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## THE ECONOMIC CONSEQUENCES OF ARGENTINE INDEPENDENCE\*

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### ABSTRACT

*After de facto Independence from Spain in 1810 the economy of Buenos Aires enjoyed a dramatic improvement in its terms of trade, in the order of 400%. The removal of mercantilistic restrictions imposed by Spain as well as the reduction in transport costs produced a significant and gradual change in the prices of exportables and importables, as local prices converged towards international prices. The response of the Argentine economy was along the principles of the Theory of Comparative Advantage, that is, the production of exportables increased and the supply of goods competing with imported goods fell. Because exportables were capital and land intensive, and importables labor intensive, the rewards of capital and land increased sharply and wages fell.*

### RESUMEN

*Después de la independencia de hecho de España en 1810, la economía de Buenos Aires gozó de una mejora dramática en sus términos de intercambio, del orden del 400%. El retiro de las restricciones mercantilistas impuestas por*

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*España, así como la reducción en el costo del transporte, produjo un cambio significativo y gradual en los precios de los bienes exportables e importables, pues los precios locales convergieron hacia los precios internacionales. La respuesta de la economía argentina se alineó con los principios de la teoría de la ventaja comparativa, es decir, la producción de los bienes exportables creció y la oferta de productos que competían con los bienes importados bajó. Los beneficios del capital y de la tierra aumentaron y los salarios cayeron dado que los bienes exportables eran capital y tierra intensivos, y los bienes importables trabajo intensivos.*

## 1. INTRODUCTION

The territory that is now Argentina underwent a *de facto* separation from Spain in 1810, officially declaring its independence in 1816. Undoubtedly the separation had notable political and military consequences, such as the establishment of an autonomous form of government and regional leadership in the struggle against remaining Spanish power; thus these processes have attracted the attention of numerous scholars. However, the separation from Spain also had a strong economic impact, especially in the period between 1810 and 1825, during which there occurred a marked improvement in the terms of trade (approximately 400%), that has not received the same attention.

This study will document this phenomenon's existence while also examining the economic effects of the massive change in relative prices. First, we quantify the magnitude of the variation in the terms of trade and describe its causes. Next, we present the main implications of the conventional model of international trade in which the improvement in the terms of trade results in an increase in the rewards of the productive factors used intensively by exportable goods, whose production grows. In addition, this variation causes a reduction in the price of the factors that are used intensively for importable goods, whose production is reduced (Stolper-Samuelson Theorem). The predictions of the model are then contrasted with the changes observed in the economy. This analysis will be limited to Buenos Aires, a region that included the former capital of the Viceroyalty of Río de la Plata, and the surrounding countryside. In 1810 it had about 80,000 inhabitants, approximately half of which resided in the city of Buenos Aires. In this same year, the countryside had about two million hectares used for agriculture and cattle raising.

## 2. THE COLONIAL COMMERCE SYSTEM

The Spanish Empire applied mercantilist regulations on its colonies that were similar to that of other Empires, such as the British. This system affected the domestic price of traded goods due to the following factors:

- a) All products exported from or imported to America were required to pass through a Spanish port, typically Cádiz. As the majority of Argentine exports, primarily consisting of hides, were destined for the European nations, this implied an increase in transportation costs due to the impossibility of using direct routes. The same occurred with a large part of Argentine imports, which consisted of European manufactured articles re-exported by Spain.
- b) The transport of merchandise between American and Spanish ports had to be done in Spanish ships, while the transport between the Spanish and European ports was carried out by non-Spanish vessels. The unloading and re-loading of merchandise increased the transportation costs, a factor that was exacerbated by the high price of the Spanish freightage versus other more economical options. According to one estimation, Spanish freightage was at least double that of the British freightage of the period.<sup>1</sup>
- c) All exports from and imports to America had to be done through a Spanish firm, precluding the use of foreign merchant houses. This factor limited competition, increasing financial expenses and intermediation costs.
- d) Spain also imposed various taxes on the products that took part in international trade. Taxes were paid on Argentine hides upon leaving Buenos Aires, entering Spain, and again upon leaving Spain. The sum of these duties represented from 70% to 100% of the original value of the product.<sup>2</sup> A non-Spanish manufacture imported by the colony paid taxes upon entering Spain, leaving Spain, and again upon entering Buenos Aires. The total amount of taxes authorized on imported products reached around 40%.<sup>3</sup> The imports of some European products, such as British cotton textiles, or non-Spanish wine and oil, was prohibited.

All of these factors reduced the domestic price of exports and increased the price of imports. However, cracks appeared in this scheme with the Napoleonic Wars, when the metropolis could not maintain the mercantile structure. From 1797 until 1799, Spain authorized direct trade between its colonies and neutral nations, as Great Britain had blocked Spanish ports. After 1805, when the European conflicts began anew, Spain again authorized trade with neutral nations. The British invasions of Buenos Aires in 1806 and 1807 promoted trade with Great Britain for a short time. Undoubtedly all these events weakened the Spanish mercantilist system, although it should be noted that they were transitory measures, taken in a context of international conflicts that were themselves making trade more difficult

<sup>1</sup> This comparison is of the freightage from London to an American port, versus freightage from Cádiz. See Walton, 1810, ii, pp. 155-156.

<sup>2</sup> The relative weight of the tax depended on the value of hides in Argentina. See Saguier 1991, pp. 111-112.

<sup>3</sup> Bliss, 1959, p. 20.

and expensive. According to an estimate wartime transport costs were six times those of peacetime.<sup>4</sup> The war, therefore, acted as a factor that was capable of neutralizing the convergence between domestic and international prices. Finally, it should be mentioned that throughout the colonial period there was considerable smuggling of exports as well as imports. According to an estimate, almost half of the European products that arrived in Buenos Aires did so illegally.<sup>5</sup> Although smuggling also functioned as a liberating factor of trade, the risk of illegal transactions, and the high transaction costs they implied, put a limit on its effects on price convergence.

### 3. TERMS OF TRADE AND PRICE CONVERGENCE

The liberalization of trade in Buenos Aires began some months before the *de facto* separation from Spain. The alliance of Great Britain with Spain beginning in 1808 paved the way so that by the end of 1809 the last Spanish Viceroy declared the freedom to trade with foreign ships (primarily British), as long as it was done through a Spanish resident of Buenos Aires. The traded goods continued paying the colonial tariffs although the transportation costs were reduced, both by avoiding the stop in Spain and using more economical freightage. After the separation from Spain in May of 1810, commercial freedom expanded, as the restriction on the nationality of the merchant was eliminated. In addition, there were no longer prohibited products of any kind. Moreover, the export taxes paid by hides was appreciably reduced, falling from 50% to 10%, and eventually dropping to 4% in 1822.<sup>6</sup> The import duties, more difficult to estimate, maintained the average colonial levels, with some fluctuations, of about 40%, falling to 21% by 1822.<sup>7</sup> Added to these factors was the drop in freightage produced by the end of the Napoleonic Wars and the conflict between Great Britain and the United States, a very important factor due to its strong repercussions on the final price of the most voluminous products. Although there are no estimations of the shipping costs between Buenos Aires and European or North American ports between 1810 and 1825, there must have been a drop similar to other Atlantic shipping costs, which were reduced at least by 50%.<sup>8</sup> Finally, economic independence meant that the merchant houses could act more freely and efficiently. The installation of numerous British firms in Buenos Aires meant having intermediaries who knew well the principle market for hides and more relevantly, who had access to the most important capital market of the time. In both cases this was Great Britain.

<sup>4</sup> Saguier, 1991, p. 111.

<sup>5</sup> Bliss, 1959, p. 25. See also Villalobos, 1986.

<sup>6</sup> See Street, 1967, p. 164 and *Registro Oficial de la Provincia* (1873), vol. 1821, p. 115.

<sup>7</sup> The colonial tariff was estimated based on Humphreys, 1940, *British*, p. 30 and Bliss, 1959, *Del Virreinato*, p. 41.

<sup>8</sup> See North, 1958, Cuenca, en Barbier y Kuethe, 1984, and Harley, 1988.

The trade liberalization produced, over time, a convergence of domestic and international prices. Table 1 shows the price of exported and imported products in 1810 and 1825:

TABLE 1  
PRICE OF EXPORTS AND IMPORTS AND TERMS OF TRADE  
(in silver pesos)

Exports	1810	1825
Cow hide (35 pounds)	1,7	6,2
Horse hide (unit)	0,45	0,84
Tallow (25 pounds)	1,8	1,7
Salted meat (100 pounds)	1,7	4,2
Price of exports	100	334
Imports		
Yerba from Paraguay (25 pounds)	1,8	3,2
Oil (small jar)	3,5	1,4
Cocoa from Guayaquil (100 pounds)	17,2	10
Rice from Brazil (25 pounds)	1,9	1,5
Sugar from Brazil (25 pounds)	2,3	3,1
Wine from Malaga (pipe)	138,7	78,7
Gin from Holland (pipe)	149	75
Cotton canvas (piece)	27,5	20,5
Silesian linen (piece)	23,6	9,5
Silk serge (yard)	5,1	1,8
Silk sowing thread (pound)	13,5	5,2
Paper (ream)	11,4	3,5
Price of Imports	100	70
Terms of Trade	100	477

Source: 1810: Average of the current prices listed in the *Correo de Comercio* of March 24, 1810; April 28, 1810; October 20, 1810 and September 1, 1810. 1825: Average of current prices listed in the *Gaceta Mercantil* of March 26, 1825; April 23, 1825; September 3, 1825 and October 22, 1825. The price of salted meat corresponds to Montevideo, and was taken from the *Correo de Comercio* of March 24, 1810 and July 18, 1810. To establish the evolution of the general price of imports each product was weighted in relation to its value, according to Humphreys 1940, p. 44. The weights were, in the order appearing in the table: 0,82; 0,08; 0,03; 0,07. To establish the evolution of the price of imports the values appearing in Humphreys, 1940, p. 56 (annex) was used. The index is not optimal, since the prices of some important imported goods, such as common cotton cloth, were not found. To avoid their under-representation, textiles were given a general weight of 50%, according to the weight textiles had in total imports. Within textiles, each variety was weighted identically. The rest of prices, corresponding to other products (the other 50% of the weight) were weighted according to the values they presented. The weights were, in the order appearing in the table: 0,083; 0,008; 0,006; 0,016; 0,129; 0,12; 0,089; 0,125; 0,125; 0,125; 0,125; 0,048.

The price of all exports increased significantly, by 234%. Especially notable are hides, which almost quadrupled in value. Considering that international prices of Argentine exports experienced only a slight increase,<sup>9</sup> what is observed is a strong convergence between the CIF and FOB values of exports, for the reasons mentioned above. On the other hand, the prices of imports fell about 30%. The imported products had different situations. American products, such as *yerba mate* and sugar, increased in value. The price of the rest of the products was appreciably reduced. The price of textiles, the most important import item, fell to at least half of their initial value. The increase in export prices, together with the reduction of import prices implied an improvement in terms of trade of 377%. Observers of the period noted this huge change in relative prices. One report prepared by British merchants of Buenos Aires in 1824 indicated that “. . . while the colonial system existed, all manufactures and other European goods sold at three times their present prices; while the produce of the country was given in exchange at a fourth part of what is now paid for it.”<sup>10</sup> According to the report there had been extraordinary progress in trade, although it did not fail to mention that there had been a disparate impact on distinct sectors of the economy.

#### 4. ANALYTICAL FRAMEWORK: THE NEOCLASSIC MODEL OF INTERNATIONAL TRADE WITH THREE GOODS AND TWO PRODUCTIVE FACTORS

To characterize the economy of Buenos Aires, a traditional neoclassic model of international trade (Factor Proportion Model) with three goods and two productive factors can be used. In particular, the model assumes the existence of three different productive sectors: exportable goods (X), importable goods (M) and non-traded goods (N). It also supposes that goods are produced with production functions subject to linear returns to scale that utilize in different and variable proportions two factors of production: capital (K) and labor (L). The third factor of production relevant to the analysis of the economy of Buenos Aires, land, is assimilated into factor K. This economy is supposed to take the prices of tradable goods as given, since the region could not influence the international market. In addition, the total endowment of both factors is assumed to be initially fixed for the region<sup>11</sup>. However, perfect mobility of the (homogenous) labor factor is supposed to exist between the different sectors of production. Regarding the capital-land factor, it is assumed that in the short term it is fixed in the sector to which it was originally assigned, but that it is mobile in the medium and long term. Even when the factors increased significantly in the period under analysis (1810-

<sup>9</sup> The increase was 7%. For an estimate of the evolution of international prices related to Argentina, see Newland, 1998.

<sup>10</sup> Humphreys, 1940, p. 30.

<sup>11</sup> Although the factors of production grow between 1810 and 1825, they increase in similar proportions.

1825), the analysis is conducted maintaining the endowments as given by the Rybczynski Theorem (Rybczynski (1955)) that affirms that for a given level of prices of the final goods an increase in productive factors will not affect the remuneration of the factors. A model where all reference to monetary variables is absent has been chosen, based on the fact that the currency circulating in the region of Buenos Aires was made up almost exclusively of silver pesos convertible into silver. The main predictions of the model (developed in the appendix) are illustrated in Figure 1 using the traditional Lerner and Pierce Iso-Value Curve. The figure is depicted in the space of  $r$  and  $w$ , the rental prices of  $K$  and  $L$  respectively.

FIGURE 1

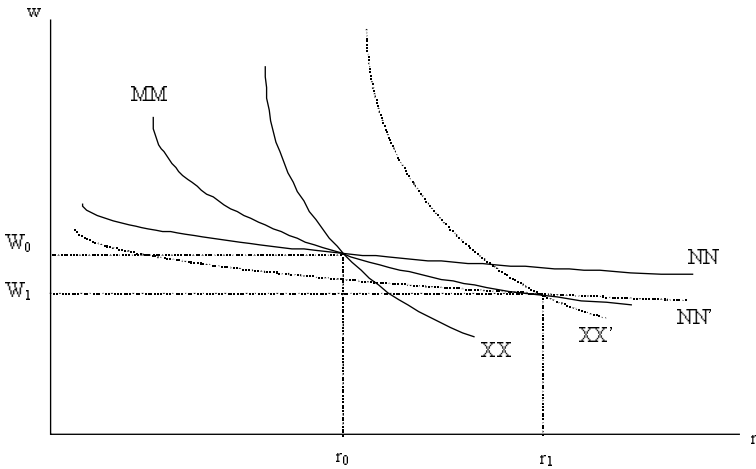
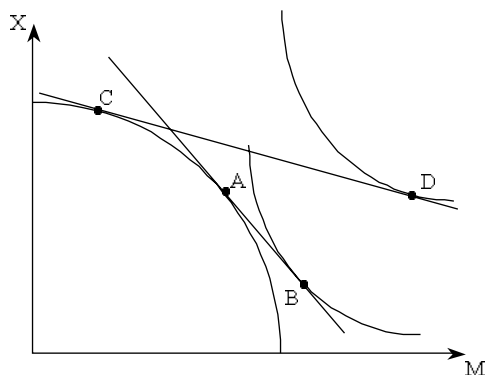


Figure 1 shows that under the assumptions made above the increase in the price of good  $X$  shifts the exportable Iso-Value Curve from  $XX$  to  $XX'$ , causing  $NN$  (the Iso-Value Curve of the non-traded goods) to shift to  $NN'$  due to a reduction in the price of  $N$ . As can be seen, in the new equilibrium the interest rate increases and the wages decrease in absolute terms. In addition, it can be observed that in the new equilibrium the three goods are produced, as would be expected, making use of less capital-intensive techniques (in the new equilibrium the tangents of these curves are less steep).

In Figure 2 one can observe that the final result implies an increase in the quantities of  $X$  produced and a drop in the levels of  $Y$  (illustrated by the movement in the graph from  $A$  to  $C$ ). Also, there is an increase in the levels of utility thanks to which the members of this economy now face more favorable international terms of trade which permitted them to move through the boundary of consumption possibilities frontier to  $D$ , the new equilibrium for quantities consumed. It is this increase in the production of  $X$  together with the drop of  $Y$  that generates an excess demand for the factor used intensively for the exported good and an excess supply of the scarce factor (labor).



FIGURE 2



In the short term, however, capital is specific to each of the three sectors of this economy (as in Neary (1978)), thus the model has under these circumstances three goods and four factors (the three distinct capital stocks and homogeneous labor). So, the nominal wages will grow because of the effect of the rise in the price of exportable goods, which will provoke labor to flow toward that sector.<sup>12</sup> Given that capital (and land) are, in the short term, specific to each sector, the payments to that factor used in the production of exports will increase for two reasons: because the final price of exported goods grows and because the marginal physical productivity of capital also went up due to the increase in the availability of the complementary factor, labor. The import sector, in turn, will see income reduced on its capital stock, while it loses labor that is displaced towards the export sector. The prices of the non-tradable goods increase due to a rise in their demand generated by a positive income effect (if N is normal goods) and by the substitution effect (due to the increase in the price of exports).

## 5. PREDICTIONS AND HISTORICAL EVIDENCE

After Independence, the economy of Buenos Aires exported almost exclusively pastoral products, produced with intensive use of land and capital (cows). The other activity connected to the use of land –agriculture– was more labor intensive.

As was described in the previous section, the conventional theory of trade predicts that, over the long term, given the change in the terms of trade this economy will produce: 1) an expansion in the production of the exportable good (cattle raising) and a decline in the importable goods (among others agriculture), together with a gradual emigration of the factors towards cattle raising; 2) an

<sup>12</sup> Edwards, 1988, studies this situation in detail.

increase in the remuneration of capital and land; and 3) a drop in wages. Given the scarce availability of data, our analysis will be conducted in analyzing the effects on the economy after a long-term period. A comparison of these long-range predictions with the historical evidence follows:

*Expansion of ranching and decline of agriculture*

Between the years of 1810 and 1825 there was a very notable expansion of cattle raising. A comparison of the cattle exports from 1811-1815 with those of 1821-1825 shows that its value practically triples.<sup>13</sup> The cattle stock increased considerably, almost doubling (see Table 2). With the new prices of cattle products, the *estancieros* made an effort to increase the number of animals, which implied that the quantity of hides offered did not initially increase. Moreover, the quantity of land grew appreciably, doubling, at the expense of the territory occupied by the indigenous. In the years 1810-1825, the frontier moved toward the south of its colonial limit, the Salado River. In 1817 the town of Dolores was founded in the new territory and in 1823, after a military campaign against indigenous inhabitants, so was the town of Tandil.

TABLE 2  
EVOLUTION OF PASTORAL PRODUCTION AND POPULATION IN BUENOS  
AIRES, 1810 AND 1825

	1810	1825
Urban population	42872	59154
Rural population	37168	75307
Total population	80040	134461
Land (millions of hectares)	2,25	4,2
Land (millions of hectares)	5,1	12,4
Cattle (millions)	1,5	2,8

Source: Population was estimated based on Amaral, 1998, p. 166. The first land estimate is according to Amaral, 1998, p. 118 (see text). The second estimate of land is the surface inside the frontier presented in the map included in García Belsunce, 1976, p. 161. Cattle stock was estimated according to Garavaglia, 1990, p. 230 and Amaral, 1998, p. 122.

The countryside of Buenos Aires had been an important producer of wheat during the colonial period. The wheat was not only cultivated to supply Buenos Aires, but also for export to other markets. However, the agricultural situation became worse after the revolution. The export of wheat stopped in 1817; in 1819 Chilean wheat was imported and, from 1820, flour was acquired from the United States. The imported quantities were significant. In 1822 approximately 48,000 barrels of flour arrived, in 1823 over 65,000.<sup>14</sup> That a region with abundant

<sup>13</sup> Newland, 1998, p. 410.

<sup>14</sup> Parish, 1839, p. 36.

land would import flour shocked foreigners, one of them commenting, "That a nation of such fertile lands must buy its bread abroad is astonishing."<sup>15</sup> The reduction of the agricultural sector is reflected in the drop in local wheat production, the predominant crop. In 1806, 14,000 tons were produced, a number that fell to 12,500 tons in 1819, dropping to 6,000 in 1820.<sup>16</sup>

*Increase in the remuneration from capital and land*

TABLE 3  
EVOLUTION OF THE PRICE OF LAND AND CAPITAL  
(in silver pesos)

	1810	1825	Increase (%)
Cow (unit)	1,4	5,1	264,2
Land (yard)	0,2	0,7	250
Interest rate	6%	More than 18%	

Source: The price of cows and of land was taken from Garavaglia, 1995, pp. 102 and 104. Interest rate from Halperín Donghi, 1982. p. 71.

The increase in the price of exported products caused a considerable increase in the profits of cattle investments, which could have been about 30% annually. This profit level produced, then, an increase in the prices of the production factors that cattle raising used most intensely (see Table 3).<sup>17</sup> The price of a breeding cow increased between 1810 and 1825 by 264% and the price of land by 250%. This increment, compared to the increase suffered by exports in general (234%), seems to confirm the Jones Amplification result. Although the data on the evolution of the interest rate before and after 1810 is not wholly reliable, the information available indicates at least a tripling of its value, an increase coherent with the increase in profits of the cattle raising investment. Although prices of factors and exportables increased in the same proportion between 1810 and 1825, prices did not move simultaneously between those years. This was so because of the uncertainty of the maintenance of independence from Spain in the 1810s; in South America the Spanish were finally defeated in 1824, at the battle of Ayacucho in Peru. In earlier years expectations of a possible reestablishment of the mercantilistic setting kept prices of land and capital low. For instance, in 1816, the price of hides had increased by 112%. Cows, partly producer of hides and partly capital goods, had increased by only 43%. The price of land still had not moved.<sup>18</sup>

<sup>15</sup> Un inglés, 1986, p. 61.

<sup>16</sup> Garavaglia, 1991, p. 10.

<sup>17</sup> Halperín Donghi, 1963, p. 69.

<sup>18</sup> Prices in 1816 were taken from Barba, 1997, p. 120 and Garavaglia, 1995, 102, 104.

The increase in cattle raising required that it attracted labor and capital that had been applied to other sectors. The previously cited report by British merchants mentioned that the high yield of cattle raising was attracting resources previously dedicated to agriculture.<sup>19</sup> It was in this period, in addition, that established local merchants changed their activity, investing their capital in land and cattle.<sup>20</sup> For the owners of land and capital, the price increase of the factors implied a great leap in their wealth. One article of the period mentions that the newly rich cattle breeders settled in the city, constructing buildings where they could enjoy the “comforts of life”.<sup>21</sup>

### *Drop in wages*

Finally, the last prediction of the model is a drop in wages, primarily due to the reduction of labor intensive agriculture. One exercise that can be done is to estimate the drop in demand for labor due to the reduction of agriculture and contrast it with the rise in the demand for labor caused by the expansion of cattle raising. Until 1819 it can be estimated that in the countryside of Buenos Aires there were about 12,500 tons of wheat produced, which was reduced to half after 1820. What would be the drop in labor attributable to the reduction of agricultural production? If a farmer produced three tons of wheat annually,<sup>22</sup> the reduction of local production by about 6,000 tons would imply an expulsion of 2,000 farmers, which is a reduction of agricultural employment to half of its initial level. If cattle raising had absorbed this labor, the increase in cattle stock would have to be about 1.8 million heads, given the requirement of one worker for every 900 head of cattle.<sup>23</sup> However, the estimate presented here indicates that the increase in cattle stock was about 1.3 million head. Thus, this would be a factor that would tend to depress wages.

In Table 4 the level of some wage categories is presented for 1810 and 1825. Although the data is fragile, taken together it shows a slight drop in wages, by an average of 8%. This evidence confirms the variation in the return to labor in the direction predicted by the model.<sup>24</sup>

19 Humphreys, 1940, p. 45.

20 Halperin Donghi, 1963, p. 73.

21 *La Abeja Argentina* (9/15/1822), p. 298.

22 See Amaral, 1998, p. 161.

23 See Amaral, 1998, p. 161.

24 In his study about the effect of the opening of trade produced after 1858 in Japan, in which a great improvement in the terms of trade was also verified, Huber, 1971, estimated that a great increase was produced in workers' wages. This is undoubtedly due to the fact that the principle products exported by Japan, silk and tea, which were labor intensive.

TABLE 4  
EVOLUTION OF WAGES IN BUENOS AIRES  
(in silver pesos)

	1810	1825
Infantry sargent (yearly wage)	190	190
Infantry soldier (yearly wage)	144	120
Infantry captain (yearly wage)	720	720
Rural worker (yearly wage)	50	55
Rural foreman (yearly wage)	168	128
Urban worker (daily wage)	0,62	0,56
Teacher (yearly wage)	600	500
Index	100	92

Source: The infantry wages for 1810, are for 1806, taken from Halperín Donghi 1982, pp. 136-137. The Infantry wages for 1825 were taken from Ravignani, 1937, ii, p. 381. The wages for the rural worker (peon) and foreman (capataz) correspond to the last years of the colonial period. The rural wages for 1825 correspond to 1831. See Amaral, 1998, p. 39, 49 and 220. Teacher (male) wages were taken from Newland, 1992, pp. 77-79. The wages for urban workers were taken from Johnson, 1990, p. 139 and Halperín Donghi, 1982, p. 211. The index is in base 100=1810, and is the average for all categories.

## 6. CONCLUSIONS

This article has shown that Independence from Spain contributed, in a large proportion, to a drastic change in the price of final goods that were produced in Buenos Aires. The economic consequences that large increase in export prices (and a fall in import prices) had on the local economy has also been explored. In general, the predictions that are derived from the neoclassical model of international trade are confirmed: the improvement in the terms of trade produced an expansion of the pastoral sector and an increase in the reward of the factors that this sector utilized most intensively, capital and land. Likewise, cattle raising tended to expand and consequently to absorb factors used in the other sectors. The result was a reduction in the production of the agricultural sector. Given that agriculture was labor intensive, a drop in nominal wages was produced. While Independence implied an increase in availability of goods for consumption, and therefore an increase in the level of utility achieved by the inhabitants of Buenos Aires as a whole, it also had strong redistributive effects. The income (and wealth) of the *estancieros* (owners of rural capital and land) increased considerably, while the opposite occurred with the workers wages.

The dramatic change in relative prices suffered by the Argentine economy after independence has been to a great extent unnoticed, and no general explanation of how this was related to significant changes in the production of goods and services and in the rewards to factors of production has been given. This article hopes to have clarified this process, which must also have occurred in most other

Latin American economies in the beginning of the XIX century, cases that still await analysis and explanation.

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APPENDIX  
 THE FACTOR PROPORTION THEORY OF INTERNATIONAL TRADE  
 WITH THREE GOODS AND TWO PRODUCTIVE FACTORS

In this appendix we derive the main implications that arise from the standard factor proportion model with three goods and two productive factors.

To establish the implications of the model we begin by assuming that, in the long run, using logs (and assuming that firms minimize costs), it is possible to express due to the Euler Condition:

$$(1) \quad \theta_{LX} \ln w + \theta_{KX} \ln r = \ln P_x$$

$$(2) \quad \theta_{LY} \ln w + \theta_{KY} \ln r = \ln P_y$$

$$(3) \quad \theta_{LN} \ln w + \theta_{KN} \ln r = \ln P_n$$

where  $w$  is the nominal wage (or the monetary reward to the labor factor),  $r$  is the return on capital, and  $p$  accounts for nominal prices of the different kinds of goods. The  $\theta$  are the different factors' income shares on the total value of production.

Differentiating those equations the following expressions are obtained:

$$(4) \quad \theta_{LX} \hat{w} + \theta_{KX} \hat{r} = \hat{P}_x$$

$$(5) \quad \theta_{LY} \hat{w} + \theta_{KY} \hat{r} = \hat{P}_y$$

$$(6) \quad \theta_{LN} \hat{w} + \theta_{KN} \hat{r} = \hat{P}_n$$

where  $\hat{x} \equiv d \ln x$ , is the differential of the log of the variable. These equations can be written in a matricial way:

$$\begin{vmatrix} \theta_{LX} & \theta_{KX} & 0 \\ \theta_{LY} & \theta_{KY} & 0 \\ \theta_{LN} & \theta_{KN} & -1 \end{vmatrix} \begin{vmatrix} \hat{w} \\ \hat{r} \\ \hat{P}_n \end{vmatrix} = \begin{vmatrix} \hat{P}_x \\ \hat{P}_y \\ 0 \end{vmatrix}$$

Finally, to obtain the rate of change of factors rewards in response to changes in the prices of final goods, Cramer's Rule is used:

$$d \ln r / d \ln P_x = -\theta_{LY} / (\theta_{LX} \theta_{KY} - \theta_{KX} \theta_{LY}) > 0$$

$$d \ln w / d \ln P_x = \theta_{KY} / (\theta_{LX} \theta_{KY} - \theta_{KX} \theta_{LY}) < 0$$



$$d \ln r / d \ln P_Y = \theta_{LX} / (\theta_{LX} \theta_{KY} - \theta_{KX} \theta_{LY}) < 0$$

$$d \ln w / d \ln P_Y = -\theta_{KX} / (\theta_{LX} \theta_{KY} - \theta_{KX} \theta_{LY}) > 0$$

since it is assumed that  $(\theta_{LX}/\theta_{KX}) < (\theta_{LY}/\theta_{KY})$  or that the exportable sector, relatively to the importable sector, is a capital intensive sector. Therefore, if X is relatively capital-intensive and Y labor-intensive, the presence of an increase in the price of the exportable good, like the one faced by the economy of Buenos Aires, will cause an increase in the return on capital (and on land) and a decline of wages, the nominal return to the scarce factor (Stolper-Samuelson Theorem<sup>25</sup>).

Moreover,  $r$  will grow more than  $P_X$  ("Jones' Amplification result"), so the real return on the abundant factor will grow in real terms no matter what is the price used to deflate it. And, if it is assumed that N (as it usually is) is the most labor-intensive sector or  $(\theta_{LN}/\theta_{KN}) > (\theta_{LY}/\theta_{KY})$ , it results that the price of N will fall. This last result can be checked easily since:

$$d \ln P_N / d \ln P_X < 0 \text{ if } (\theta_{LN}/\theta_{KN}) > (\theta_{LY}/\theta_{KY})$$

given that it has been already assumed that  $(\theta_{LY}/\theta_{KY}) > (\theta_{LX}/\theta_{KX})$ . This unambiguous result about the direction of  $P_N$  is obtained thanks to the fact that the Euler Condition holds and therefore the values of  $r$  y  $w$  alone determine  $P_N$ , with the demand of N not playing any role in the determination of its price. This property was clearly shown when the system of equations was presented as a set of matrices. In that system, the matrix of coefficients that multiplies the endogenous variables has a block-recursive structure. The two first equations determine completely  $r$  and  $w$  and therefore, the third equation provides the equilibrium value of N, once  $r$  and  $w$  are already determined.

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See Stolper and Samuelson, 1941.