New Zealand and Uruguay: do energy natural endowments matter? Economic performance in the long-run (1870-1940):

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Abstract

Settler economies are characterized for abundance of natural resources. However, natural capital is not homogeneous between countries and it can induce different consequences in terms of economic performance. This paper discusses the effect of natural resources on economic performance as a part of the debate about the "curse (and blessing) of the natural resources hypothesis", and it focuses the analysis on a couple of settler societies –New Zealand and Uruguay– considering energy natural resources. Literature about economic development of settler economies that identifies differences within the "club" with disparities in terms of natural resources is very scarce. Our proposal is to look for diversities in energy natural endowments (basically coal endowments and suitable conditions for hydroelectric generation) to explain (at least partially) different welfare levels between both economies. Despite many similarities –referred to productive structure, movements in productive factors and insertion in international markets– New Zealand and Uruguay presented, during 19th century and the first decades of the 20th century, huge differences in income per capita levels. Therefore, we need to study other spheres of economic system to find new answers in this matter. Analytical framework associated with the curse of the natural resources offers some interesting lines of argument for our concern. Differences in favour of New Zealand to the production of coal and natural conditions to generate electric energy with low costs explain those disparities. Our findings are new evidence that support the curse hypothesis of natural resources.

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Introduction

Settler economies are characterized for abundance of natural resources. However, natural capital is not homogeneous between countries and it can induce different consequences in terms of economic performance. This paper discusses the effect of natural resources on economic performance as a part of the debate about the "curse (and blessing) of the natural resources hypothesis", and it focuses the analysis on a couple of small settler societies –New Zealand and Uruguay– considering energy natural resources. Literature about economic development of settler economies that identifies differences within the "club" with disparities in terms of natural resources is very scarce. Our proposal is to look for diversities in energy natural endowments (basically coal endowments and suitable conditions for hydroelectric generation) to explain (at least partially) different welfare levels between both economies. Despite many similarities –referred to productive structure, movements in productive factors and insertion in international markets– New Zealand and Uruguay presented huge differences in income per capita levels and productivity diversification during the last decades of the 19th century and the first decades of 20th century up to the World War II. Therefore, we need to study other spheres of economic system to find new answers in this matter. Analytical framework associated with the curse of the natural resources offers some interesting lines of argument for our concern. We have found that New Zealand posed coal reserves and natural conditions to generate electric energy with relatively lower costs than Uruguay. These differences would explain, at least partially, these disparities. Our findings are new evidence that support the curse (and the blessing) hypothesis of natural resources.

Settler societies of the 19th and 20th centuries seem to share common features that make them a comparable group of economies. Their economic and social development often presented parallel paths, as a result of similar dynamic relations between waves of immigration, marginalization of native people, European capital importation, land abundance, free labour (at least after the mid-19th century), socially-useful political institutions[1] and development of neo-European cultures (Lloyd & Metzer, 2006). By the late 19th Century the settler economies were well integrated into the world economy. New Zealand and Uruguay are members of that group of countries that Lewis (1983:209) identifies as *"template economies"* and according with Foreman-Peck (1995:105), these economies coincide with *"the group of non-European countries which in*

[1] Institutions designed to develop the economy rather than extract rents for some domestic or foreign elite.

the twentieth century can be classified as developed".[2] In this paper we choose two countries of the "club" that have a long tradition in the comparative analysis: New Zealand and Uruguay. In the 1970s and 1980s we attended an important wave of articles, comments and thoughts about the comparative evolution of these countries: Barrán & Nahum (1978); Denoon (1983); Kirby (1975) and Rama (1979). However, the interest in comparative approaches had a reversal during the 1990s, when the economic recommendations were in more general terms (with minor emphasis on specific advices) and focused on commercial liberalization and monetary policies.

The comparative work took a renewed impulse in the starting of the 21st century. Probably the combination of a broader debate in Economics –that incorporated actively concepts as institutional and technological change– and the increasing discussion about the development model in Australasia and Rive Plate motivated the resurgence of the topic. Articles as Álvarez (2007 a, b); Álvarez & Bortagaray (2007); Álvarez et. Al (2011); Bértola & Porcile (2002, 2007); Carbajal & De Mello (2007); Greasley, Madsen & Oxley (2000); Duque & Román (2007); Willebald (2007, 2010) illustrate the new interest in the comparative Economic History of Australasia and the countries of the River Plate.

The "golden age" of the settler societies coincided with the First Globalization era (1870-1914), a process characterized by the integration of the markets of goods and productive factors, convergence, free trade and peace. In the 20th century the main challenge for these economies was how to deal with the transition from settler society to some form of post-settler configuration and the different trajectories and degrees of success that the process has produced. As it usual in the literature, our empirical evidence contemplates the period 1870-1940 to cover a complete economic cycle, from the expansion that started in the 1870s-1880s and the prosperity that went with the boom prices previous to the World War I (WWI), until the moderation of the 1920s and the posterior contraction and recession of the 1930s.

After this introduction, we present some of the main stylized facts of the period (Section 1) and consider, in a comparative perspective, economic growth, convergence –relative to the "core" of the world economy and within the "club" of the small settler economies– and structural change (in terms of the domestic economy and the trade structure). Then, we review the debate about the different economic performances within the "club" to differentiate particular conditions to economic development (Section 2). This evidence opens the possibility to propose conjectures and

[2] The author aggregates Japan to the list. When the author stays "*twentieth century",* he refers to the period from 1900 to the First World War.

possible explanations for the unequal performances and we present our analytical framework and strategy to test our hypothesis (Section 3) and answer our main question: Were energy natural resources different in New Zealand and Uruguay? We propose a statistical appraisal to advance in some possible responses (Section 4) and conclude with final remarks and our agenda (Section 5).

1. Some stylized facts of the period

The period 1870-1914 was a real "golden age" for settler economies. At the root of the expansion was the Industrial Revolution, a process founded in a deep technological progress that changed the social and economic relationships in a world scale. The integration of the commodity and factor world markets during the first great globalization boom was one of the more important processes of the world economy in the last two centuries. Liberal dismantling of mercantilism and transport revolution worked together to generate global markets during the 19th century. The decline in the transport costs was constant in the century, but there was an anti-globalization policy reaction after the 1870s that was not large enough to cause a return to the 1820 levels of economic isolation. Mass migration remained free by the end of the century (although the immigrant subsidies disappeared) and global capital markets became steadily more integrated as European investors believed in important growth prospects overseas.

The recent studies by Lindert, O'Rourke, Taylor and Williamson on globalization, growth and inequality set a prolific line of research and debate about a topic that have a great importance to understand the expansion of Atlantic economy (Lindert & Williamson, 2001; O'Rourke, Taylor & Williamson, 1996; O'Rourke & Williamson, 1994, 1999; Taylor & Williamson, 1997; Williamson, 1995, 1996, 1999, 2002).

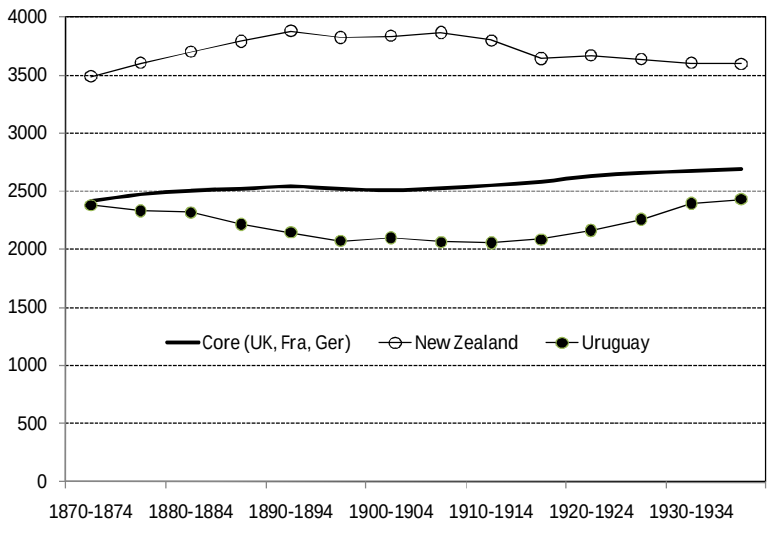
In this conceptualization, the template regions, with scarce population, exposed to the effects of the First Globalization, took advantage of being endowed with abundant natural resources and received the "blessing" of their natural capital. These economies grew quickly from the last decades of the 19th century to the WWI encouraged by the international conditions of a dynamic demand and the flows of productive factors (labour and capital). However, "the blessing was diabolical"[3] because was associated with a persistent worsening in the income distribution. The economic growth and the evolution of the inequality were mediated for the combination of technological and institutional factors that delineate several differences within the "club". [4]

[3] Barran y Nahum (1978):189.
[4] For a review, see Willebald (2009).

What did happen within the "club"? It is real that our countries presented similar development patterns but, when we focus on specific features, emerge important differences. Berger & Willelbald (2011), Willebald & Bértola (2011) and Willebald (2011) state that while the intensity of the First Globalization and its consequences for the settler economies followed a broad common pattern, the countries reacted in different ways, and this probably determined their economic performance in the subsequent decades. These economies based their production on primary activities but in spite of this, at around the time of WWI, they achieved levels of development close to the "core". However, income per capita was higher and inequality was worsening less in ex-British possessions (Australia, New Zealand, Canada) than in the South American Southern Cone (Argentina, Chile and Uruguay), and in the former group economic specialization was relatively less concentrated on primary activities. In terms of the curse/blessing of natural resources, the ex-British colonies were more blessed and less damned by their abundance of resources than the other ex-colonies.

We consider this assertion and consider the economic performance of New Zealand and Uruguay. Effectively, both economies ended the 19th century with income levels very close to the "core" of the world economy (considering the average of UK, France and Germany's GDP per capita) but the direction of the gap is illustrative. Both economies were rich in relative terms but the differences in favor of New Zealand were huge (Figure 1).

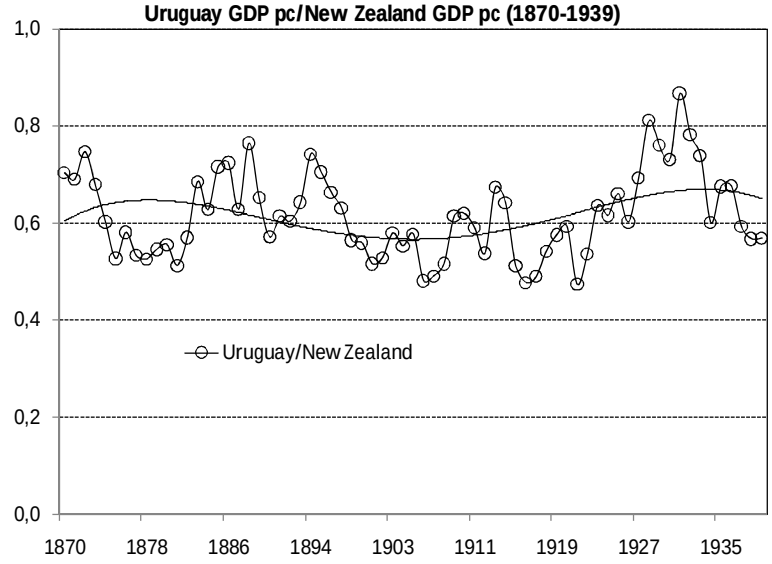
Figure 1
INCOME PER CAPITA IN NEW ZEALAND, URUGUAY AND THE "CORE"
1990 Geary-Khamis dollars, 10-year averages



Source: Maddison (2001, 2003).

Both economies experienced trajectories of strong expansion in the period but they did not mean a catching-up process within the "club" (see Figure 2). From 1870 to 1939, the Uruguay income per capita represented 62 per cent of the New Zealand's one (average) with an irregular trajectory and without a defined tendency.

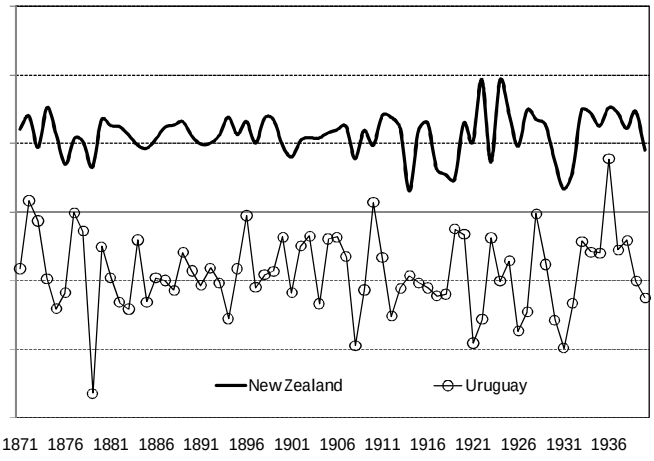
Figure 2
CATCHING-UP PROCESS WITHIN THE "CLUB": NEW ZEALAND AND URUGUAY
Uruguay GDP pc/New Zealand GDP pc (1870-1939)



Source: Maddison (2001, 2003).

In particular, the irregularity was one of the main features of the economic evolution of Uruguay (see Bértola and Lorenzo, 2004) in the long-run. In Figure 3, we chart the annual GDP per capita growth rates for both economies and the differences in terms of variability are very significant.

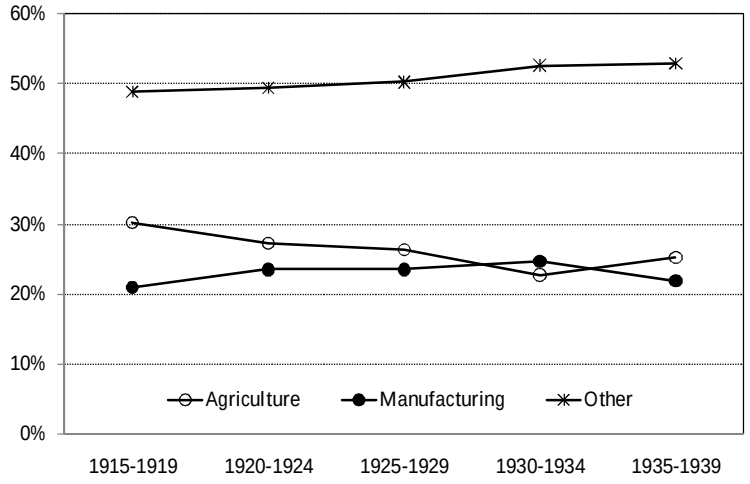
Figure 3
ANNUAL GROWTH OF INCOME PER CAPITA IN NEW ZEALAND AND URUGUAY
In percentage



Source: Maddison (2001, 2003).

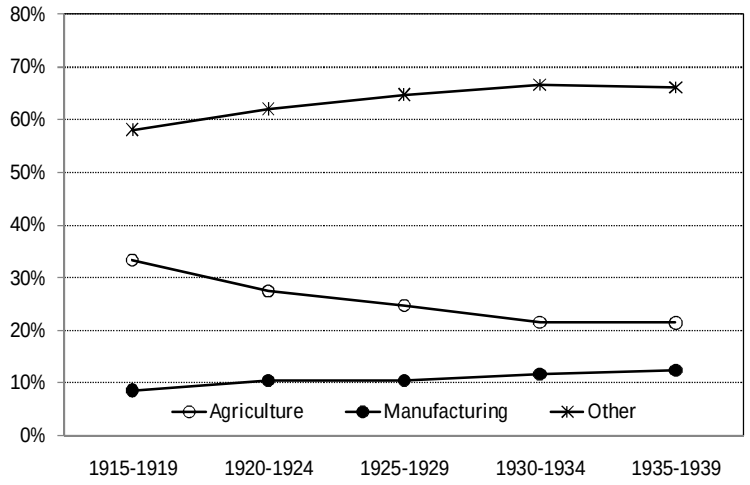
With regard to productive structure, both economies showed a high and decreasing share of agriculture value-added during the first decades of the 20th century with similar levels and dynamics. However, the main difference derived from the other activities. In particular, the manufacturing represented a marginal participation in the productive structure of Uruguay and, on the contrary, it signified a relevant activity in the New Zealander economy after the WWI (Figures 4 and 5).

Figure 4
NEW ZEALAND: PRODCUTIVE STRUCTURE
Shares on total GDP, current prices



Source: Lineham (1968).

Figure 5
URUGUAY: PRODCUTIVE STRUCTURE
Shares on total GDP, current prices

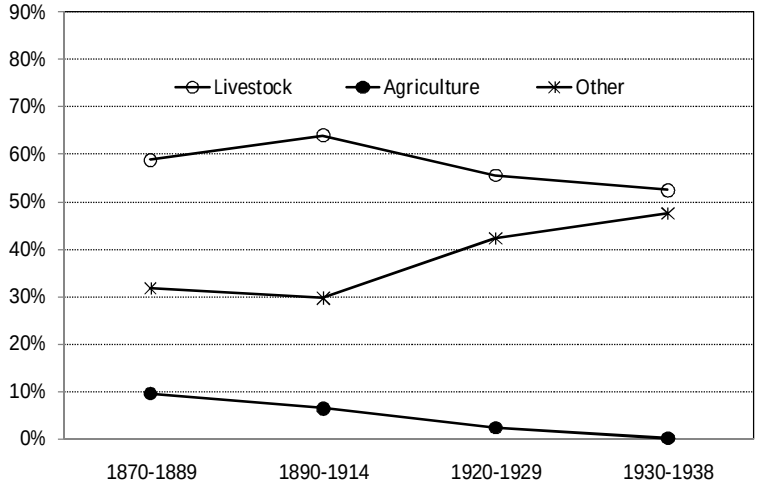


Source: Bértola (1998), Bertino & Tajam (1999), Bonino, Román & Willebald (2011).

These features in the productive structure ran concurrently with the exporter structure. While in New Zealand the share of exported commodities different from livestock and agriculture goods

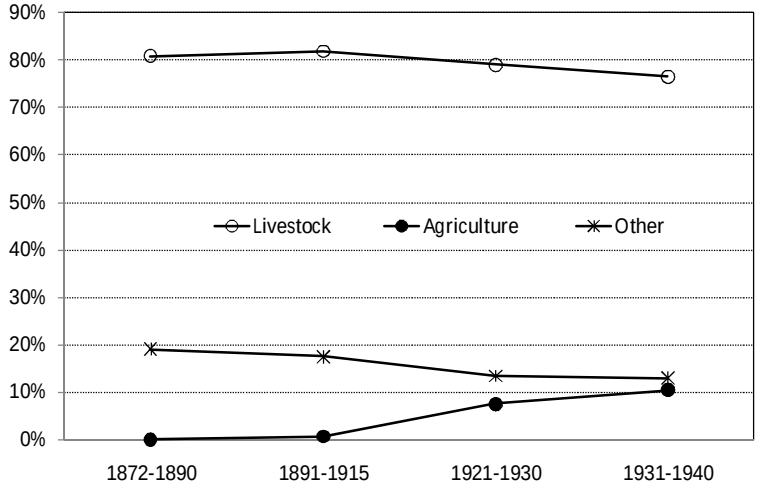
increased from the end of 19th century, Uruguay intensified its dependence on primary products (see Figures 6 and 7).

Figure 6
NEW ZEALAND: TRADE STRUCTURE
Shares on total exports, current prices



Source: Willebald (2007).

Figure 7
URUGUAY: TRADE STRUCTURE
Shares on total exports, current prices



Source: Willebald (2007).

Therefore, within a similar development pattern, New Zealand constituted a richer and more diversified economy that, probably, presented more suitable conditions to face the structural change that rose with the change in the techno-economic paradigm of the 1920s.

2. Debate about different economic performances within the "club"

In recent literature, the discrepancies in terms of development within the "club" have been explained by the institutional matrix that produces a set of organizations, rights and privileges; the stability of the structure of exchange relationships in political and economic markets; and a state that provides (or not) a set of political rules and promote the enforcement of rights. In general, studies contrast the experience of Latin America vs. North America and they propose concepts as disorder vs. order in the economic change (North et al., 2000), the "South American way" (Landes, 1998:Ch. 20), cultural heritage (North, 2003) and different ways of organizing a society (a social order) identified with a "limited access order" (North et al., 2010). The application of these concepts to contrast the South American Southern Cone countries with the ex-English colonies is straightforward. Referred to Uruguay and New Zealand, some scholars demonstrate that the divergent path "can be explained by the existence of different institutions governing the agricultural sectors of the [two] countries, which in turn generated different distributions of both land property rights and product shares in the agricultural sector" (Álvarez et al., 2011:165) (see, besides, Álvarez & Willebald, 2011). However, differences in terms of natural resources have presented scarce attention up to now. In some sense, this is the "natural" result of comparing economies, precisely, conform a "club" because they share the feature of abundant natural resources. Nevertheless, some exceptions can be mentioned. On the one hand, Álvarez, Bértola & Porcile (2007: 12) state "Australia, and to a lesser degree New Zealand, had a significant mining sector, and this meant more diversified exports and also a supply of raw materials and energy for the country's own industry. Mining explains why GDP per capita in Australia was initially so much higher than in Argentina (around 1880)." (own translation). On the other hand, Willebald (2011) focuses on the different types of land to explain differential performances within the settler "club". That economy that expands its frontier by the best lands "received" the blessing of the abundance of natural resources in terms of growth, but faced the curse of a deeper worsening in the income distribution in the agriculture. Land quality determines, technically, the appropriability conditions of the natural resources, and the quality of the institutions (in terms of their capacity to moderate concentrated rent appropriation) conditioned the long-run performance of the period. [5]

Our aim is to contribute in this line of research to find new elements in the comparative analysis of the "club" and the energy resources offer a good argument. Bertoni (2009):8 states "Uruguay is a small country [...and] does not have very steep slopes to make possible waterfalls

[5] Denoon (1983), Dieguez (1969), Duncan & Fogarty (1984) and Platt & Di Tella (1985) suggest similar elements in their analyses of comparative development for some members of the club, but without stressing the point.

potentially usable to the energy generation. As agents chose this kind of generation, the required waterfall had to be created artificially. In addition, the territory has an extensive hydrographic system but the hydraulicity is random because the water caudal is consequence of an extremely irregular pluvial regime [...]. The inexistence of fossil fuels completes a complex scene from the point of view of the natural resources related to energy supply". Was Uruguay dammed by their (absence) of energy natural resources? Can this shortage contribute to explain, at least partially, the differential economic performance compared to New Zealand?

3. Framework and analytical strategy

In a previous work (Willebald, 2010), we identified four analytical approaches to understanding the relationship between natural resource endowment and economic development. Three of them are associated with the "resource curse hypothesis", a dominant concept in the literature since the publication of Sachs and Warner's paper in 1995. The fourth approach is related to the "blessing" that natural resources confer on economic growth, a notion that held sway in the mainstream until the middle of the 20th century.

One approach focuses on the productive structure and considers the allocation of resources among activities with different spillovers and scale economies, and the influence these have on economic growth. Some activities would provide better opportunities for expansion than others, and therefore economic specialization becomes a key issue. Economies based on primary activities (natural resources-intensive economies) and where manufacturing and services have a small share in the internal generation of value would grow more slowly than other economies where labour division is more complex and innovative capacity is strengthened by systemic relationships. This approach includes the contributions of the Latin American Structuralism and the Developmentalist Theories of the 1950s-1960s and also of the recent analyses from the Neo-Schumpeterian and Evolutionist Schools. "Dutch disease hypothesis" occupies a key position in the approach that emphasizes changes in productive structure. Countries with abundant natural resources undergo booms and busts at irregular intervals because of price variations and because new resources are discovered. This evolution would create sudden changes in export earnings and in real currency exchange rates, and would affect the performance of foreign direct investment and productive activities, especially in tradable industries. The framework of the Dutch Disease hypothesis is useful to discuss the dynamic of the adjustment even though it is not essential to understand it. In other models it is possible, as well, to find different effects of the abundance of natural resources on income growth and income level. Economies with huge natural resources can achieve high

incomes per capita although the transition into a new equilibrium may imply negative growth rates.

A second approach is based on the recent literature about the "resource curse hypothesis". In this model the idea is that an abundance of, or heavy dependence on, natural resources influences some variable "x" which affects economic growth. The channels of transmission of this effect can be understood in terms of crowding out: an abundance of natural capital tends to displace other modalities of capital such as social, human, physical and financial assets, and tends to damage foreign direct investment. In general, failures in economic policy and weaknesses in institutions generate conditions adverse to economic growth, and resources are allocated to activities with low contributions to social welfare. This analysis is usually based on rent-seeking behaviour, which includes the government granting privileges to private agents, corruption, inequality and restrictions on political freedom. An abundance of natural resources may reduce incentives to accumulate human capital and depress public and private expenditure on high quality education. It may also be accompanied by low incentives to save and invest in a context of weak demand for machinery and equipment and low real interest rates. When capital accumulation is the main source of resources for growth and technical change, economies in which land rents and/or opportunities for land speculation are higher will grow less. In this context, the possibilities to connect financial capital with production are reduced and credit markets are imperfect and segmented. These considerations may be extended to foreign direct investment, which will find few attractive alternatives apart from the main natural resource exploitation activities.

The third approach is the so-called "factor endowment and institutional change hypothesis". In accordance with this view, the core of economic development is the interaction of critical exogenous factors such as geography, climate and institutional legacy. We can identify two perspectives here. First, the endowment of natural resources may directly affect economic development because geographic and environmental factors would determine land quality, potential production and the available technology. Second, the environment, geography and natural endowments may have indirect effects on economic development through the institutional structure and changes in institutional arrangements.

Finally, a fourth approach considers that natural resources are a blessing for growth. According to the "staple theory", several countries have developed integrated economies by exporting primary products (typically some settler economies). The existence of backward and forward linkages supports this view because some activities have more potential than others to induce

dynamism in the economy. The "vent for surplus theory" suggests that external trade was the way in which idle natural resources started to generate value, and this opened the way for quick expansion.

Our conceptual framework focuses on the productive structure approach and use concepts of the Neo-Schumpeterian and Evolutionist Schools to explain differences in terms of natural resources. Perez (2002, 2009) identifies five technological revolutions and techno-economic paradigms in the world history of the last 250 years: the great British leap (the "Industrial Revolution" from the 1770s onwards), the Victorian Boom (the age of the steam and railways, from the 1830s onwards), the Belle Époque (the age of the steel, electricity and heavy engineering, from 1870s onwards) and the post WWII boom. They are a time of widespread application of the new paradigm for innovation and growth across the whole economy and of spreading the social benefits much more widely while, at least partially, reversing the income polarisation of the "installation period". Investment is led by production capital, usually favoured by government policies and supported by a more regulated financial system. This period ends with the maturity of the technological revolution and its paradigm, the exhaustion of their potential for further innovation or productivity increases and the saturation of markets. All that sets the conditions for financial capital to look for other outlets, among which are the loans to faraway countries and the funding of new –potentially revolutionary– technologies.

However, the appearance of revolutionary new technologies will not automatically guarantee adoption from branch to branch and on a world scale. Diffusion in the early phase demands a simple vehicle of propagation, accessible to millions of individual decision agents and coherent with their decision-making criteria. That vehicle is long-term cost effectiveness. Although many of the products of each technological revolution can be inaccessibly expensive at first, at the core of each of these great waves of innovation there is a key input, which is very cheap, offers to remain cheap and, in conjunction with a constellation of generic innovations, radically transforms the relative cost structure confronting entrepreneurs, managers and engineers. Precisely, electricity was one of the main key inputs of the techno-economic paradigm that dominated the economic evolution of the word economy during the First Globalization and the interwar period. Therefore, our question about the relationships between the abundance of natural capital and the types of natural resources that an economy possesses is immediate.

Energy modernization process of the last decades of 19th and early 20th implied the intensive introduction of electricity in diverse economic and social activities. The electric power diffusion

and the heavy engineering application imposed a new pervasive techno economic paradigm (Freeman, 1989; Pérez, 1983). Since the 1880s, the technical system of the electricity challenged the coal and steam paradigm that had led the modern economic growth from the beginning of 19th century until then. The electric power offered the possibility to separate goods production from energy generation and allowed the expansion of the mechanization in new branches of manufacturing. Although the electricity diffusion was essential to improve the social welfare as well and it was part of the essential conditions of economic development of the "core".

Electric power is a secondary energy source, which means that we get it from the conversion of other primary sources of energy, and thermal and hydropower generation were the technological alternatives to produce electricity. Therefore, those countries with abundant coal, oil reserves or hydropower capacity had relative advantage to incorporate the new technical system[6] and, in consequence, to introduce themselves into the new techno economic paradigm. Bertoni (2002:41) estimated the per capita consumption of electric power in different small countries during the early decades of the 20th century. Table 1 shows the difference between New Zealand and Uruguay in three benchmarks (1913, 1920, and 1930). In the first year, the electricity consumption was similar in both countries but as we observe the following figures it is apparent the divergence.[7]

Table 1
ELECTRICITY CONSUMPTION PER CAPITA
In KWH

	1900	**1913**	**1920**	**1930**
NORWAY	20	765	1386	2290
SWIZERLAND	52	352	614	1085
SWEEDEN	18	219	377	710
BELGIUM		146	139	452
NEW ZEALAND		**14**	**80**	**417**
FINLAND	5	51	78	298
DENMARK		29	69	139
URUGUAY	**2**	**17**	**33**	**70**

Source: Bertoni (2002:41) Cuadro Nº IV.3.

[6] As stated Myllyntaus (1999:94): "In the early twentieth century, contemporaries had already observed that countries with considerable hydropower resources tended to have more electricity to consume than other countries".
[7] In 1920, the ratio between both indicators was 2.4 in favour of New Zealand and it increased until 6 in 1930.

Did our economies have similar conditions to face the new techno-economic paradigm? Were they prepared to generate energy in quantity and quality required by the economic process? Or, on the contrary, they were their energy conditions a bound for economic development?

Considering the significant differences between New Zealand and Uruguay in terms of income level, welfare and productive diversification, and the importance of energy natural resources for the generation of abundant and cheap energy, our hypothesis is that New Zealand was more blessed than Uruguay in terms of energy resources and this would explain, at least partially, the discrepancies in terms of economic development. To test this hypothesis, our analytical strategy involves a descriptive and comparative analysis of: (i) coal production; and (ii) suitable conditions to generate hydroelectric energy with low costs.

4. Were energy natural resources different? A statistical appraisal

Shortage or abundance of certain natural resources can be considered a determinant for the adoption and diffusion of electricity. Particularly, they are very important the water falls and mineral fuel existence to generate electric power. The presence of coal reserves is the first difference in terms of the capacity to generate electricity between New Zealand and Uruguay.

Data about coal mining activity are available from 1867 (Bloomfield, 1984:154) but it was just from 1878 when this activity evidenced a dynamic development. Between 1878 and 1891 the output of coal increased from 162.218 tons to 668.794 tons (New Zealand Official Handbook, 1892). The production continued increasing until the first decade of the 20th century when the industry reached an historical maximum. Then import of coal increased dramatically from 124.000 tons on 1900 to 573.000 tons on 1925 (Bloomfield, 1984:201) to substitute the less and less domestic production. As consequence, coal was replaced as primary energy to generate electricity along the early 20th century. Then we focus on the hydropower capacity to compare different endowments between New Zealand and Uruguay.

By 1930 both countries showed very different degree of development of hydroelectricity power. As New Zealand had already built several hydroelectric dams, Uruguay did not have anyone. We consider that this disparity responded to different hydropower potential.

Hydroelectric energy is produced by the force of falling water. Production of this energy is dependent on both the available flow and the height from which it falls. Water represents potential energy when it is accumulated behind a high dam. It is transformed into mechanical energy when the water rushes down the sluice and strikes the rotary blades of a turbine. The

amount of electricity which can be generated at a hydroelectric plant is dependent upon two factors: (i) the vertical distance that the water covers when it falls, which it is called the "head" (measured in meters); and (ii) the flow rate (measured as a volume per unit of time). In absence of historical statistics to estimate the hydropower according to these criteria, we can use as indirect evidence, the topography characteristics and quantity and regularity of precipitations.

Uruguay has a dense hydrographic network with two main rivers: Uruguay, and Negro rivers. The former is the border with Argentina so its potential hydropower is shared between both countries. The river Negro is, unquestionably, the most voluminous flow of water which irrigates the country; it runs from east to west and "cuts" the country in two regions (south and north). Low hills and broad grassland are topographic characteristics of Uruguay and as consequence the caudal of the flows of water is closely related with rainfalls. In general, precipitations are abundant but they are irregularly distributed along the year and even between years; we can observe years with heavy rainfalls and others with scarce precipitations (it is not strange that large regions of the country suffer important droughts). Absence of natural lakes and high elevations allow an easy displacement of rainfall water and this creates uneven conditions to storage it. Therefore, investment in hydroelectric plants must create these conditions, with high costs, and the history of the sector is very clear in to show the general consensus about the necessity of thermal plants as backup power.

On the contrary, in New Zealand, the generous reserve of water-power is obviously a result of the topography and precipitation. A large proportion of the country is mountainous and much of the mountain area is high (Ogilvie Buchanan, 1930:444-446). This author dealt with information that suggests a high degree of regularity of rainfall and river flows. In addition, lakes –the best natural regulator of river flow– are numerous and many of them are of considerable size (Ogilvie Buchanan, 1930:449).[8]

Like the topographic factors are a static condition we start the exploration of the incidence of hydropower endowment on economic development comparing the rainfalls in both countries. Table 2 shows the average annual rainfall in Uruguay and New Zealand in the first decades of the 20th century. Here we can observe two important differences. On the one hand, Uruguay had lower and more irregular rainfalls than New Zealand along the period. In average, the precipitations were between 25% and 30% lower and the standard deviation was five times

[8] According to Te Ara-The Encyclopedia of New Zealand, "New Zealand is a land of lakes… Excluding offshore islands, New Zealand has 775 lakes… Lakes cover about 1.3% of the land area" (http://www.teara.govt.nz/en/lakes).

greater in Uruguay than New Zealand. The absence of natural lakes in Uruguay induces higher difficulties to manage the irregular rainfalls and imposes the necessity to build artificial lakes to storage water, and the contemporaneous people were aware of the dimension of the problems. By 1925 the Uruguayan technicians said that to build a hydroelectric plant in the river Negro would imply the creation of the largest artificial lake of world.[9]

Table 2
URUGUAY AND NEW ZEALAND: AVERAGE RAINFALL
In mm

	Uruguay	New Zealand
Years	**mm**	**mm**
1901	727.8	1,388.7
1902	928.7	1,289.8
1903	977.6	1,403.9
1904	742.8	1,591.9
1905	756.6	1,199.1
1906	638.9	1,165.2
1907	550.5	1,309.3
1908	920.2	1,157.5
1909	868.3	1,317.3
1910	676.9	1,241.4
1911	1,271.0	1,224.9
1912	1,496.8	1,216.9
1913	1,075.2	1,216.9
1914	2,399.7	1,216.9
1915	1,068.5	1,118.4
1916	574.4	1,138.0
1917	706.6	1,259.4
1918	856.3	1,294.0
1919	1,207.0	1,278.8
Average		
1901-1915	**1,006.6**	**1,270.5**
1901-1919	**970.7**	**1,264.7**

Uruguay			
Standard deviation		Variation coefficient	
1901-1915	459.40	**1901-1915**	45.6
1901-1919	426.21	**1901-1919**	43.9

New Zealand			
Standard deviation		Variation coefficient	
1901-1915	120.35	**1901-1915**	9.5
1901-1919	110.66	**1901-1919**	8.8

Note: New Zealand 1912-14: average ten years.
Sources: Uruguay: Dirección General de Estadística (1921) "Anuario Estadístico 1919". Montevideo.
New Zealand: The New Zealand Official Year book (several years).

If we accept that hydroelectric power has a close relationship with the rainfalls, New Zealand would have had a clear potential advantage respect to Uruguay. Ogilvie Buchanan (1930) offers an extraordinary overview about the potential hydropower in New Zealand in the second decade of 20th century. For Uruguay, Oxman (1960) offer a similar picture to the 1950s. From the information provided by both authors we propose a comparison of the hydropower potential and the information is presented in Table 3 (see detailed data in Table 4).

[9] See, for instance, Libro del Centenario (1925):266.

Table 3
POTENTIAL HYDROPOWER IN NEW ZEALAND AND URUGUAY
In MW

Uruguay		New Zealand	
Río Negro	493	North Island	475
Río Uruguay	700	South Island	2.088
Other sites	39		
	1.232	TOTAL	**2.563**

Sources: Ogilvie Buchanan (1930) and Oxman (1960).

Table 4
POTENTIAL HYDROPOWER SITES IN NEW ZEALAND AND URUGUAY

Uruguay	
Location	**KW**
Río Uruguay – Salto Grande (Ayuí)	1,400,000
Río Queguay (Barra Viraró)	15,000
Aº Cuñapirú (Los Cuervos)	10,000
Río Negro (Rincón del Bonete)	128,000
Río Negro (Baygorria)	105,000
Río Negro (Paso del Puerto)	140,000
Río Negro (Yapeyú)	120,000
Río San Salvador	910
Río Santa Lucía (Piedra Alta)	1,360
Río Tacuarí (La Cachoeira)	2,500
Río Cebollatí (Sierra del Tigre)	9,000
	1,931,770
Salto Grande (only 50%)	-700,000
	1,231,770
Fuente: Oxman. R. (1960:53)	

New Zealand		
Location	**HP**	**KW**
North Island		
Kaituna	65,000	48,490
Horahora	15,000	11,190
Wairoa	4,200	3,133
Arapuni	163,000	121,598
Aratiatia	136,000	101,456
Waikaremoana	129,000	96,234
Tariki	26,000	19,396
Makohini	75,000	55,950
Mangahao	24,000	17,904
South Island		
Rotoroa	60,000	44,760
Clarence	100,000	74,600
Waimakariri	30,000	22,380
L. Coleridge	81,000	60,426
L. Tekapo	400,000	298,400
L. Pukaki	50,000	37,300
Kurow	37,000	27,602
Teviot	30,000	22,380
Waipori	26,800	19,993
L. Aunoto	100,000	74,600
L. Monowai	16,000	11,936
L. Hall	48,000	35,808
L. Hilda	55,000	41,030
L. Manapouri	840,000	626,640
L. Te Anau	600,000	447,600
L. Hawea	80,000	59,680
L. Ohau	125,000	93,250
Wataroa	80,000	59,680
Wanganui	40,000	29,840
	3,436,000	**2,563,256**

Source: Ogilvie Buchanan. R.(1930): "Hydro-Electric Power Development in New Zealand". *The Geographical Journal*. Vol. 75. No. 5 (May. 1930). pp. 444-457.

We can observe that New Zealand had twice the hydroelectric potential than Uruguay in its territory. This figure represents the nominal potential energy not taking into account the effect of irregular rainfall that we consider before. Further the topographic characteristics in Uruguay did more expensive the works in hydroelectric plants in Uruguay.

5. Final remarks and next steps

Settler economies are characterized for abundance of natural resources. However, natural capital is not homogeneous between countries and it can induce different consequences in terms of growth, income levels and productive structure.

We discuss the effect of natural resources on economic performance in terms of the debate about the "curse" (and the "blessing") of the natural resources hypothesis, we focus our analysis on a couple of small economies –New Zealand and Uruguay– that make up the group of economies of recent European settlement (settler economies) and we consider, specifically, the energy natural resources.

Literature about economic development of settler economies that identifies differences within the "club" with disparities in terms of natural resources is very scarce. We look for diversities in energy natural endowments (basically coal endowments and suitable conditions for hydroelectric generation) to explain (at least partially) different welfare levels between both economies. Despite many similarities between both countries –referred to productive structure, the dynamics in the flows of productive factors and the modality of participation in international markets– New Zealand and Uruguay presented, during the 19th century and the first decades of the 20th century, significant differences in income per capita levels. Consequently, we need to study other spheres of economic system to find new answers in this matter. The analytical framework related to the "curse" of the natural resources offers some interesting insights the topic.

According to our analysis, the discrepancies in favour of New Zealand to the production of coal and natural conditions to generate electric energy with low costs explain those differences. Our findings are new evidence that support the curse hypothesis of natural resources. In the next steps of our research, we will propose a contrafactual exercise to answer the following question: What had happened with per capita income gap if Uruguay had been endowed with similar energetic natural resources than New Zealand? Our conjecture is that the low participation of manufacturing in the Uruguayan industrial structure had, in the difficulties to generate energy, one of the main explicative factors. Then, the outcome was an evolution of permanent energy restriction in a context of persistent energetic dependence.

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