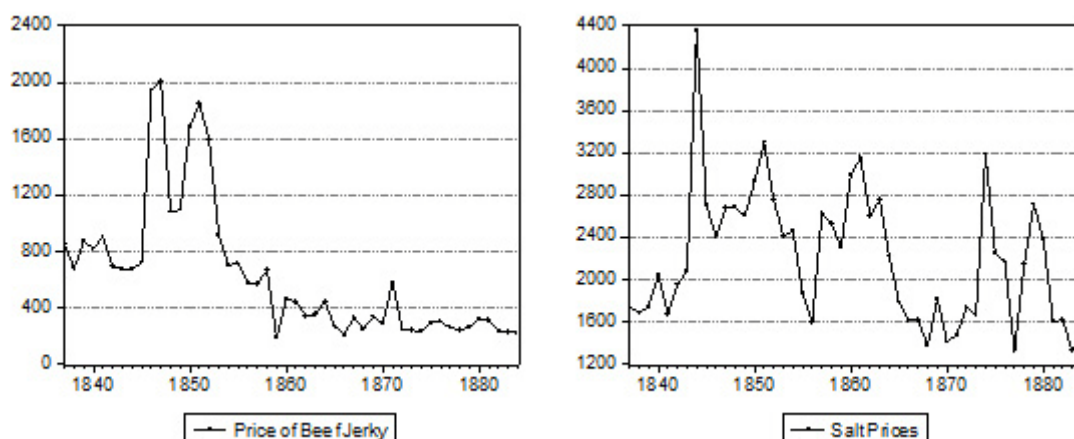
The first step to analyze the relationship between variables is to verify if the series are stationary. The appendix presents the results for the unit root tests, which show that all variables, expect salt prices, are integrated of order 1. Since the interest of the paper relies on analyzing long term processes and not their rates of change, a Vector Error Correction model (VECM) is used to accommodate the nonstationary features of the data. To test for the existence of a long-run equilibrium relation between the variables, a cointegration analysis using the Johansen procedure is presented in the appendix. Given that the series presents strong fluctuations in some specific periods, all variables are transformed to their logarithmic form to minimize heteroskedasticity issues (Banerjee et al, 2003).

Using the Johansen procedure, both Maximum Eigenvalue and Trace statistics indicate the existence of one cointegration vector for the logarithm of Beef Jerky Exports (LQ), Prices (LP), Slave Prices (LS) and real exchange rate (LRER). Since Salt Prices (LSA) is stationary, this variable is incorporated as exogenous in the VECM. Two exogenous year dummies are also used. One dummy is in 1883 (d1883), related to

the plunge in prices in anticipation to the local end of slavery. The other is for the year 1842 (d1842), for the real exchange rate series. Also, to comply with the assumptions of the model, the appendix presents statistics for the LM autocorrelation test and normality tests for the VECM residuals. The results for the cointegration vectors and its adjustment coefficients are presented in table 3.

Table 3: Vector Error Correction Estimates

Long Run Parameters	LQ(-1)	LP(-1)	LRER(-1)	LS(-1)	Constant
	1.000	1.190	-0.668	0.205	-16.709
		[4.54]	[-1.60]	[0.56]	
Error Correction Term	D(LQ)	D(LP)	D(LRER)	D(LS)	
	-0.344	-0.202	-0.075	0.025	
	[-3.86]	[-1.78]	[-2.93]	[0.40]	
Short Run Parameters					
D(LQ(-1))	-0.45	0.29	-0.04	0.015	
	[-3.53]	[1.82]	[-1.25]	[0.16]	
D(LP(-1))	0.16	-0.11	0.03	0.05	
	[1.22]	[-0.64]	[0.82]	[0.55]	
D(LRER(-1))	0.64	-0.24	-0.48	0.22	
	[1.62]	[-0.48]	[-4.17]	[0.80]	
D(LS(-1))	0.11	-0.007	-0.06	-0.27	
	[0.59]	[-0.29]	[-1.12]	[-2.02]	
Constant	-0.06	-1.36	-0.82	-0.41	
	[-0.04]	[0.85]	[-2.26]	[-0.47]	
LSA	0.19	0.17	0.10	0.05	
	[0.11]	[0.82]	[2.17]	[0.49]	
D1842	0.03	-0.38	0.38	0.18	
	[0.11]	[-0.99]	[4.32]	[0.84]	
D1883	0.04	-0.06	0.07	-0.77	
	[0.14]	[-0.17]	[0.86]	[-3.58]	
Adj. R-Squared	0.41	0.24	0.58	0.38	
SSR	3.158	5.109	0.263	1.537	
F-Statistic	5.030	1.503	6.430	2.938	

46 observations, t-statistics in [ ]

Since the VECM relates to simultaneous representations of a system, its individual coefficients do not have a clear interpretation. The primary interest relies on the error correction terms, which show if variables adjust in the short run to deviations from equilibrium. From table 3, the only variable that does not adjust is Slave Prices. The error correction term equals to zero means that this variable is weakly exogenous (Burke, Hunter 2005). Also, the long run parameter of the real exchange rate is not different from zero, meaning that this variable is exogenous in the long-run.

From the results, the error correction parameters must be consistent with the proposed model. From the three variables that have an error correction term, the Real Exchange Rate does not behave in a way as to correct short term deviations.[11] The low coefficient (-0.07) represents that this variable is acting in a very weak manner against adjustment. As expected, quantity and prices are responsible for the adjustment to deviations from equilibrium. To better understand the impact between variables we present in table 4 results from variance decomposition analysis for five periods. From these results, there is no evidence that changes in slave prices had a significant impact on the quantity and prices of beef jerky exports. For the real exchange rate, there is some small impact on the quantity exported.

Table 4: Variance Decomposition of Quantity and Prices of Beef Jerky Exported

Period	LQ	LP	LRER	LS
Quantity				
1	100.00	0.00	0.00	0.00
2	92.10	3.18	4.64	0.06
3	82.30	14.09	3.16	0.44
4	75.30	20.65	3.68	0.35
5	69.76	26.51	3.26	0.45
Prices				
1	26.09	73.90	0.00	0.00
2	24.02	75.89	0.03	0.04
3	29.59	70.21	0.12	0.06
4	32.47	67.19	0.11	0.20
5	35.43	64.20	0.12	0.24

As the interest relies on the impact of shocks in the real exchange rate and slave prices in the beef jerky productions, to complement the previous table, graph 6 presents results of an Impulse Response Analysis for 10 periods. As slave prices don't have any impact (less than 0.3 percent) on quantity exported and price, we only present the graph for the real exchange rate.

The quantitative analysis presented in this section does not provide evidence that the rise in slave prices had a negative impact on the beef jerky production. There was some impact on the exchange rate on the quantity of exports but its effect is small and cannot be used as an important factor for production stagnation in Rio Grande do Sul.

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[11] Also, since we fail to reject that the long term coefficient is different from zero at 95%, it can be stated that the RER is long-run exogenous.

Graph 6: Impulse Response Analysis of LQ to LRER
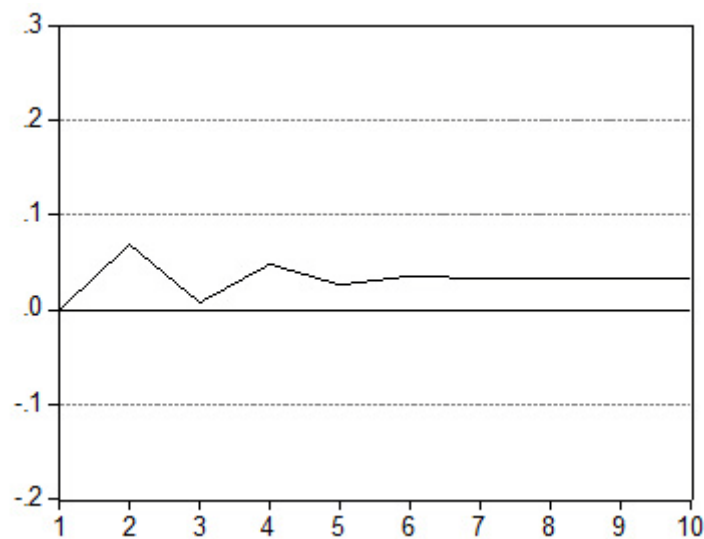
5. CONCLUSION

Beef jerky's production decline was not restricted to Brazil, it was a global phenomenon. The end of slavery in several countries across the Americas at the second half of the nineteenth century and an increase in wages in Europe's consumers markets led to the consumption of better quality products. Tariff protection and political instabilities in Uruguay benefited Rio Grande do Sul beef jerky production until the end of the 1860's, when with the loss of its privileged position it acquired a new market share. We provide evidence that differences in labor regimes cannot be accounted for the different trajectories in livestock between the regions. We also found that despite some effect of real exchange in prices, the effect is too small for being accountable as the reason of the sector decline. With the new series on Rio de Janeiro market prices, it can be stated that both products had similar prices and different market shares were related to product quality and higher productivity in Uruguayan production.

With the estimates that wage labor was more expensive, Uruguay also had incentives to use more capital intensive production, since its labor costs were higher than in Brazil. Therefore, Uruguay cattle industry's growth came with its diversification in exports, especially canned and refrigerated meat. The foreign investment from British companies, that made the Uruguayan transition possible, was absent across the border. These results indicate that the increase in beef jerky production in Uruguay was probably a result from an increase in non salted meat. As happened in the United States,

the increase in non salted preserved meat led to an increase in cattle stock from which inferior pieces were used to produce beef jerky.

The international demand, represented by European markets, had changed, and Uruguay managed to transform and diversify its industry to meet consumers' needs. Even though it could not face United States meatpacking industry, the Rio do Prata region made substantial improvements in the last quarter of nineteenth century. At the same time, Rio Grande do Sul industry stagnated: the beef jerky remained crucial to the province while it was not anymore for other regions.

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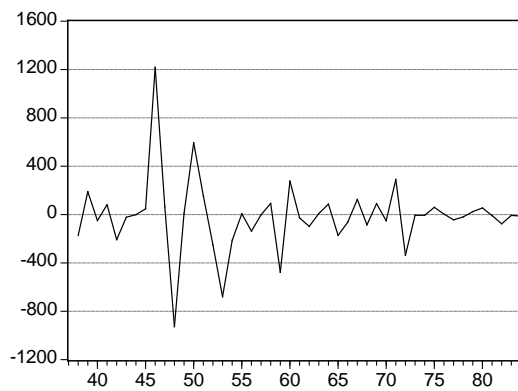
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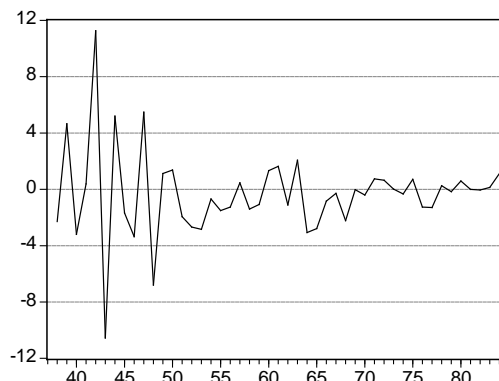
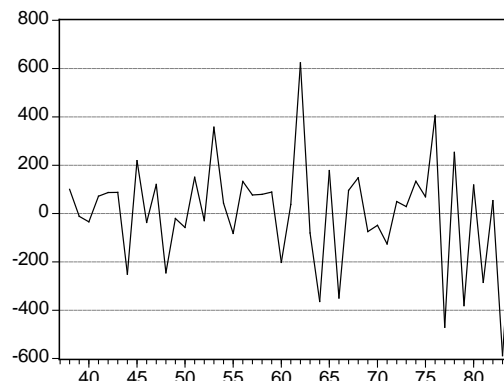**APPENDIX A:**

1 – Heteroscedasticity analysis.
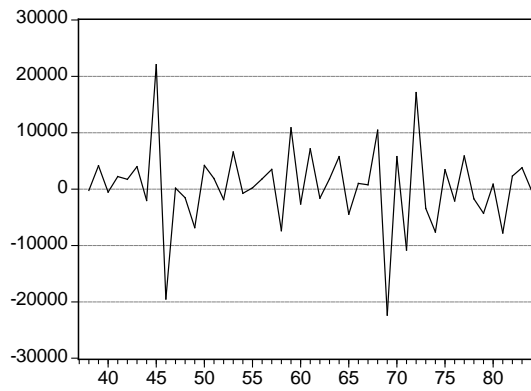
D(Quantity)
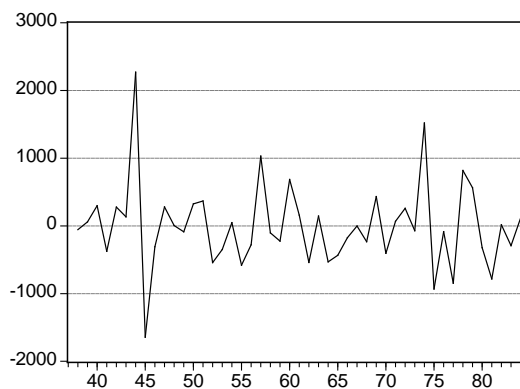

D(Prices)

D(RER)

D(Slave Prices)

D(Salt Prices)

Since the series present evidence of heteroskedasticity, we use the logarithm transformation.

2 – Unit Root Tests.

2.1 - ADF - Dickey e Fuller

According to Dickey and Fuller (1981) for a sample size of 50 and probability of 0,95, the critical values for the constant and trend are, respectively, 3,14 and 2.81. Using information criteria (AIC, SIC and HQ) to select the number of lags, table 1 presents the statistics for the model with constant and trend, while the third column is for the model with only a constant. From these results, the model with constant and trend is not appropriate for the variables LQ, LS e LSa, while the model with a constant is not appropriate for the variable LS.

Table 1: Statistics for trend and constant models

	Statistic (trend and constant)		Statistic (constant)
LQ @trend	1.009	LQ constant	**4.309**
LP @trend	**-2.923**		
LRER @trend	**-2.814**		
LS @trend	-1.391	LS constant	2.073
LSa @trend	-1.752	LSa constant	**3.345**

Using these different specifications, the following table presents the ADF unit root statistics for the five variables. Since the null hypothesis is for the existence of a unit root, we find evidence for a unit root in LRER and LS. The variable LP rejects the null at 5 percent but not at 1 percent. The variables LQ and LSA do not present evidence of unit roots.

Table 2: ADF unit root test

	LQ	LP	LRER	LS	LSA
DF test Statistic	-4.221	-3.568	-3.012	-0.040	-3.351
Critical Value (5%)	-2.926	-3.508	-3.508	-1.612	-2.925

2.2 - DF-GLS – Elliott, Rothenberg e Stock

Since the inclusion of deterministic terms may result in lower power for the ADF statistical test, we use the DF-GLS unit root test. We use this test with the variables LQ, LP, LRER and LSA, which have deterministic trends. The number of lags were selected based on the SIC criteria. Based on the test results, we find evidence for unit roots on the variables LQ, LP and LRER. The variable LSA is stationary.

Table 3: DF-GLS Unit Root Test

	LQ	LP	LRER	LSA
ERS DF-GLS test statistic	-0.855	-3.509	-2.752	-3.122*
Critical Value (1%)	-2.615	-3.770	-3.770	-2.615
Lag Length (SIC)	1	0	0	0

2.3 - KPSS - Kwiatkowski, Phillips, Schmidt e Shin.

As a way to verify the previous results, we also use the KPSS unit root test. The null hypothesis of this test is that the variable is stationary. To select the model specification we use graphical analysis of the variables, presented in table 1. For lag selection, we use the Newey-West information criteria with Barlett Kernell as the spectral estimation method. The statistic also provides evidence that all variables, except LSA, have a unit root.

Table 4: KPSS unit root test

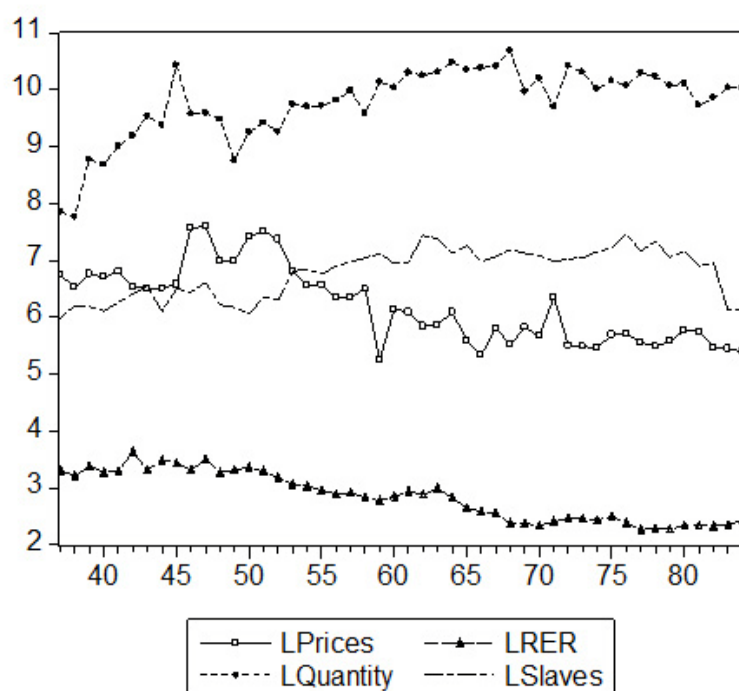|	LQ	LP	LRER	LS	LSA
KPSS test stat Const	0.663*	0.720*	0.841*	0.564*	0.336
Critical Value C (5%)	0.463	0.463	0.463	0.463	0.463
KPSS test stat Trend	0.190*	0.103	0.095	0.201*	0.109
Critical Value T (5%)	0.146	0.146	0.146	0.146	0.146
Bandwidth	5	4	5	4	3

Figure 1: Variables trends (logs)

3 - Lag Criteria for the Vector Error Correction Model:

With four variables I(1), the following table shows that one lag is an adequate selection for the model.

Table 5: VAR Lag Order Selection Criteria

Lag	LogL	FPE	AIC	SC	HQ
1	30.50617	5.71e-06*	-0.725308	-0.049757*	-0.481050*
2	46.23700	5.89e-06	-0.711850	0.639254	-0.223334
3	60.43677	6.81e-06	-0.621838	1.404817	0.110936
4	74.20539	8.52e-06	-0.510270	2.191938	0.466763
5	88.04650	1.17e-05	-0.402325	2.975434	0.818966
6	104.8820	1.59e-05	-0.444102	3.609208	1.021447
7	113.4825	4.16e-05	-0.074123	4.654739	1.635684
8	169.1074	1.64e-05	-2.055368*	3.349046	-0.101303

Sample 1837-1884, 40 observations. Endogenous variables: LQ, LP, LRER, LS.

3.1 - Johansen Procedure:

Based on the previous graphical analysis of the nonstationary variables, we assume a model with a constant inside the cointegration vector and another on the VAR. Both the trace and maximum eingenvalue statistics indicate the existence of a cointegration vector.

Table 6: Johansen Cointegration Vector Test

	Unrestricted Cointegration Rank Test (Trace)			
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value 0.05	Prob. **
None *	0.557964	57.88214	47.85613	0.0043
At most 1	0.228640	20.32945	29.79707	0.4007
At most 2	0.118850	8.387854	15.49471	0.4249
	Unrestricted Cointegration Rank Test (Maximum Eigenvalue)			
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	Critical Value 0.05	Prob. **
None *	0.557964	37.55269	27.58434	0.0019
At most 1	0.228640	11.94159	21.13162	0.5534
At most 2	0.118850	5.820244	14.26460	0.6364

Sample 1839-1884, 46 observations. Series: LP, LQ, LRER, LS.
Trend assumption: Linear deterministic trend
Lags interval (in first differences): 1 to 1

4 – Residual Test

For the residual vector to conform to the assumptions of the model, the residuals cannot be autocorrelated and should have a normal distribution. To test for autocorrelation, we use the LM test. For the normality hypothesis, we use the Cholesky test. The LRER and LS did not have normal residuals due to two outliers. Therefore, we

use one dummy for the LRER variable for the 1842 and another for the LS variable for the year 1883. The null hypothesis for the LM test is no serial correlation at lag order h.

Table 7: VEC Residual Serial Correlation LM test

Lags	LM-Stat	Probability
1	17.87280	0.3314
2	19.64557	0.2366
3	10.52889	0.8376
4	15.75987	0.4698
5	11.97683	0.7456

Sample 1837-1884, 46 observations.

Table 8: VEC Residual Normality test

Component	Skewness	Chi-sq	df	Probability
1	0.133134	0.135888	1	0.7124
2	-0.106905	0.087620	1	0.7672
3	0.266783	0.545660	1	0.4601
4	-0.272250	0.568254	1	0.4510
Joint		1.337423	4	0.8550
Component	Kurtosis	Chi-sq	df	Probability
1	1.731522	3.083984	1	0.0791
2	2.208278	1.201412	1	0.2730
3	1.917748	2.244931	1	0.1341
4	2.400673	0.688453	1	0.4067
Joint		7.218780	4	0.1248
Component	Jarque-Bera		df	Probability
1	3.219873		2	0.1999
2	1.289032		2	0.5249
3	2.790591		2	0.2478
4	1.256707		2	0.5335
Joint	8.556203		8	0.3811

Sample 1837-1884, 46 observations. Orthogonalization: Cholesky (Lutkepohl).
H0: residuals are multivariate normal.

5 – Exogeneity tests

Since the cointegration coefficient of the variable LS is not different from zero, it can be stated that this variable is weakly exogenous. To reinforce this result, the LR test is carried out to the relationship between exogeneity and cointegration.

Table 9: LR Test

Cointegration Restrictions: A(4,1)=0 (Convergence achieved after 9 iterations)	
LR test for binding restrictions (rank = 1)	
Chi-square(1)	0.193767
Probability	0.659799

The test statistic does not allow the hypothesis, that the LS variable is weakly exogenous, to be rejected. Strong exogeneity implies, besides the existence of weak

exogeneity, that the variable has temporal precedence (Granger causality). From the result of the following table, LS is not strong exogenous.

Table 10: Granger Causality Test

Null Hypothesis:	Obs	F-Statistic	Probability
D(LS) does not Granger Cause D(LQ)	46	0.04937	0.82521
D(LQ) does not Granger Cause D(LS)		1.8E-07	0.99967
Lags: 1			

APPENDIX B: DATA

Year	RER	Quantity	Prices	Slave Prices	Salt Prices
1837	27,30	2601	854,21	400,00	1744
1838	25,02	2360	681,09	500,16	1689
1839	29,68	6497	871,23	488,15	1749
1840	26,49	5959	821,95	453,94	2047
1841	26,88	8187	904,07	525,67	1673
1842	38,14	9932	697,61	612,49	1951
1843	27,60	13910	676,11	699,95	2084
1844	32,80	11888	676,04	448,74	4354
1845	31,12	33963	724,30	667,19	2712
1846	27,76	14496	1942,26	630,15	2404
1847	33,24	14671	2008,08	750,50	2684
1848	26,45	13138	1082,96	505,20	2690
1849	27,58	6318	1094,38	484,47	2604
1850	28,95	10515	1688,48	426,44	2929
1851	27,01	12386	1846,00	576,36	3298
1852	24,34	10541	1596,34	547,02	2757
1853	21,50	17128	917,63	904,12	2408
1854	20,82	16387	705,07	946,60	2457
1855	19,31	16617	712,31	863,84	1878
1856	18,05	18436	575,77	996,75	1600
1857	18,52	21930	574,28	1073,51	2631
1858	17,12	14559	668,22	1152,45	2528
1859	16,05	25433	191,91	1241,16	2305
1860	17,38	22808	469,77	1038,67	2991
1861	19,02	29956	443,47	1075,97	3149
1862	17,92	28341	346,82	1699,21	2609
1863	19,99	30171	355,55	1618,79	2754
1864	16,93	35952	442,69	1254,50	2223
1865	14,15	31518	271,44	1432,43	1790
1866	13,32	32532	208,20	1082,60	1616
1867	13,04	33315	334,69	1178,35	1616
1868	10,82	43748	250,11	1326,12	1383
1869	10,80	21406	340,52	1251,33	1817
1870	10,40	27190	290,46	1202,58	1412

1871	11,15	16394	582,47	1076,33	1481
1872	11,80	33513	247,28	1125,64	1741
1873	11,82	30087	241,77	1154,15	1669
1874	11,50	22491	236,74	1287,86	3188
1875	12,21	25937	297,95	1357,02	2257
1876	10,95	23847	303,69	1762,62	2172
1877	9,66	29734	261,25	1291,98	1327
1878	9,92	28005	242,05	1545,01	2145
1879	9,76	23709	266,80	1163,61	2710
1880	10,36	24575	321,97	1281,42	2388
1881	10,36	16818	313,97	996,09	1606
1882	10,32	19130	238,82	1049,31	1622
1883	10,46	22925	232,92	461,28	1330
1884	11,59	22644	221,62	459,51	1454