Avoiding the Dutch disease? The Chilean industrial sector in the nitrate trade cycle. 1870 – 1938.[1]

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Abstract

The Dutch disease associated to the expansion of the Natural Resources sector is broadly analyzed in the economic history of the developing countries, due to the fact that is one of the most important restrains to achieve the economic development. One of the most interest historical cases of Dutch Disease is the one associated to the Chilean nitrates cycle (1880 – 1930) However, except a first attempt by Palma (2002), there is not a quantitative study that analyses the relation between nitrate export trade and "deindustrialization" or lack of industrial development in this period. To search in the roots of this relationship, the authors had estimated a new industrial GDP and have compared this variable with the terms of trade with the core and their neighbors, relative wages and other macroeconomic indicators to achieve a clear perspective of what really happened during this period. In previous works we have also found an inverse correlation between industrial development and the nitrate cycle. This outputs could be compared the ones obtained by Lüders and Wagner (2003), and their analysis of the optimal tax. This could be even more interesting if we consider that the years around the I World War, could be a good opportunity to the industrial expansion, due to the collapse of the traditional manufacturing supplier. In this context, an expanding industry could respond to this external stimulus.

Keywords: Dutch disease; industry; nitrates; GDP; terms of trade.

JEL Codes: N16; N66; O14

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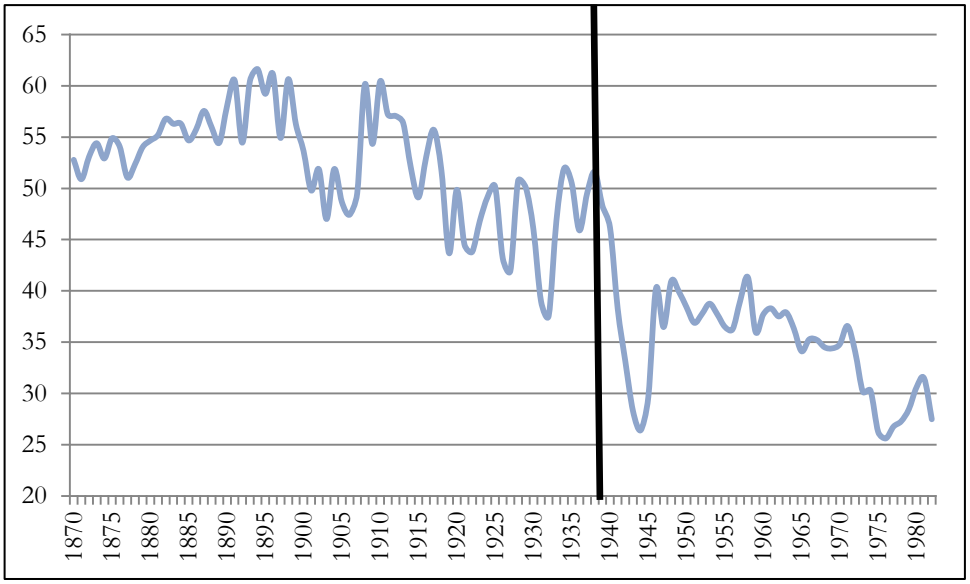
1. Introduction

Since the 1980s many articles have been written arguing for an early industrialization in Latin America (Suzigan 1988; Williamson 2011) before the period known as ISI. This argument has a long discussion about the effects of this industrialization in economic growth and public policy in the last period, because is not feasible industrialization project from scratch, if there was a previous industrial base. One possible guilty of the industrial underdevelopment is the called Dutch disease, a phenomenon affecting the countries with an explosive improve in commodities' exports, but with lack of competitiveness in the industrial sector.

Chile, since 1880's, as effect of the victory in the War of the Pacific[4] (1879 – 1883) against Peru and Bolivia, it had an impressive improvement in the saltpetre exports. The question for the economic historians is: Were saltpetre exports an improvement to industrial development of the country or were a resource curse? The GDP per capita it could be a good proxy; in 1870 the income of Chile represented the 53% of the GDP per capita of USA. This indicator was downgrade to 46% in 1940 and its best moment reached 61% (1912). Analysing this data is possible to think that the effects of the nitrates in the Chilean economy are not visible in the GDP per capita as a measure of convergence with the economic leader.

Figure 1 - Chilean GDP as percentage of the USA GDP per capita



Source: (Maddison 2006).

Is this lack of convergence with the economic leader the best choice to compare the effect of saltpetre trade in the Chilean economy? Probably not; but if we compares with countries with a similar GDP per capita en 1880, the results are in the same line; Chile was losing competitiveness and capacity to growth. It could be a better approach make a new industrial output and compare this indicator with the influence of the saltpetre trade in the principal macroeconomics indicators of the Country, as the exchange terms, relative prices and distribution of the investment structure. Some authors, as (Palma 1979; 2000a) claims that the effect of the saltpetre trade was not detrimental to the economy and there is

[4] Some authors tries to use the name "Saltpetre War" and avoid the name "War of the Pacific"

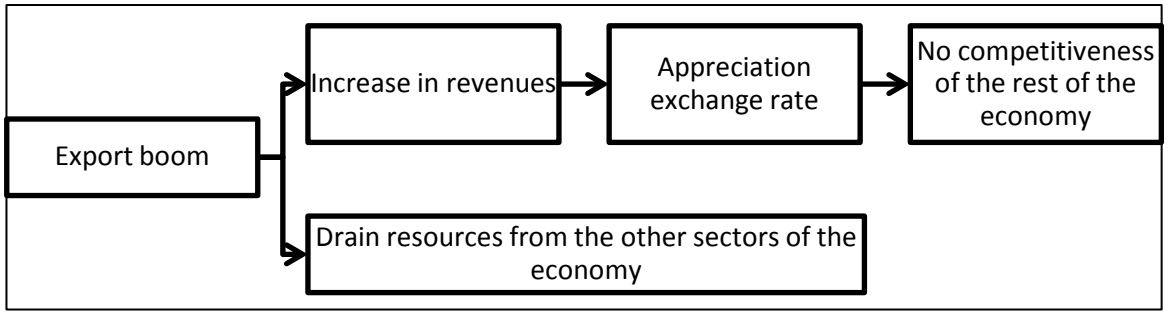
no evidence about dropping exchange rates in the period. However, the data used by Palma are too aggregated, and there is no disaggregation among tradable and non – tradable goods.

In this paper, the objective is to use a new quantitative approach for the industrial development considering machinery data base, elaborated from the Chile's foreign trade and statistical yearbook and foreign trade statistics from UK and USA. The importance of this data base is based in three principal characteristics: firstly, is a long run series, between 1870 and 1938 (the most common year to set up the beginning of the industrial policy by the state); secondly, consider an index of machinery prices; and lastly, is disaggregated by productive sector composition (agricultural, mining, industry and transport equipment). With these new series, it's possible to observe the real amount expended in capital formation in industrial machinery (henceforth CFM) by the country and allow us to have a new approach to the early industrialization in Chile, considering the effects of saltpetre trade cycle over the Chilean economy and its industrialization. The composition of machinery and its prices are proxies of the degree of industrialization and for the cost opportunity to invest in other sectors out of mining. The chosen period 1844 – 1938 is important in the Chilean economic history because is a period with a great number of unexplored statistical sources, and it covered all the years before the ISI.[5] The paper is structured as follows; point 2 analyses the symptoms (or their absence) of Dutch disease in the Chilean economy; point 3 offers a new estimation of the industrial GDP, in the aim to know the effects of the saltpetre boom on industry. Section 4 closes with the conclusions.

2. The Symptoms of the Dutch Disease in Chile 1870 - 1940

Dutch disease appeared when an increase in revenues due to an export boom, leads to an appreciation in real exchange rate which and, in parallel, this affects the competitiveness of the rest of the economy. At the same time, higher potential profits in the export sector drain resources (investment) to the leader sector (that is, to the mining sector o linked to them as transports and mining infrastructures).

Figure 2 – Drivers of Dutch Disease



(W. Max Corden and Neary 1982; W.M. Corden 1984; Van Wijnbergen 1984) in their seminal works, points out that countries which experienced a natural resources boom, experienced a strong process of de-industrialization due to the fact that exports boom sector attracted labour and investment and, at the same time, service sector experienced a strong push due to the increase in the level of income. In parallel, higher

[5] (Gómez Galvarriato and Williamson 2008) had done a similar approach, just with the USA and UK foreign exports. In the case of (Tafunell 2009), his comparative work begins in 1890.

wages in natural resources sectors added to the appreciation in the exchange rate reduced the competiveness of the "traditional" exporter sector. At the end, the result is a less diversified economy, strongly dependent on the evolution of the natural resources prices (more volatile) and a less potential growth. Many interesting works on this issue, has been published since then, and many interesting contributions on country cases were done.[6] We also highlight some studies with a more optimistic view as the one done by (Davis 1995) on the positive performance of mineral-exporter and less developed countries if they were compared with the other less developed countries, and (Mikesell 1997) who stress that not all the boom exports implies Dutch disease. (Alvarez and Fuentes 2006; van der Ploeg 2011) have made interesting surveys on this topic considering some of the most important approximations to this field and list part of the case studies in the world.

If we focus our attention to the Chilean case, Dutch disease has been widely analysed in their different boom export periods. (Jeftanovic Petrinovic 1992) and (Palma 2000b) provides opposite views of their existence during the Nitrate booms. In one side, (Jeftanovic Petrinovic 1992) considers a model with three sectors (tradable, non-tradable and export sector), to confirm the existence of a slowdown in agriculture and industry at the beginning of the 20th century due to the draining of labour and investment to the salitre sector. In that caee, the author only considers the evolution of real exchange rate and the existing series of industrial GDP due to the lack of data.[7] Their conclusions consider the existence of Dutch disease in the industry and in the agriculture. On the other side, (Palma 2000b) stress the no existence of Dutch disease due to the active paper played by the state in spent most of the surplus appropriated with their fiscal policy and the expenses of the productive process. Other works from Chile, were focused in the analysis of the expansion of the copper sector during the 20th century as (Pereira et al. 2009). Later, (Giarda and Landerretche 2011) analyses the first decade of the 21st century and the impact of the expansion of copper prices.

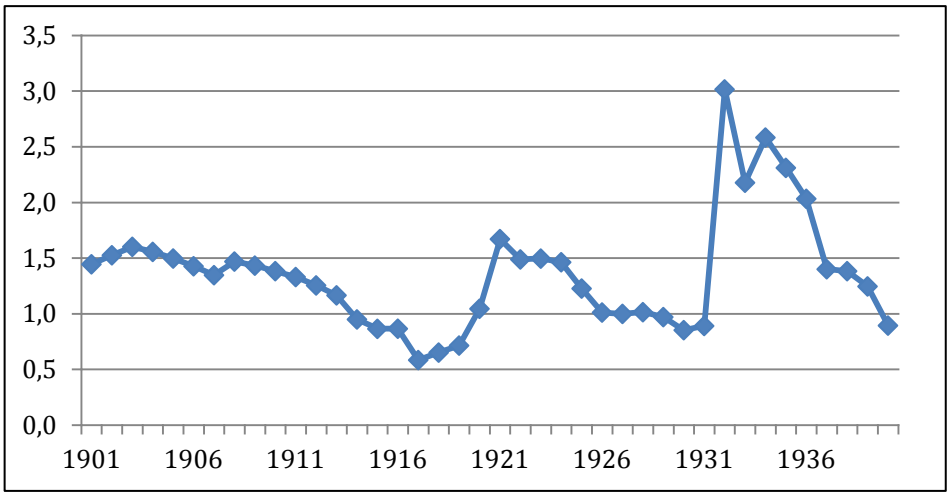
In our case, to try to understand the impact of nitrates boom in the performance of the industry in the beginnings of the 20th century we consider the approximation that the one used by (Dobrynskaya and Turkisch 2010) to test the existence of Dutch disease, due to the impact of the export boom in Russia, at the end of the 20th century. To check the existence of Dutch disease in Chile, during the nitrate boom period, we are going to analyze the existence of their symptoms, namely 1) appreciation of the exchange rate, 2) rise in real wages, 3) growth in the service sectors and 4), a slow-down in industrial production.

[6] Oil boom cases as (Usui 1997).
[7] The autor considers the Industrial GDP from (Ballesteros and Davis 1963) which were considered as a optimistic serie.

1) Appreciation of the exchange rate.

The rise of exchange rate is basically the main assumption of the Dutch disease. A real appreciation of the domestic currency is a net loss in competitiveness. The exports of commodities and the rise in internal prices increase the cost to produces goods for exports. Was there a rise of the exchange rate between 1901 and 1931, from a maximum 1.6 in 1903 to a minimum of 0.58 in 1917, due the IWW. In the long run, from 1901 to the end of the period, we didn't see a real appreciation

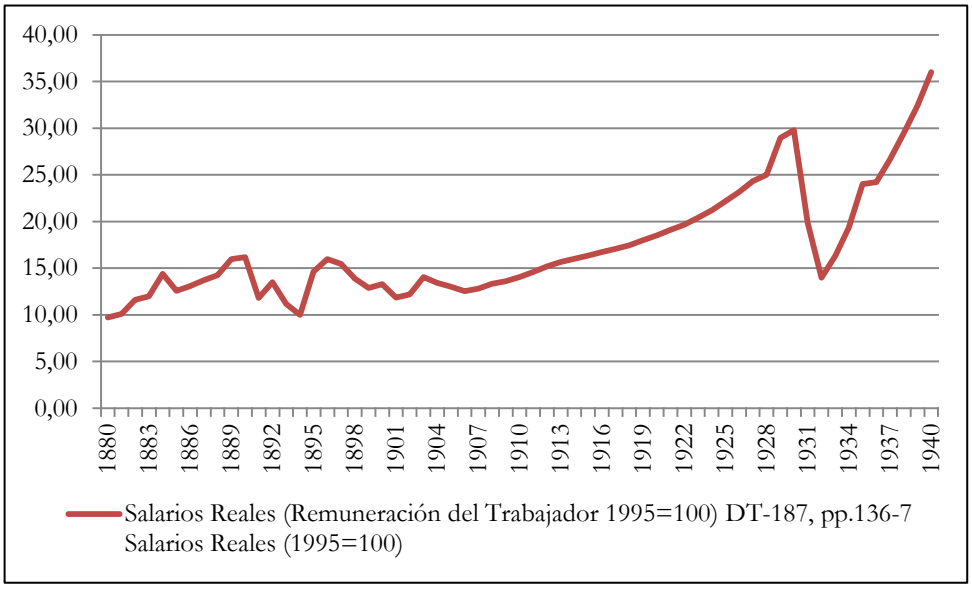
Figure 3 - Evolution of the exchange rate in Chile, 1900 – 1940



2) Rise in real wages

The behaviour of real wages has been a source of many studies, among them the specifics of Braun (2000) and Matus (2009) . The latter author has shown that in terms of sectors, the only economic activity that had clearly positive trend was the industry, while other sectors remained stagnant. This is a contradiction with the main idea of the Dutch disease; the other explanation is that the modern sector had better salaries than the others.

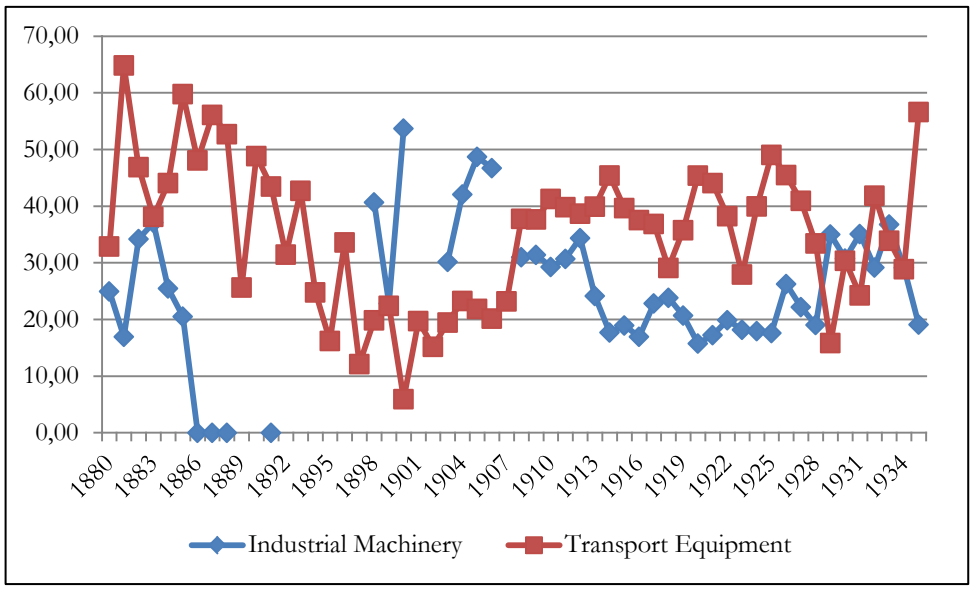
Figure 4 - Real wages in the Chilean economy



3) Growth in service sectors

Which is the proxy for the growth in the services sector? The best statistics it would be the share in the GDP of services sector. Sadly, we don't have yet whit this kind of data, but we can use as proxy investment in the services sector (Ducoing, 2011). If there were not Dutch disease in Chile, the investment it would be directed to the industry, agriculture and mining; in Figure 5 we can appreciate the continuous growth of the transport share in the gross capital formation. Of course, the existence of railways is a condition to sustainable growth, but is notorious the preference of the investors by the transport instead industry. If we consider the railway and total transport investment as proxy of growth in the sector services, this could be a symptom of Dutch disease in Chile, because the incentives for the economics agents are in the commodities sector (nitrates) instead the manufactures, and is more rentable the investment in Transport equipment to take the minerals to the shores.

Figure 5 – Industrial machinery and Transport Equipment share in the Gross Capital formation in machinery 1880 – 1938



Source: Ducoing (2011; 2012)

3. Was the Chilean industrial production performance affected by Dutch Disease?

The fourth symptom of Dutch Disease is an expected slowdown in industry. The role played by the industrialization in Chile before the Great Depression, has been widely analysed by the Chilean bibliography. The foundation of the SOFOFA[8] in 1883 started a period of deep reflexion around the role that the industry would have to play and their promotion.[9] The expansion in the nitrate sector diverts the focus from the industry. Industrial policies weren't a priority during the nitrate era (1880 – 1929).[10]

[8] Sociedad de Fomento Fabril.
[9] In 1877, due to the problems in the taxation, a change in import taxes was observed, especially in machinery and equipment goods. The level of the tax was around 15%, and it lasted till 1880s. (Ortega 2005, 310).
[10] A detailed analysis on the paper played by the State in the promotion of the industry see (Ffrenc-Davis et al. 2000, 114–153).

To go further in the study of the evolution of the economy in this period, is essential the understanding of the performance of the Chilean industry GDP. The first attempts were the some descriptive analysis as the ones done by (Pinto and Ortega 1991; Ortega 2005) about some specific case's study which allow us to affirm, the existence of a previous industrialization process during the nitrate era, which failed due to the absence of an active industrial policy. Featured authors have attempted to quantify the weight of industry in the country through various techniques. The most widely accepted estimate by the literature of National Accounts (Díaz, Lüders, and Wagner 2007) is the regression method developed by (Kirsch 1976), who starting from industrial GDP of (Muñoz Gomá 1968) established that the relationship between industrial GDP and import of industrial raw materials measured is fairly accurate relationship. However, Kirsch did not have many of the elements that are currently available as a series of industrial machinery and disaggregated estimates of apparent energy consumption.[11] Incorporating these new series, and following the same methodology proposed by Kirsch, we aim to provide a new estimate of the industrial level of Chile between 1870 and 1938 with the objective of coming as close as possible to pre ISI industry. With the input of a new industrial GDP, it could be possible measure the effects of the nitrate trade cycle over the industry along the period 1870 – 1938.

As we have said, (Kirsch 1976) obtained a linear regression from the previous estimations of the industrial GDP of (Muñoz Gomá 1968), raw material imports, intermediate goods and a dummy to capture periods with higher protectionism. The resulting expression was:

$$Ln\ (GDP\ ind_t) = 6.669 + 0.428 \cdot Ln(IMPRM_t) + 0.143 \cdot DMTARIFF \qquad (1)$$

(Kirsch 1976) emphasizes the precariousness of the resulting output despite the higher grade of explanation of the OLS estimation, due to the existence of autocorrelation in the error term.[12] (Díaz, Lüders, and Wagner 1998) obtain the missing data for the period 1880 – 1914 considering the "most probable Kirsch index" from:

$$Indice\ Kirsch\ =\ 59{,}6265\ -13{,}57425 \cdot T\ +\ 4{,}501584 \cdot T^2\ -0{,}594484 \cdot T^3 +$$
$$+0{,}042252 \cdot T^4\ -0{,}001694 \cdot T^5\ +3{,}59 \cdot 10^{-5} \cdot T^6\ -3{,}09 \cdot 10^{-7} \cdot T^7 \qquad (2)$$

For the previous period, between 1860 and 1880, (Díaz, Lüders, and Wagner 1998) considers that the industrial output over the number of firms (Y) followed an annual time trend (1880, T=1) and depends on the number of industrial workers (L), as we observe in equation (3):

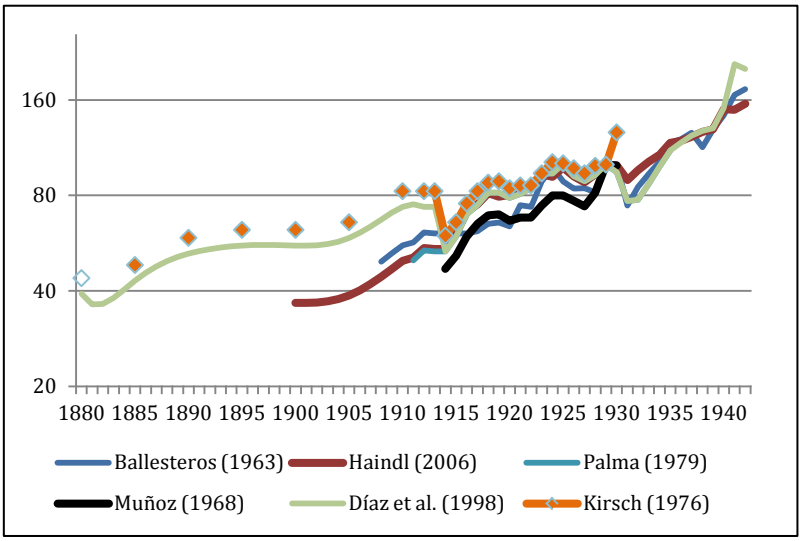
$$Y = 2{,}032163 + 0{,}034310 \cdot T + 1{,}549 \cdot L \qquad (3)$$

[11] (Ducoing 2010; 2011).
[12] (Ballesteros and Davis 1963, 178) also points out the existence of autocorrelation.

From equation (2) and considering the number of workers for each firm and the number of firms, for the period 1860 – 1880, they obtain the industrial output. Other estimations for the industrial GDP were the ones from (Ballesteros and Davis 1963). These authors consider the production data from the industrial firms provided by the official statistical sources from 1908.[13] The resulting output was deflated by a weighted price index which considers six manufacturing raw materials, before 1929. After 1929 they consider the official price index for the industry.[14] From 1929 onwards, they consider the deflated values instead of the physical product because they were more reliable if we consider a downward estimation. Other estimations of industrial output were the ones provided by (Palma 1979) for the period 1911 – 1935. This was the one used by (Haindl Rondanelli 2006) in their latter GDP reconstruction between 1900 and 2000.

When we compare all this estimations we observe the existence of important discrepancies around the period previous to the I World War (see Figure 6). While (Kirsch 1976) and (Díaz, Lüders, and Wagner 1998) consider that the levels of industry in 1913 were similar to the ones observed at the end of the war, and therefore, the weight of the industry in the economy was already important at the end of the 19th century. In contrast to this view, the outputs provided by the other authors showed that the I World War was a period of strong expansion of the industry, and hence, industry at the begging of the 20th century was less developed.

Figure 6 – Industrial output series, 1880 – 1940 (1929 = 100)



Source: Various authors.

This contradiction appears as a key point in the understanding of the Chilean industrial performance. Data from official sources in current prices (*Anuarios Estadísticos (Industria)*) could be observed in Table 1.

[13] Data came from Industry in the *Anuario Estadístico*. Some limitations and difficult arises in the sources. The series were not homogeneous. Some years it considered firms with more than 5 workers and from 1916 onwards, it considered firms with more workers. This sub biased the latter estimations.

[14] *Estadística Chilena*. Various years.

Table 1 – Industry production ($ m.c.)

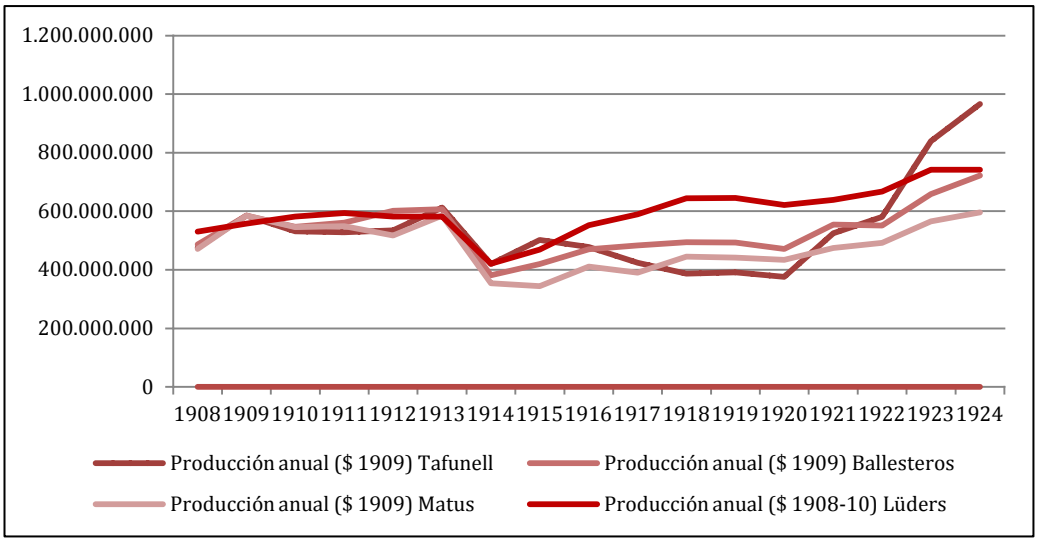
Año	*Producción*	*Año*	*Producción*
1908	469,123,133	1917	720,919,430
1909	584,909,560	1918	766,776,872
1910	531,493,917	1919	905,151,651
1911	535,037,093	1920	993,220,128
1912	563,339,541	1921	1,014,276,595
1913	654,837,495	1922	1,064,089,995
1914	445,731,319	1923	1,172,601,971
1915	580,996,077	1924	1,328,184,534
1916	651,581,446		

Fuente: *Anuario Estadístico* (Industria). Varios años.

The next step is the transformation into constant prices. This point appeared as a key point in the reconstruction of the industry figures. If we compare different the resulting output considering the available industry price index from (Ballesteros and Davis 1963; Díaz, Lüders, and Wagner 1998; Tafunell 2011) as well as other consumer price index (Matus González 2009) to compare the robustness of all of them. As we have observed previously, differences on the level of industry previous to the I World War arises (see

Figure 7).

Figure 7 - Evolution of indutry product, 1908 – 1920 (in constant prices of 1913)

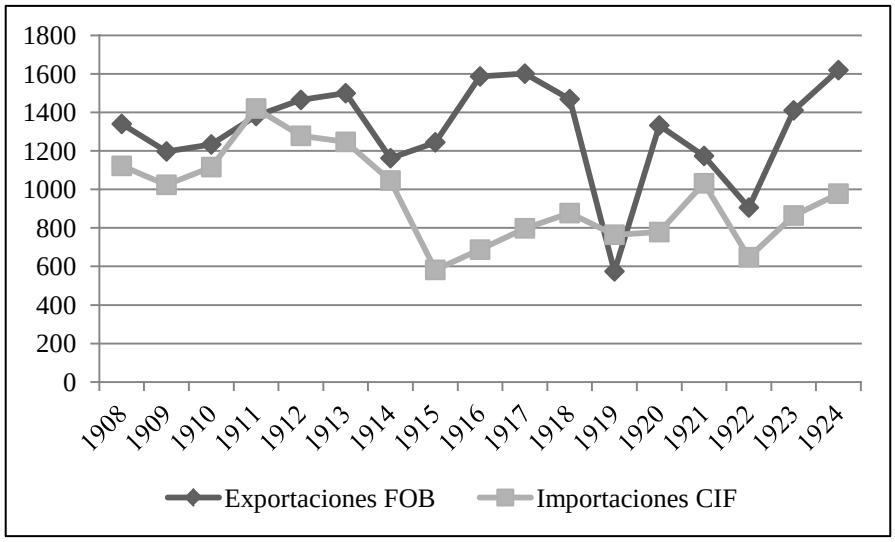


Source: Anuario Estadístico (Industria). Various years. Industry deflator from (Ballesteros and Davis 1963; Díaz, Lüders, and Wagner 1998; Tafunell 2011).

The observation of the evolution of other variables could provide some light to solve this contradiction. The evolution of the number of manufacturing employers and firms clearly shows a less optimistic view of the performance of the Chilean manufactures. Total exports and total imports during this period (see Figure 8), jointly with the evolution of machinery imports from Germany, reinforced the less optimistic

view. Meanwhile, exports were higher during the most part of the war; imports suffer a strong fall from 1913 to end of the war. If we consider that the emerging Chilean manufacture was strongly limited by imports due to the existence of inputs dependence for the production, this fall during the war years, also limited the manufacturing performance.

Figure 8 – Total exports and total imports, 1908 - 1920 ($ from 1995)



Source: Braun et al. (1999).

Another way to check the pessimistic and the optimistic view is the observation a new set of variables which could explain the possible existence of an investment effort of the economy: the share and the growth rate of the gross fixed capital formation from (Ducoing 2010; 2011). Table 2 shows that the share of GFCF gradually fell from 48.7% in 1908 to 22.8% in 1920. This could be related with the fact that industry was losing importance as a main driver of investment decisions during this period.

Table 2 – Share of industrial machinery over total GFCF

Años	*Porcentaje*	*Años*	*Porcentaje*
1908	48,71	1915	34,4
1909	46,72	1916	24,1
1910	35,10	1917	17,7
1911	31,0	1918	18,9
1912	31,4	1919	16,9
1913	29,3	1920	22,8
1914	30,7		

Source: Ducoing (2011)

This data also confirm some of the appreciations obtained previously (foreign trade, manufacturing employers, …): the 1900s were extremely dynamic in terms of machinery imports, especially industrial machinery, and the level reached in 1908 was not recovered until 1927. That make obvious that a slowdown in machinery investment is observed before the I World War and, at a same time, this confirm

the existence of an upper estimation of the recovery in industry at the end of the war. This result relativizes the boom of the 1920s pointed out by (Palma 2000a) because their starting point was in 1914, the worse year in industry, overestimating the recuperation and underestimating the existing level before the war (see Table 3).

Table 3 – Production index and manufacturing exports, 1914 – 35

Años	*Manufacturing Production*	*Exports*	*Años*	*Manufacturing Production*	*Exports*
1914	100	100	1925	189,1	126,1
1918	153	111	1928/29	181	167,1
1919	153,4	39,6	1932	145,5	30,6
1922	158,6	68,3	1935	208,3	48,7

Source: Palma (2000), pp. 49

Considering theses contradictory results and the existence of some problems obtaining these estimations, the estimation of a new industrial output series to understand the industry performance is justified. Due to the difficulties in built a new estimation directly, we consider the same methodology as the one used by (Kirsch 1976) considering other complementary macroeconomic variables which reinforce the new estimation and correct some of the existing problems. As we have said, we consider the gross fixed capital formation from (Ducoing 2010), the energy consumption from (Rubio et al. 2010) and a time trend.

With these corrected data we repeat the regression using the methodology proposed by (Kirsch 1976). In that case, we have chosen to consider exports (EXP) and energy (CAE) as explanatory variables. We have also considered the gross fixed capital formation (GFCF), but have not been significant and its inclusion did not improve the degree of explanation of the model. To capture the strong oscillations and the external shock is the arrival of the First World War and the Great Depression (which also suffers impact the industry's dependence on the external sector), we introduced a dummy for the years 1914 - 1919 and another for the period 1930 to 1933. While in the first case it was found that significant, the second was not significantly improved and also the degree of explanation. The same has happened with the trend variable.

Table 4 – OLS estimation for the period 1908 - 1938

constant	*9,01***
ln_CAE	0,34**
ln_Exp	-0,09
ln_FBCF	0,06*
DMWWI	-0,21**
DMGD	-0,13**
Trend	0,019**
R-Adj	0,8783
DW	1,6220

From these coefficients and considering the data of exports and apparent consumption of energy, we obtained new estimates of the industrial GDP of Chile for the period 1880 - 1938, considering the data used by (Kirsch 1976). The results points out an overestimation of the starting point of the industry before the nitrate era, on previous analysis as in (Díaz, Lüders, and Wagner 2007) data. This strongly affects the growth rate in this sector during the period of analysis and also affects the interpretation of the supposed slowdown of industry. Table 5 shows that industrial growth was higher than growth in total GDP during most part of the period, especially during the nitrate era.

Table 5 – Growth rate for industrial GDP and Total GDP, 1880 – 1940

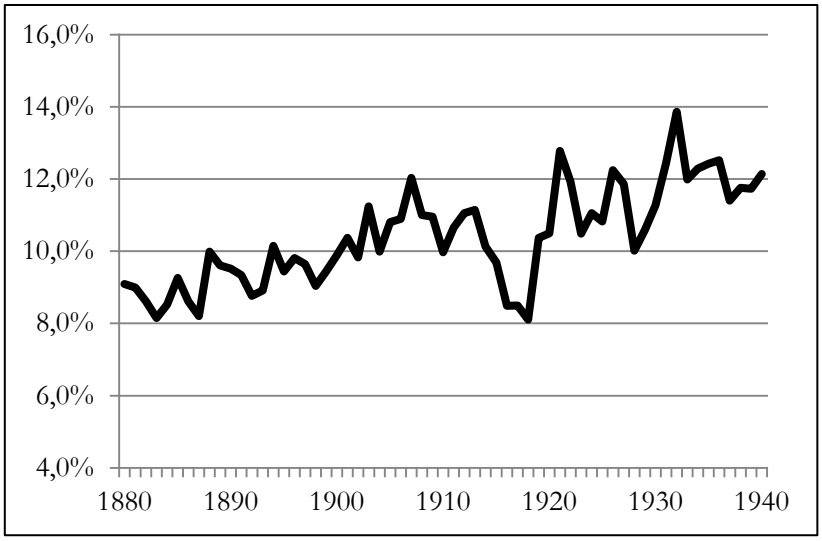
	Industrial GDP	Total GDP
1880-1890	3,15%	2,67%
1890-1900	3,10%	2,71%
1900-1913	4,82%	3,86%
1913-1919	-3,69%	-2,53%
1919-1923	5,69%	5,41%
1923-1929	5,13%	4,94%
1929-1933	-6,34%	-9,19%
1933-1938	8,65%	8,46%

This reinforces an optimistic view of the performance of the industrial sector. Nevertheless, we have to stress the fact that the starting levels were very low, less than 10%, and more pessimistic than the data proposed by (Díaz, Lüders, and Wagner 2007). This could explain part of the intensity of growth rates during the decades of the mining boom and reduces the growth during the First World War.

4. Conclusion

The main objective of this work wants to analyse the existence of Dutch disease during the Chilean export boom between 1880 and 1938, namely the existence of slowdown in the other sectors of the economy, due to the investment diversion and the fall in the competiveness of the tradable sector. After considering some of Dutch disease symptoms, we could not confirm their existence. Seeing the growth rates of industrial GDP, a continuous growth is observed, at least, at the same intensity as the one observed in total GDP. Real exchange rates and wages seems did not had a behavior than matched with the theory of Dutch disease.

Figure 9 – Share of Industrial GDP over total GDP



Source: Ducoing & Badía – Miró (2011)

From the set of symptoms considered, the only which goes in the same direction that Dutch disease predicts was the share of the Industrial GDP over total GDP. At the end of the period, it was around 12% and around 1900 was 11%. Certainly, the rate of industrial growth reached the rate of growth of total GDP, but never was its motor. The nitrate cycle was a great period for the Chilean economic growth, but the country did not take advantage of this process, and the export boom didn't favour a strong structural change which could modernize the economy. At the beginning of Imports Substitution Industrialization, circa 1940, the share of Industrial GDP on the economy has been stagnated by almost forty years.

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