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Agricultural Institutions, Industrialization and Growth: The Case of New Zealand and Uruguay in 1870-1940*

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Abstract

In this paper we apply a model of early industrialization to the case of New Zealand and Uruguay in 1870-1940. We show how differences in agricultural institutions may have produced different development paths in two countries which were similar under many respects. While in New Zealand the active role of the Crown in regulating the land market facilitated access to land, in Uruguay land was seized by a small group of large landowners. Our model shows that land concentration may have negatively influenced industrialization and growth by impeding the formation of a large group of middle-income landowners and, as a consequence, the development of a domestic demand for basic manufactures. We support this view with a comparative analysis of agricultural institutions and industrial development in New Zealand and Uruguay.

JEL classification: D33; O14; P52; Q15

Keywords: Agricultural Institutions; Industrialization; Growth; New Zealand; Uruguay; Functional Distribution; Agricultural surplus.

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1 Introduction

In this paper we investigate how institutions governing the agricultural sector may have affected the evolution of industrial production and GDP in New Zealand and Uruguay during the period 1870-1940. To this end we apply a model of early industrialization under functional distribution and hierarchical preferences, proving that the mentioned differences in agricultural institutions can in principle produce the observed patterns of industrialization and growth.

New Zealand and Uruguay were two countries of new settlement that before the end of the nineteenth century succeeded in achieving a moderately high income per capita. Both countries prospered thanks to their flourishing agricultural sectors: they were characterized by the abundance of natural resources and by sparse population, made up mostly of descendants of European immigrants. Their initial economic growth was based on exports of food and raw materials to a rapidly expanding international economy. By the last quarter of the nineteenth century New Zealand and Uruguay had achieved levels of income per capita higher than many leading European countries. However, their subsequent trajectories were quite different. Although it is true that both countries found it increasingly difficult to sustain growth in the first half of the twentieth century, the case of Uruguay was particularly disappointing. The country grew at high rates in the 1920s, when the external markets were buoyant, but it could not sustain growth after 1930: its GDP per capita in 1940 was about the same as in 1912. On the other hand, New Zealand, while experiencing a fall in the rate of growth after the 1930 crisis, was able to trigger an industrial takeoff that was not negligible, especially if measured in terms of the diversification of industrial production, horsepower usage and size of production units (Willebald and Bértola, 2007).

Our aim is to shed light on this puzzle by taking into account the role of agricultural institutions in the two countries. Indeed, although similar in many respects, New Zealand and Uruguay had rather different institutions governing their agricultural sectors. In particular, they had different rules and practices concerning access to land and the distribution of agricultural product among the suppliers of production factors. In New Zealand the British Crown adopted a policy of land distribution to new migrants, and in general to those entering the labor market, that rapidly expanded the number of landowners in the country. By contrast, in Uruguay land ownership was rapidly concentrated – as a consequence of the appropriation of public lands by a few landlords – and remained highly concentrated afterwards. Furthermore, the share of agricultural product retained by New Zealander landowners was systematically lower than that of their Uruguayan counterparts. Our thesis is that these differences, shaping the distribution of purchasing power in the population, had a major impact on the size of the domestic markets for manufactured goods. More precisely, in Uruguay domestic demand for basic manufactures was smaller than in New Zealand, generating a systematic relative disadvantage for Uruguay in the exploitation of mass production. This led to a weaker process of industrial diversification and industrial expansion in the case of Uruguay.

In order to clarify our intuition we present a model of early industrialization based on Murphy et al. (1989). What this model shows most clearly is that industrial takeoff

depends on the composition of domestic demand for manufactures which, in turn, depends on the distribution of income. Two key assumptions give rise to this outcome: first, consumers have hierarchical preferences; second, industrialization in the manufacturing sector entails the substitution of an increasing return technology (with fixed start-up costs) for a constant return technology. Bilancini and D’Alessandro (2008a,b) have shown that adding the assumption of functional distribution of income is sufficient for industrial takeoff to depend on both the distribution of land ownership and the distribution of agricultural product between landowners and peasants.

The main contribution of the present paper is to apply this framework to the case of New Zealand and Uruguay. In order to keep our argument as parsimonious as possible, we suppose in the model that the two countries were equal in every respect except the concentration of land ownership and the share of agricultural product going to workers. We show such differences are sufficient to produce divergence in terms of both industrialization and GDP growth. In other words, we provide a theoretical argument whose implications are consistent with available historical evidence about the evolution of the two countries and which highlights the importance of agrarian institutions in early industrialization. Of course, we do not intend to argue that this is the only cause of the different development paths followed by New Zealand and Uruguay. We only claim that the mechanism that we highlight – and that to the best of our knowledge has not been put forward in comparative studies of these two countries – may have played a significant role.

Recently the debate on geography and institutions has revived interest in the determinants of divergent development paths across countries. A growing body of literature has sought to compare the institutions emerging from the colonization process in different regions (Acemoglu et al., 2001; Galor et al., 2008) and particularly in the regions of new settlement (Denoon, 1983; Engerman and Sokoloff, 1997, 2005). Differently from this literature which focuses on the indirect effects of agrarian institutions on economic development, the present paper suggests that there is a direct relation going through the demand side and which has to do with the composition of demand for manufactures (Murphy et al., 1989; Willebald, 2007).¹

The interest in comparing the development of Uruguay with that of New Zealand is not new. At the end of the 1970s two Uruguayan historians pointed out that “Uruguayans have been comparing themselves with New Zealand for at least seventy years” (Barrán and Nahum, 1978, p.191). Notwithstanding this long tradition, most comparative studies were produced in the 1960s and 1970s. Two strands of literature can be identified. The first looked at New Zealand and Uruguay within the context of the countries of new settlement, comprising a more general comparison between the River Plate and the Australasian regions (see for instance Bértola and Porcile, 2002; Williamson, 2002; Willebald and Bértola, 2007; Blattman et al., 2007; Alvarez et al.,

¹Other authors focus on the key link between access to frontier land, institution building and growth, which has been explored by the economic history literature since the seminal work by Jackson Turner. In the case of the United States, the existence of *free* land in the frontier may have contributed to keep real wages higher in the East (Margo, 1999), encouraging the use of more advanced technology and leading to higher labor productivity growth.

	Non-industrial exports as % of Total exports	Exports as % of GDP
<i>Period 1870-1899</i>		
New Zealand	99%	16%
Uruguay	100%	22%
<i>Period 1890-1909</i>		
New Zealand	96%	23%
Uruguay	100%	19%
<i>Period 1920-1939</i>		
New Zealand	99%	25%
Uruguay	100%	18%

Table 1: Share of non-industrial exports (live animals, foods, drinks, raw materials or simply prepared products) and share of GDP due to export revenues: New Zealand and Uruguay **Sources:** Blattman et al. (2007), Willebald (2007).

2007). The second approach emerged from studies of the agrarian sector which emphasized the potential for the diffusion in Uruguay of the technology and production practices that were successful in New Zealand.² In this context, Kirby (1975), studying the 1960s and 1970s, presents an interesting analysis of the main similarities between the two countries and investigates their land tenure systems. Although his concerns were tied to the policies which Uruguay should implement in order to promote economic development, he clearly pointed out that “the parallel development of New Zealand and Uruguay obviously stopped short, or diverged, sometime in the past” (Kirby, 1975, p. 264). In this respect, our paper focuses on a plausible explanation of this earliest divergence.

The rest of the paper is organized as follows. The next section highlights the similarities between the two countries as well as their different evolution in terms of industrialization and GDP per capita. In section 3, we review the available historical evidence about the agricultural institutions in New Zealand and Uruguay and argue about their consequences in terms of property rights and income distribution. In section 4 we apply the model developed in Bilancini and D’Alessandro (2008a,b) to the case of New Zealand and Uruguay, showing how agricultural institutions may have generated divergent industrial and GDP growth. Section 5 provides our final remarks.

2 New Zealand and Uruguay between 1870 and 1940

At the end of the nineteenth century, the economies of Uruguay and New Zealand were similar in many respects. In the first place, GDP per capita in both countries was relatively high, even compared with that of developed countries. In real terms, New Zealand’s was slightly higher than that of the United States, and Uruguay’s was at

²Our proposed explanation is independent of – though not incompatible with – those which stress differences in the performance of the agricultural sectors or the lack of sufficient stimuli for agricultural production – such as pointed out in the classical comparisons between Australia and Argentina by Davie (1960); Duncan and Fogarthy (1984); Álvarez and Bortagaray (2007).

	New Zealand	Uruguay
Latitude of southern-northern extremities	35 – 47°	30 – 35°
Annual average temperature (Celsius)	12.8	17
January mean temperature (Celsius)	18.0	24.5
July mean temperature (Celsius)	8.0	10.9
Annual frost days	15	21
Average annual rainfall (mm)	992	1005
Lowest monthly rainfall (mm)	61 March	65.6 July

Table 2: A comparison of climate indicators for areas of intensive pastoral activity: San José de Mayo (Uruguay) and Palmerston North (New Zealand). **Sources:** Kirby (1975).

about the United States level (Maddison, 2003). Moreover, both countries were heavy exporters of non-industrial (mostly agricultural) goods. During the First Globalization era (1870-1914) both countries specialized in exporting foodstuffs to a dynamic international economy. As table 1 shows, this specialization persisted until World War II. Moreover, for both countries exports represented a very significant fraction of GDP – between one-sixth and one-fourth – though for New Zealand it had been increasing and and for Uruguay it had been decreasing slightly.

Another similarity is factor endowments, in particular population and land. In 1870 New Zealand and Uruguay had a similar population mostly made up of early European colonizers. After 1870 and up to the World War II, both countries experienced a rapid population growth and received massive inflows of European immigrants.³ Overall, between 1824 and 1924 the temperate regions of new settlement were the destination of about 43 million emigrants from Europe; New Zealand and Uruguay were no exception to this (Kenwood and Loughheed, 1990). Between 1870 and 1940 the population of New Zealand increased from 291,000 to 1,633,645 of whom 413,847 were immigrants.⁴ In the same period U’s population increased from 420,000 to 1,980,000, including about 297,185 immigrants (Álvarez, 2005).

Given the available technologies, the total amount of potentially productive land in the two countries was remarkably similar, at about 17 million hectares. However, Uruguay had already achieved this extent in 1870 and the area remained almost constant thereafter. In New Zealand in 1870 only about 8 million hectares were occupied, and it took until 1911 for the figure of 17 million to be reached. This was a relative advantage for Uruguay. Furthermore, the climate was quite similar in the two countries. As shown by table 2, in the typical area of intensive pastoral activities the relevant climate indicators were very close. Finally, although the quality of land was not exactly the same in the two countries, the literature points out that this factor could not account for the different economic performance (see Álvarez and Bortagaray, 2007).

³The First Globalization era witnessed massive emigration of Europeans to many regions of the globe, spurred by rapid population growth in Europe and migration from rural areas (Williamson, 2002). Substantial increase in transport productivity in the last quarter of the nineteenth century allowed a dramatic fall in transportation costs and the integration to world markets of new regions supplying food and raw materials.

⁴The small Maori population is considered in the population figures of New Zealand.

	New Zealand	Uruguay
<i>GDP per capita, PPP Dollars 1995</i>		
1870	3100	2225
1938	6463	3723
<i>Relative GDP per capita, New Zealand = 100</i>		
1870	100	77
1938	100	58
<i>Annual rate of growth</i>		
1870-1938	1.05%	0.75%
1870-1913	1.20%	1.00%
1913-1938	0.90%	0.35%

Table 3: GDP per capita and annual growth rates in 1870-1938: New Zealand and Uruguay. **Sources:** Maddison (2003), Willebald and Bértola (2007) .

Notwithstanding such similarities, in the early twentieth century New Zealand was developing faster than Uruguay and substantially increased the gap during the last decade before the World War II. Table 3 reports the annual rate of growth experienced by the two countries during the period as a whole as well as in the two subperiods 1870-1913 and 1913-1940. As mentioned above, in 1870 the per capita income of New Zealanders was already higher than that of Uruguayans. However, the gap increased during the following seventy years. In 1870 GDP per capita in Uruguay was only 23% less than that of New Zealand, but in 1938 it was 42% less (Maddison, 2003). Both countries lost ground with respect to the faster industrializing countries such as the United States, but Uruguay lost substantially more than New Zealand.

The key difference between the two countries is the asymmetric development of industrial production and, in general, the asymmetric adoption of industrial technology. We define industrial technology (see the theoretical section below) as technology which displays increasing returns.⁵ From this perspective it is the presence of increasing returns that distinguishes industrial from artisanal forms of manufacture production. As shown in the upper part of table 5, New Zealand and Uruguay had a small industrial sector in the early twentieth century – the countries’ production consisted largely of non-industrial goods. During the second decade New Zealand was able to diversify and produce relatively more machinery and metal products than Uruguay. These sectors are usually seen as being more knowledge- and scale-intensive than sectors such as food, drink and tobacco⁶, which responded for a larger share of the Uruguayan production. In any case, while both countries succeeded in moving towards the industrialization of some aspects of agricultural production – such as refrigerated meat and dairy products – New Zealand moved much earlier in this process, and indeed was among the first countries to export refrigerated dairy products. Certainly, this was an important step in the diffusion of industrial methods throughout the economy.⁷

⁵It should also be recalled that increasing returns in industrial production are at the heart of Kaldor’s classical model of learning and development (Kaldor, 1961).

⁶See the classical analysis by Pavitt (1984).

⁷We emphasize that in this paper we refer to industrialization as a broader process. In particular,

	Uruguay	New Zealand
Domestic industrial production	162,584,114 (pesos)	84,892,000 (pounds)
Domestic industrial production (pounds)	25,199,026	84,892,000

Table 4: Estimated value of industrial production for the domestic markets of Uruguay and New Zealand in 1936. Production data exclude sectors whose production is mainly directed to export (such as farming goods, including frozen meat). **Sources:** production: Dirección General de Estadísticas y Censo (1961); Bértola (1991); Bloomfield (1984); exchange rates: Maubrigades (2003); Williamson (2010).

Furthermore, although Uruguay seems to have gradually adjusted towards a more capital intensive production system, it still failed to catch up with New Zealand. The relevant difference here is the kind of technology adopted. As shown in the lower part of table 5, New Zealand had more productive units which employed a larger number of workers and used a greater amount of horsepower than their Uruguayan counterparts. Moreover, this difference increased markedly from the 1900s to the 1930s, especially as regards the amount of horsepower per unit of production – a reasonable proxy for the diffusion of capital-intensive technologies in which increasing returns prevail.

Finally, although we do not have source data for the total domestic demand for industrial goods, we can attempt an estimation. We do have comparable data on industrial production by sectors for the year 1936. Therefore, if we exclude those sectors whose production was mainly exported – mostly food, and especially frozen meat – we can obtain a rough idea of industrial production for the domestic market. Moreover, if we accept that total industrial production for the domestic market equals both supply and demand – i.e. we are at equilibrium – then we have a rough idea of the size of domestic demands for industrial products. This is reported in table 4. Our figures suggest that in 1936 industrial production for the domestic market was substantially larger in New Zealand.

The increasing differences in the economic performance of New Zealand and Uruguay did not stop after World War II. Instead, the gap widened in terms of both industrial development and GDP growth (Maddison, 2003; Willebald and Bértola, 2007). In this paper we do not try to explain the later divergence. However, if one follows Kirby (1975) in suspecting that developments after World War II had their roots in the events of 1870-1940, the analysis that we carry out in the next two sections may be of some interest even for understanding more recent facts.

At this point a caveat is necessary. In this paper we focus on institutions and early industrialization, but the two economies also had other significant differences that may have contributed to explain their asymmetric trajectories. We will mention a few of these differences.

First, there are geographical differences: New Zealand is a pair of islands relatively isolated from conflicts and wars with its neighbours, while Uruguay was deeply involved in the Argentinian civil wars (in the first half of the eighteenth century), was invaded

we refer to the diffusion of increasing return technology across non-food production.

by Brazil in 1864, and formed with Brazil and Argentina the “Triple Alliance” against Paraguay in the Paraguay War of 1865-1870. In addition, the fact that New Zealand was more distant from the UK than Uruguay may have given New Zealand a natural protection against the competition of British industrial goods. On the other hand, New Zealand was not free from internal strife, and the Maori-settler conflict (the New Zealand Wars) were an important disturbing factor between 1843 and 1872, which engaged various actors, including in some cases the British Army (see on this Belich, 1988, 2001).

Secondly, New Zealand developed mechanisms of access to credit, technology and markets that were absent in Uruguay.⁸ These mechanisms contributed to increase New Zealand’s productivity and thereby helped it to respond to a rising international demand for foodstuffs better than Uruguay. But it should be noted that this difference between New Zealand and Uruguay was to some degree endogenous to the institutional framework. In effect, New Zealand made significant efforts to diffuse technology as part of its policy for settling workers in an expanding frontier. A growing number of farms, small allotments and less favorable soils existed side by side with the parallel effort for building the necessary (technological and financial) conditions required to make these farmers viable from an economic point of view.

Finally, there were also institutional differences related to the international context, and these cannot be ignored. It was highly significant that New Zealand enjoyed much better conditions of access to the British market after 1930 than Uruguay. Britain gave its dominions preferential access to its market after the crisis (according to the terms of the Ottawa Treaty), while Uruguay had to accept severe restrictions on exports (Bértola and Porcile, 2002). This of course had an impact on growth in each country after 1930. We would not deny the importance of this asymmetry, but we will argue that the divergence between the two countries was already visible before the crisis. Moreover, with the collapse of the external markets, growth began to depend more on the diversification of industrial production aimed at the domestic demand than on exports. Our argument is that the institutions that sustained a more equal income distribution in New Zealand and higher levels of demand for industrial goods were conducive to industrial growth and therefore helped to cushion the negative effects of the 1930 crisis.

Summing up, at the end of the nineteenth century the similarities between New Zealand and Uruguay were not sufficient to lead them along the same development path in the following seventy years. More precisely, although the two countries resembled each other in terms of GDP per capita, production, exports, population and land stock, New Zealand managed to grow moderately faster and to develop a substantially larger

⁸On the other hand, New Zealand set up much earlier than Uruguay centres for technological research and diffusion in the agricultural sector. Among them were the Lincoln Agricultural College (1878), the Department of Agriculture (1895), the Cawthron Institute (1919), the Massey University (1926) and the establishment of the Department of Scientific and Industrial Research (1926). In addition, New Zealand counted on a specific institution, the stock and station agent, which provided not only technological advice but also long term credit for buying land and equipment, as well as information about external markets (Ville, 2000).

	New Zealand	Uruguay
<i>Share of gross manufactures values in</i>	1915-1916	1919
Foods, drinks and tobacco	59.8	69.1
Textile, clothing and leather	18.8	7.6
Machinery and metal products	7.4	0.0
Other	14.0	23.3
<i>Share of gross manufactures values in</i>	1937-1938	1936
Foods, drinks and tobacco	57.4	57.0
Textile, clothing and leather	9.8	19.2
Machinery and metal products	12.6	8.7
Other	20.2	15.1
<i>Horsepower and employment in</i>	1910	1908
Thousands of horsepower	100	23
Horsepower per production unit	28.4	16.8
Total employees	45965	22224
Employees per production unit	13.1	9.2
<i>Horsepower and employment in</i>	1939	1936
Thousands of horsepower	903	115
Horsepower per production unit	142.4	10.9
Total employees	108722	65962
Employees per production unit	17.1	6.3

Table 5: Data on manufacturing in the first half of the twentieth century: New Zealand and Uruguay. Note: data for 1908 refer only to the Montevideo district. **Sources:** Willebald and Bértola (2007) and references therein.

industrial sector. The last fact is especially surprising if one considers that neither country exported a substantial amount of industrial goods. Actually, New Zealand's larger demand for industrial goods must have been sustained by domestic demand. This in turn shows that the two countries had different patterns of domestic demand. In next two sections we explore how differences in agricultural institutions between New Zealand and Uruguay can have been responsible for this.

3 Institutional Differences in the Agricultural Sector

So far we have contrasted the similarities between New Zealand and Uruguay at the end of the nineteenth century with the differences shown in their subsequent GDP growth and industrial development. However, if one looks at the institutional framework governing the agricultural sector, the two countries already showed significant differences in 1870.

Although the productive capacity of the potential land stock was very similar, land occupation followed rather different patterns in New Zealand and Uruguay. This resulted in major differences in landholding practices. In New Zealand the British Crown regulated the land market strictly, facilitating a steady increase in the number of landowners. In Uruguay land was soon appropriated by a small number of landowners, making it very difficult for newcomers and younger people to access land, and thus maintaining the restriction. Furthermore, the two countries were characterized by a

different distribution of the agricultural product between landowners and landless peasants. More precisely, the share of agricultural product appropriated by landowners was higher in Uruguay than in New Zealand.

As we will argue, both a lower concentration of land ownership and a more equal distribution of land product contributed to produce a larger proportion of the population with enough purchasing power to buy manufactured goods which, in turn, made the introduction of industrial technology more profitable. ^t

3.1 The institutional setting in the nineteenth century

New Zealand. The New Zealand subject literature has emphasized that the process of land distribution in the country was highly idiosyncratic, representing a factor that contributed to the emergence of an agrarian society with high welfare levels. The distribution of land constituted a political and economic resource that the state used widely in the nineteenth century with a view to securing the efficient use of land.

In Article II of the Waitangi Treaty of 1840 Britain acknowledged the individual and collective rights of the native Maori over their territories. The Waitangi Treaty was a turning point in New Zealand economic history, as it represented the moment at which the Maori ceded the sovereignty of their territory in exchange for autonomy and property rights. In general terms, the Treaty was systematically ignored, giving rise to a massive transfer of land to European colonizers.

Land distribution among the colonizers followed the British tradition of making explicit the Royal origin of property titles. Colonizers could not negotiate directly with the natives; but the intermediation of the Crown was required. The Colonial authorities and the representatives of the autonomous government created a juridical framework that regulated the expropriation of land from the Maori and the granting of property titles to the European colonizers. Between 1840 and 1860 the process of land distribution accompanied the arrival of new immigrants, providing for the effective occupation and exploration of the allotments of land. The state controlled land distribution rigorously in order to allow a suitable proportion of the population to have access to this critical asset. Public land was sold or leased for long periods by the state, under certain conditions, which included the effective exploration of the allotments, measures for soil conservation as well as the improvement of eroded lands (Prichard, 1970; Hawke, 1985, 1999).

In the 1870s, the political and administrative reform that abolished the provincial system and centralized the government led to the establishment of the Torrens system, which greatly simplified the registration of property, facilitating the formation of a market for land. The extension of the territorial frontier after 1890, the active role of the state in distributing land and the positive effects of the use of refrigeration (which encouraged the division of the large estates with a view to adopting more capita-intensive techniques), contributed significantly to the transformation of the structure of land ownership in New Zealand.⁹

⁹The 1891 Land and Income Tax established a progressive tax on land property for three categories of tax-payers. Keall (2000) suggests that income from this tax represented in 1922 about 10 % of the total income of the state.

The Land for Settlement Acts of 1892 and 1894 were key juridical pieces regulating the distribution of land between 1892 and 1912. The first abolished the system of selling land in installments and incorporated the leasing of public lands (including a purchase option up to a maximum of 8.000 hectares). The initial period of leasing was 10 years with a purchase option, but the lease could be renewed for a maximum of 25 years, after which the land was occupied in perpetuity (900 years). By means of this mechanism the producer actually became the owner. The same Law granted to the government a budget of 50,000 pounds sterling per year (increasing to 250,000 pounds sterling in 1894) to expropriate land and promote the division of the latifundia.¹⁰ The extent of latifundia fell from 3.2 million hectares in 1891 to 1.4 million in 1910, as a result of both the influence of the public policy and the advantages of a more capital-intensive type of exploitation. In 1907 the National Endowment Act provided for an extension of the amount of public lands for leasing, with a view to financing the system of public education and supporting the old-age pension system adopted in 1894.

In sum, New Zealand established property rights in the rural sector during the initial stages of colonization. This secured the extension of property rights for the new waves of white colonizers, while and at the same time kept a tight control on the holders and uses of public land. In this way, NZ facilitated the access to land of a significant proportion of its population, effectively preventing small oligarchic groups from taking control of land.

Uruguay. In the nineteenth century Uruguay showed great vulnerability in political and institutional terms, marked by recurrent financial crises and a lack of effective control over the national territory (Bértola, 1991). Between 1830 and 1870, the successive governments that ruled the country adopted a policy of selling public land instead of offering this land for leasing contracts. Moreover, the continuous political instability that haunted Uruguay in that period prevented the consolidation and effective working of a market in factors of production. The state lost its control over public lands in favor of latifundia, being unable to determine precisely their extent and location in the national territory.

In 1830, when Uruguay adopted its first Constitution, public lands represented 80% of the territory, the national frontiers had already been defined and the population was only 70,000. The access of the population to land was a highly contentious process that the state could not organize properly, being unable to resist the pressure of large landowners, the financial demands produced by frequent fiscal crises, and the military and political power of the *caudillos*, of paramount influence among the population that had neither formal property titles nor leasing contracts protecting their interests.¹¹

¹⁰The estimated income received by the state from the renting out of public lands between 1892 and 1894 was high enough to pay the costs of the expropriation of the large estates in this period (as shown in Álvarez, 2005).

¹¹The occupation of public land was such a chaotic process that at the beginning of the twentieth century, when the Batlle and Ordoñez administration sought to implement new policies for encouraging agricultural production, the amount of public lands was still unknown. It is likely that these lands did not represent more than 15% of the national territory at that time, and that the state received no income

The consolidation of property rights in the rural sector was achieved in the second half of the 1870s, in the context of the military regimes which began with Colonel Latorre in March 1876. The emergence of new technologies in weaponry (the Mauser and Remington rifles), transportation (railways) and communication (telegraph) offered a decisive advantage over the rural *caudillos*. At the same time, the delimitation of the rural properties was made possible by the diffusion of the iron fence, the *alambramiento*, in the landscape of the pampas (Barrán and Nahum, 1967, 1971, 1972, 1973; Jacob, 1969; Millot and Bertino, 1996; Moraes, 2001; Franco, 1968). This consolidated the dominance of large estates in the rural sector, to which a substantial part of public lands was eventually incorporated.

In sum, property rights in the Uruguayan rural sector were fragile at the beginning, and were consolidated only in the last quarter of the nineteenth century. This coincided with the transfer of large amounts of land to a small group of landowners, which by and large remained of the same size for several decades thereafter. This type of land occupation effectively restricted the access to land and fostered land concentration.

Year	New Zealand	Year	Uruguay
1891	43808		
1896	58940	1908	43589
1911	73876	1913	58530
1930	82985		
1940	90931	1937	73414

Table 6: Number of farms in New Zealand and Uruguay. **Sources:** Uruguay - Censo de población y agropecuarios (1908, 1916, 1937) y Base de datos del Programa de Población - UM - FCS - UDELAR. Nueva Zelanda - Hawke (1985); Briggs (2003).

Year	Total		Rural	
	Uruguay	New Zealand	Uruguay	New Zealand
1890	24	12	122	23
1895	21	18	107	35
1900	19	17	95	34
1905	17	16	65	33
1910	15	16		
1915	13	15	63	35
1920	12	14		
1925	11	13		
1930	10	11		
1935	9	11	50	35
1940	9	11		

Table 7: Hectares of occupied land per inhabitant (Total and Rural), NZ and Uruguay. **Sources:** Uruguay - Censo de población y agropecuarios (1908, 1916, 1937) y Base de datos del Programa de Población - UM - FCS - UDELAR. Nueva Zelanda - Hawke (1985); Briggs (2003).

from them.

3.2 The distribution of land ownership and agricultural product

A rough idea of the distribution of land ownership can be obtained by looking at the average number of farms in the two countries. Table 6 shows the number of farms in New Zealand and Uruguay at different points in time. The number of farms was significantly greater in the case of New Zealand.¹² This is relevant especially because New Zealand had a smaller amount of available land than Uruguay until 1911. Table 7 shows the changes in the area of occupied land per inhabitant in the rural sector. The figures are much larger in Uruguay. In 1890 population density in rural Uruguay was about half that in New Zealand. Moreover, the figure for occupied land per rural inhabitant remained approximately stable, reflecting the fact that the rural population increased *pari passu* with the supply of land. These differences are also reflected in the evolution of occupied land per capita, which remained stable in New Zealand while falling sharply in Uruguay. Overall, this suggests that land ownership was more concentrated in Uruguay.

Information about the distribution of agricultural product in the two countries can be obtained by looking at the ratio between the price of land and real wages and at the share of agricultural product going to wages. The first variable gives a rough idea of the relative value – and, hence, of the relative economic scarcity – of the two factors of production. The second variable represents a first approximation of the residual product accruing to those controlling the land stock.

Time series are available for wages and land prices for both New Zealand and Uruguay (see the Appendix for additional information on data sources). This allows us to compare the evolution of the rental/wage ratios between 1875 and 1940. We stress that comparing the absolute values of the rental/wage ratios is not safe given the nature of our data. Nonetheless, supposing that both countries were exposed to similar shocks, there are interesting insights that can be drawn from the relative movements of the two trends. Figure 1 shows that the rental/wage ratio in New Zealand and Uruguay followed a fairly similar trend: it increased until the first decades of the twentieth century and declined since 1915. This trend probably expresses the impact of the higher prices for foodstuffs and raw materials in the international economy until 1915, which in turn affected land prices in the exporting countries.¹³

Interestingly, while in the 1870s New Zealand had a markedly larger rental/wage ratio than Uruguay, in the 1930s the two countries had almost the same ratio. In other

¹²In this paper, we totally abstract from Uruguayan small-farm problem. Kirby (1975) reported some comparative data for minifundios in the period after the World War II, “45 percent of Uruguayan holdings are less than 20 hectares, compared with 26 percent in New Zealand” [p. 270]. Moreover while the modal size was 20-49 hectares, the average was 209 hectares (see also I.B.R.D./F.A.O., 1951, 62). This suggest that, although the number of farms in Uruguay increased, the relevant number of landowners in 1940 was at about the same level as that in 1870. Moreover, the increase in the number of farms in Uruguay was largely due to the subdivision of farms of less than 100 hectares, not to the reduction of latifundia. Therefore, this increase did not represent an improvement in the access to land in Uruguay (Barrán and Nahum, 1978; Bertocchi, 2006).

¹³One would have expected a less marked deterioration of income distribution in New Zealand than in Uruguay, to the extent that the supply of land was more elastic in New Zealand. However, the increase in the supply of land in New Zealand was most probably compensated by the much higher inflow of migrants, who settled mainly in the rural areas.

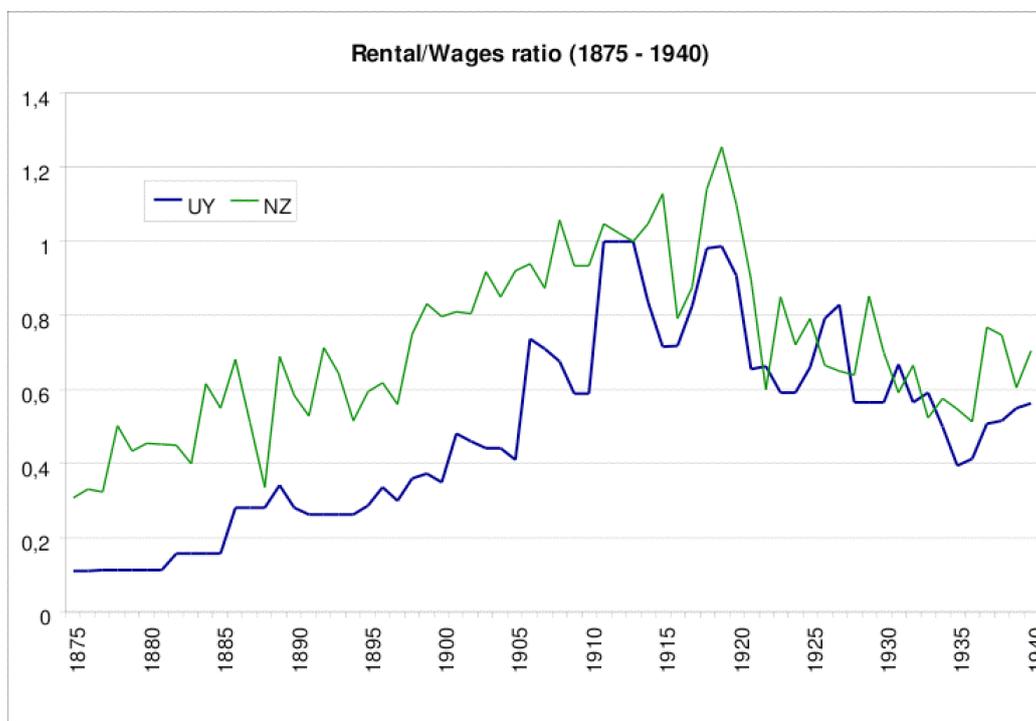


Figure 1: the Rental/Wage Ratio in New Zealand and Uruguay. **Sources:** New Zealand, Real Wages and Real Land Prices: Greasley and Oxley (2008, 27, 28); Uruguay, Real land price index estimated from the nominal land price index of Banco de Datos PHES e IPC by Bértola et al. (1998). Real wages were estimated from Bértola et al. (1998).

New Zealand			
Year	Wage Share	Residual Rent Share	Agrarian Product
1891	33.1	66.9	100
1896	31.9	68.1	100
1911	21.4	78.6	100
1936	33.1	66.9	100

Table 8: Functional distribution of the incomes in the agrarian sector: New Zealand. **Sources:** Briggs (2003); Bloomfield (1984); Greasley and Oxley (1998, 14,33); Greasley and Oxley (2003); Prichard (1970, 137, 138, 193, 194, 335); Hawke (1985, 102,234, 235).

words, in Uruguay the land rental had become more important relatively to wages with respect to what happened in New Zealand. This may be linked to the institutional differences mentioned above. In particular, this is consistent with a Uruguay having a relatively more concentrated control on land and with latifundia making land available to a lesser extent.

Another potential explanation is that there was a gap in terms of average land

Uruguay			
Year	Wage Share	Residual Rent Share	Agrarian Product
1892	22.0	78.0	100
1895	22.0	78.0	100
1908	20.3	79.7	100
1911	19.5	81.5	100
1916	24.6	75.6	100
1930	21.5	78.5	100
1937	22.8	77.02	100
1940	22.0	78.0	100

Table 9: Functional distribution of the incomes in the agrarian sector: Uruguay. **Sources:** Anuario Estadístico (1938), Censos Agropecuarios (1908, 1916, 1930, 1937 and 1943); Ardente et al. (2004); Bértola et al. (1998); Barrán and Nahum (1978); Barrán and Nahum (s/f, 319); Barrán and Nahum (1971, 637); Barrán and Nahum (1972, 430); Barrán and Nahum (1973, 467); Barrán and Nahum (1977, 429); Balbis (1995, fecha:123); Vigorito and Reig (1986, 183,184); BROU (1933, 53); Jacob (1981, 181).

productivity between New Zealand and Uruguay which shrank during the period considered. Indeed, a smaller gap might have implied that rental prices moved faster in Uruguay which, in turn, may have made the rental/wage ratio move as shown in our data. Unfortunately, however, this interpretation is weakened by the lack of reliability of cross-country comparisons of rental price levels.

Turning our attention to the distribution of the agricultural product we see again relevant differences between New Zealand and Uruguay. Tables 8 and 9 report estimates of the product shares. In Uruguay agricultural workers obtained about 20% of the total agricultural output, and in New Zealand about 30%.¹⁴ This suggests that in Uruguay landowners were able to obtain a larger share of the agricultural product than their New Zealander counterparts.

In conclusion, evidence suggests that there was a more equal income distribution in the New Zealand agrarian sector than in Uruguay. New Zealand encouraged access to land and this made possible a larger number of landowners. In addition, the distribution of the agricultural product between farmers and workers was more even in New Zealand. Both aspects had wide implications in terms of emerging patterns of demand for manufactures and, hence, for the possibility of advancing in the industrialization process. We discuss this point more formally in the next section.

4 The Model

In this section we present a simple model of industrial takeoff, based on Bilancini and D’Alessandro (2008a,b), and apply it to the case of New Zealand and Uruguay 1870-

¹⁴In New Zealand the agrarian rent was made up of two parts, one accruing to the government (about 4% of total output) and the other to private landowners (about 20%). Public holding of land was an important difference between New Zealand and Uruguay, since it crucially affected the availability of land to be distributed and allowed New Zealand to enjoy during most of the period a much more balanced fiscal situation.

1940.¹⁵ We proceed in three steps. First, we give a brief description of the model assumptions. Second, we characterize industrialization as an equilibrium outcome. Third, we particularize the model for the case of New Zealand and Uruguay, showing that institutional differences in the agricultural sector can lead to different equilibria in terms of both industrialization and income.

4.1 Assumptions

There are two sectors, agriculture and manufacture. Agriculture produces a single homogeneous divisible good, named *food*, which is used as numeraire. In the other sector, there is instead a continuum of manufactured goods represented by the open interval $[0, \infty) \in \mathfrak{R}$. Each good is denoted by its distance q from the origin. Individuals follow the same consumption pattern. There is a subsistence level of food consumption $\bar{\omega}$ and a minimum amount of food z which is preferred to the consumption of any manufacture, with $z > \bar{\omega}$. Beyond z any unit of income is spent to buy the manufactured goods following the indexed order. Such a consumption pattern is intended as a simple way of introducing a common ranking of necessities: people first need to buy food up to the level z , then basic manufactures and durables which allow a better standard of living and, only after that, they buy luxuries. For simplicity, we assume that only one unit is bought of any manufactured good. In other words, any individual with income $\omega \geq z$ uses her first z of income to purchase food and $(\omega - z)$ to purchase the manufactured goods. Any individual with $\omega < z$ consumes only food.¹⁶

Food is produced using land and labor. Labor is assumed to be homogeneous. Production is given by the constant returns function $F(L_F, T)$, where L_F is the number of peasant workers and T is the amount of cultivated land. Moreover, $F_1 > 0$, $F_{11} < 0$, $F_2 > 0$ and $F_{22} < 0$, where F_i is the derivative of F with respect to the i -th argument and similarly for F_{ij} . The agricultural product is shared between peasants and landlords. Agricultural wages is equal to $w_F = \lambda F(L_F, T)/L_F$ while the total amount of rents is $R = (1 - \lambda)F(L_F, T)$, where the parameter λ denotes the peasants' share of agricultural product.¹⁷ We assume that property rights on cultivated land are equally distributed among M landowners, thus the income of each landowner is equal to R/M . Therefore, M can be interpreted as a rough index of land property concentration.¹⁸ We also

¹⁵In the present paper we abstract from most model details and all proofs. See Bilancini and D'Alessandro (2008b) for proofs of equilibrium existence and comparative statics about land ownership concentration. See Bilancini and D'Alessandro (2008a) for the model extension where agricultural product is exogenously distributed between landowners and peasants. Moreover, the basic underlying mechanism is largely based on Murphy et al. (1989).

¹⁶This behavior is a particularization of the hypothesis of hierarchical preferences. It can be easily *rationalized* by means of a utility function. See Bilancini and D'Alessandro (2008b, fn 7) for an explicit analysis of this issue.

¹⁷We remark that λ is exogenous to the model. It may be thought of as reflecting institutional peculiarities due to the historical evolution of the country. It may also be interpreted as representing power relationships between landlords and farmers.

¹⁸We abstract from the issue of productivity changes due to variations in the size of land properties (see on this e.g. Banerjee et al., 2002, and references therein). We emphasize, however, that the qualitative results of our model would hold also if we allowed for such a possibility. Our choice is motivated

assume that landlords are richer than peasants, i.e. $R/M \geq w_F$, which implies that $\lambda \leq L_F/(L_F + M)$.

The manufacturing sector is made up of a continuum of markets, each of which is infinitely small with respect to the entire economy. The number of workers employed in the manufacturing sector as a whole is denoted by L_M while the ruling wage is denoted by w_M . Each commodity q can be produced with either of the two following technologies. The first, labeled *Traditional Technology* or TT, requires α units of labor in order to produce one unit of output. This represents the case in which commodities are produced by artisans who, at the same time, organize production and work like other waged laborers. The second, labeled *Industrial Technology* or IT, requires k units of labor to start up plus β units of labor per unit of output produced, with $0 < \beta < \alpha$.¹⁹ Lastly, we denote by E the number of entrepreneurs.

The market structure in the manufacturing sector is the following. A group of competing artisans operates in each market q of the economy. Artisans compete with each other so that no profits are earned using TT. Further, in each market there is one artisan, and only one, who knows the IT. If she decides to be an entrepreneur she can become a monopolist. As shown in Bilancini and D'Alessandro (2008b), she finds it convenient to charge a price equal to αw_M . Hence, the profits of the monopolist operating in market q are equal to $\pi(q) = [(\alpha - \beta)D_q - k]w_M$ where D_q is demand for commodity q . Therefore, an artisan knowing the IT will decide to become an entrepreneur if and only if $D_q \geq \rho \equiv (k + 1)/(\alpha - \beta)$.²⁰

Finally, we assume perfect mobility of labor among sectors and markets so that $w_F = w_M = w$. The working population is denoted by $L = L_F + L_M + E$ and each worker either supplies inelastically one unit of labor or becomes an entrepreneur. The total supply of labor is hence equal to $L - E$. Total population is denoted by $N = L + M$.

4.2 Industrialization

Industrialization is defined here as the adoption of IT in place of TT. Industrial production in this context does not mean industrial goods, but that both the agrarian and agricultural productions are based on larger-scale, increasing returns modern techniques. Recall that we assume that the two countries have access to the same technology: the critical difference between them will be, as is argued later, in terms of the economic incentives to adopt the TT or IT technology (more precisely, in terms of their relative profitability). In other words, the model will not explain divergence based on technological asymmetries (technology-gap), but on different incentives for adopting the IT. The pattern of land ownership in turn played a key role in defining these incentives.

Consider, for the sake of the argument, an economy whose agricultural sector is

by the fact that introducing such an additional ingredient would obscure the mechanism that we want to highlight.

¹⁹Note that TT shows constant returns to scale while IT shows increasing returns. The difference between these two technologies represents the economic advantage of industrialization.

²⁰We also impose that $(k + 1) > (\alpha - \beta)$, because if $(k + 1) \leq (\alpha - \beta)$ then IT never requires more units of labor with respect to TT and, hence, it is always preferred by artisans.

already in equilibrium. Denote with Ω_m the total expenditure in manufactures and with ω the income of a generic individual. Since every consumer who has already bought z units of food spends her remaining income on a unit of each manufacture in the specified order, the demand D_q faced by a generic market q is determined by the number of individuals who earn enough income to buy at least commodity q , namely the number of individuals who satisfy $(\omega - z)/\alpha w > q$.

Assume, for the moment, that λ is such that workers are poor and consume only food, i.e. $w \leq z$. Thus, the demand for manufactures is shaped by the distribution of land property rights because the latter determines the number of individuals with income greater than z . If, for instance, there are only a few rich landowners, then the extent of the manufacturing sector will be quite large and the demand faced by each market will be relatively small. If, on the contrary, landowners are many but each with a low income, then the extent of the manufacturing sector will be quite small and the demand faced by each of these markets will be relatively large. Since IT is introduced only if demand goes over a certain profitability threshold, an excessively concentrated land ownership may prevent the takeoff even if Ω_m is large. Otherwise if land ownership is sufficiently distributed then the profitability threshold may be exceeded. In such a case, some artisans become entrepreneurs, earn positive profits and the market in which they operate industrializes. The new earnings obtained by entrepreneurs start a multiplicative process of demand for manufactures. New demand generates new profits and new profits generate new demand.²¹ Such a feedback process can take place several times but in each round the amount of new profits diminishes because only a fraction of the new demand becomes new profits – the remaining part going to cover production costs. The process ends when new generated profits fail to industrialize new markets or to generate new demand for markets already industrialized.

Consider now the case where λ is large enough to imply that $w > z$, that is, workers' demand for manufactures is positive. Thus, if $(M + L) > \rho$ then some markets industrialize. As described above, the extra earnings obtained by entrepreneurs of industrialized markets start a multiplicative process of demand which may further expand industrialization and aggregate income. In general, under the hypothesis that $w \geq z$, a greater λ implies a larger w which in turn produces an increase in both industrialization and income by fostering demand for basic manufactures and, hence, a more intense exploitation of mass production (see Bilancini and D'Alessandro, 2008a for a proof of this). We emphasize that the latter mechanism based on workers' purchasing power and the previous one based on land distribution may trigger industrialization independently of each other. However, they may also work together in a synergistic way.

4.3 New Zealand and Uruguay between 1870 and 1940

We particularize the model to the case of New Zealand and Uruguay by introducing a few additional assumptions. Our aim is to translate the stylized facts reported in

²¹The precise outcome depends on how profits are distributed among entrepreneurs. This issue is investigated in detail in Bilancini and D'Alessandro (2008b).

sections 2 and 3 into the language of the model. In order to better clarify our argument we disregard any other possible difference between the two countries.

A superscript $j \in \{NZ, U\}$ indicating the country – NZ stands for New Zealand, U for Uruguay – and a subscript $t \in \{0, 1\}$ indicating the date – 0 stands for 1870, 1 for 1940 – are added to the model variables and parameters. According to this notation we have, for instance, that N_0^{NZ} is the population of New Zealand in 1870 while N_1^U is the population of Uruguay in 1940. We assume that available technologies are identical in the two countries and constant over time. Hence, we drop both subscripts and superscripts for $F(\cdot)$, α , β and k .

We further assume that the two countries are identical in all respects but two: (i) the 1870 endowment of cultivated land is greater in Uruguay while the 1940 endowment is the same, and (ii) the number of landowners grows proportionally with the land stock in New Zealand while it is constant in Uruguay (see footnote 8).²² Table 10 reports our assumptions on factor endowments and land distribution for the year 1870.

Exogenous variables in 1870	New Zealand vs Uruguay
Total Population	$N_0^{NZ} = N_0^U$
Number of Landowners	$M_0^{NZ} = M_0^U < \rho$
Peasants' Share of Agricultural Product	$\lambda_0^{NZ} = \lambda_0^U$
Available Cultivated Land	$T_0^{NZ} = \frac{T_0^U}{k} < T_0^U$
Working Population	$L_0^{NZ} = L_0^U > \rho$

Table 10: Factor endowments and land distribution in 1870, where $k > 1$.

Land in New Zealand was scarcer than in Uruguay at the beginning of the period. In effect, the expansion of the frontier in New Zealand was not a smooth process, but implied a large difference between potential free land and what was available to colonizers. Frontier land in New Zealand could not be immediately put in use for cattle production, since it consisted of swamps, woods and in some cases (mainly in the North Island) it had to be taken from the Maori population (in Uruguay the native population was massacred in the 1830s).²³ At variance with the Uruguay case, a significant effort was required before land could effectively serve for agricultural production, frequently requiring the seeding of artificial prairies. Only the pressure of a growing population

²²Later on, we will also suppose that (iii) New Zealand had a systematically higher share of agricultural product going to wages than Uruguay. Such a delay is intended to show that (i) and (ii) are enough to generate some divergence which, in turn, is fostered by (iii).

²³In our account of the institutional setting of New Zealand, the relation between natives and colonists was conflictive. The occupation of Maori's land by the Europeans took time and went together with the arrival of new migrants. This too points to the fact that land was scarce in New Zealand, even if there was still land to be occupied.

Equilibrium variables in 1870	New Zealand vs Uruguay
Food Produced	$F_0^{NZ} = F_0^U$
Wages	$w_0^{NZ} = \lambda_0^{NZ} \frac{F_0^{NZ}}{L_{F_0}^{NZ}} < \lambda_0^U \frac{F_0^U}{L_{F_0}^U} = w_0^U$
Total Rents	$R_0^{NZ} = (1 - \lambda_{NZ}^0) F_0^{NZ} = (1 - \lambda_U^0) F_0^U = R_0^U$
Landowners' income	$\frac{R_0^{NZ}}{M_0^{NZ}} = \frac{R_0^U}{M_0^U}$
Rental price	$r_0^{NZ} = \frac{R_0^{NZ}}{T_0^{NZ}} > \frac{R_0^U}{T_0^U} = r_0^U$
Rental-Wage Ratio	$\frac{r_0^{NZ}}{w_0^{NZ}} > \frac{r_0^U}{w_0^U}$

Table 11: Equilibrium outcomes in 1870

and the increase in international demand for agricultural goods made the incorporation of new land to production profitable. This is why in 1870 land was scarcer in New Zealand than in Uruguay, in spite of the fact that New Zealand had a larger amount of (potentially productive) land.

Thus, considering that land was a scarcer factor in New Zealand, the (rental) price of land is higher there. Moreover, agricultural labor is more productive in Uruguay implying that Uruguayan wages are higher (consistently with rental/wage data, see figure 1). However, Uruguayan landowners are as rich as New Zealander ones since they own a larger amount of land per capita (this is consistent with, though not implied by, Tables 6 and 7).

Furthermore, since in 1870 both New Zealand and Uruguay had per capita incomes among the highest worldwide, we find it convenient to assume that wages are slightly greater than z in both countries. This implies that the amount of food produced and consumed in the two countries is the same – denoted by F_t^j – although in Uruguay food is produced using more land than in New Zealand and, as a consequence, less labor. These equilibrium relations are summarized in Table 11.

Note that in both countries the number of landowners is too small to trigger industrialization while the size of the working population is sufficient to break even in some markets. Hence, in each country an industrial sector exists though its size is very small in terms of both people employed and variety of manufactures produced. The equilibrium production of manufactures is shown in Figure 2 for New Zealand and in Figure 3 for Uruguay. The two manufacturing sectors, considered as a whole, are of similar size in terms of variety of commodities produced. This is because landowners – who are the richest and hence have the most diversified consumption – earn the same income in the two countries. However, the industrial sector is slightly larger in Uruguay than in

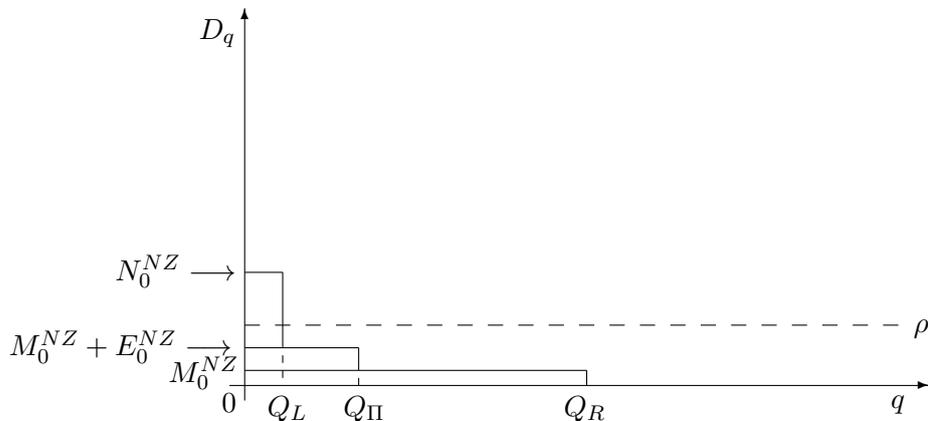


Figure 2: New Zealand manufacturing sector in 1870. The vertical axis measures the amount of manufactures produced while the horizontal axis identifies the type of manufacture. The intervals $[0, Q_L]$, $[0, Q_{\Pi}]$ and $[0, Q_R]$ represent the types of commodities demanded by, respectively, workers, entrepreneurs and landowners.

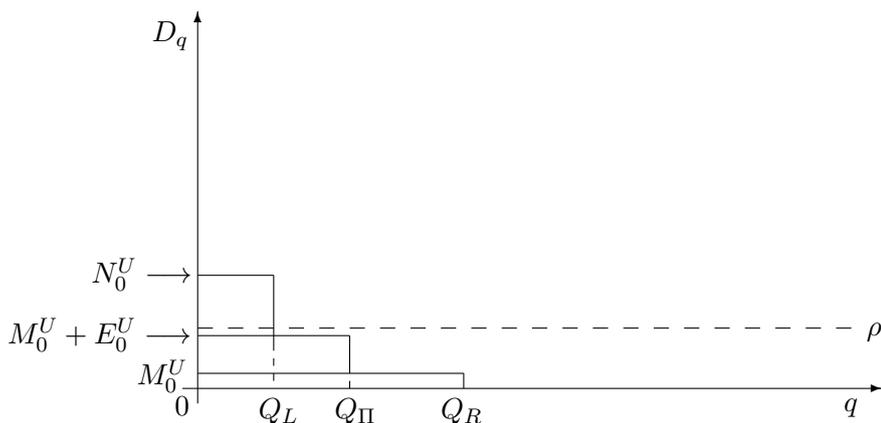


Figure 3: Uruguay manufacturing sector in 1870. The vertical axis measures the amount of manufactures produced while the horizontal axis identifies the type of manufacture. The intervals $[0, Q_L]$, $[0, Q_{\Pi}]$ and $[0, Q_R]$ represent the types of commodities demanded by, respectively, workers, entrepreneurs and landowners.

New Zealand because workers demand a somewhat larger variety of manufactures. In conclusion, under (i) and (ii) our model predicts that, if anything, in 1870 Uruguay was in a slightly better position than New Zealand for both industrial takeoff and economic growth.

We now study the equilibrium in 1940. From (i) and (ii), it follows that we have that population is still identical in the two countries but substantially larger than in

1870. Moreover, while in New Zealand the ratio between the number of landowners and non-landowners is the same as in 1870, Uruguay has the same number of landowners it had in 1870. In addition, in 1940 New Zealand has reached the same stock of cultivated land as Uruguay, which in turn has the same stock as in 1870. As a consequence, land ownership is substantially more concentrated, Uruguay than in New Zealand. These assumptions are formally stated in table 12.

Exogenous variables in 1940	New Zealand vs Uruguay
Total Population	$N_1^{NZ} = N_1^U = kN_0$
Number of Landowners	$M_1^{NZ} = kM_0^{NZ} > \rho > M_1^U = M_0^U$
Peasants' Share of Agricultural Product	$\lambda_1^{NZ} = \lambda_0^{NZ} = \lambda_0^U = \lambda_1^U$
Available Cultivated Land	$T_1^{NZ} = T_1^U = T_0^U > T_0^{NZ}$
Working Population	$\rho < L_1^{NZ} = kL_0^{NZ} < L_1^U = N_1^U - M_0^U$

Table 12: Factor endowments and land distribution in 1940, where $k > 1$.

Our model shows that such differences are sufficient to imply a gap in both industrialization and income growth. The intuition is the following. In New Zealand population growth comes with the proportional growth of the land stock and the number of landowners. Since agricultural production shows constant return to scale, and demand for food is proportional to population, it follows that equilibrium wages remain at the 1870 level while total rents increase proportionally to population. This also means that the income of each landowner remains at the 1870 level since their number also grows proportionally to population. However, mass production expands because the greater number of landowners makes the adoption of the industrial technology profitable for a greater variety of manufactures. As a result, industrial employment and income also grow substantially. By contrast, in Uruguay population growth does not come with a parallel increase in the number of landowners, while the stock of land is constant and equal to that of New Zealand in 1940. This implies, with respect to 1870, a lower average agricultural productivity of labor – due to decreasing returns – which, in turn, implies higher rents per landowner and lower wages. Furthermore, since in 1940 food production is the same in the two countries, so are wages and total rents. Therefore, the model predicts that the rental–wage ratio of Uruguay converges to that of New Zealand during the years between 1870 and 1940 (again, consistently with what described in section 3). These equilibrium outcomes are summarized in Table 13.

We find it useful to describe in greater detail what our model predicts about the development of the respective manufacturing sectors. Since Uruguayan landowners becomes substantially richer than their New Zealander counterparts, Uruguay's manufacturing sector as a whole expands more than New Zealand's. However, Uruguay has

Equilibrium variables in 1940	New Zealand vs Uruguay
Food Produced	$F_1^{NZ} = F_1^U = kF_0^{NZ} = kF_0^U$
Wages	$w_1^{NZ} = \lambda_1^{NZ} \frac{kF_0^{NZ}}{kL_{F_0}^{NZ}} = w_0^{NZ} = w_1^U < w_0^U$
Total Rents	$R_1^{NZ} = kR_0^{NZ} = kR_0^U = R_1^U$
Landowners' income	$\frac{R_1^{NZ}}{M_1^{NZ}} = \frac{kR_0^{NZ}}{kM_0^{NZ}} < \frac{R_1^U}{M_1^U} = \frac{kR_0^U}{M_0^U}$
Rental price	$r_1^{NZ} = \frac{kR_0^{NZ}}{kT_0^{NZ}} = r_0^{NZ} = r_1^U = \frac{kR_0^U}{T_0^U} > r_0^U$
Rental-Wage Ratio	$\frac{r_1^{NZ}}{w_1^{NZ}} = \frac{r_1^U}{w_1^U}$

Table 13: Equilibrium outcomes in 1940, where $k > 1$

a smaller industrial sector – both in terms of industrial employment and variety of commodities produced – because most Uruguayan manufactures are still produced with the traditional technology. Indeed, in Uruguay, the only commodities produced with the industrial technology are the few types that are demanded by workers. Thus, entrepreneurs are few and very rich because they sell their commodities to every individual with the consequence that their own demand for manufactures is not sufficient to impel mass production (see Figure 4). By contrast, in New Zealand there are many landowners and, although they are substantially poorer than Uruguayan ones (and poorer than the richest New Zealander entrepreneurs), their number generates a demand for manufactures which is sufficient to break even. Therefore, it follows that all commodities demanded by landowners – which include those demanded by workers – are produced with the industrial technology. As mass production expands, new groups of middle-income entrepreneurs arise whose demand for manufactures further sustains the process of industrialization (see Figure 5).

Let us now turn to the other important difference between New Zealand and Uruguay: the share of agricultural product going to agricultural workers. This aspect has been neglected so far but actually it may have played a non-negligible role. As illustrated in section 3, in New Zealand the share of agricultural product going to agricultural workers had been larger, on average, by one-tenth of the total agricultural product. We translate this fact into the language of the model by positing that: (iii) $\lambda_1^{NZ} = \lambda_0^{NZ} > \lambda_0^U = \lambda_1^U$. Since in 1870 agricultural labor is more productive in Uruguay, having $\lambda_0^{NZ} > \lambda_0^U$ is not sufficient to make real wages in New Zealand higher than in Uruguay. However, in 1940 the land stock is the same in the two countries and, hence, labor productivity in agriculture is equal. Therefore, workers in New Zealand earn a higher wage which translates in a larger variety of manufactured goods demanded. Thus, more artisans becomes

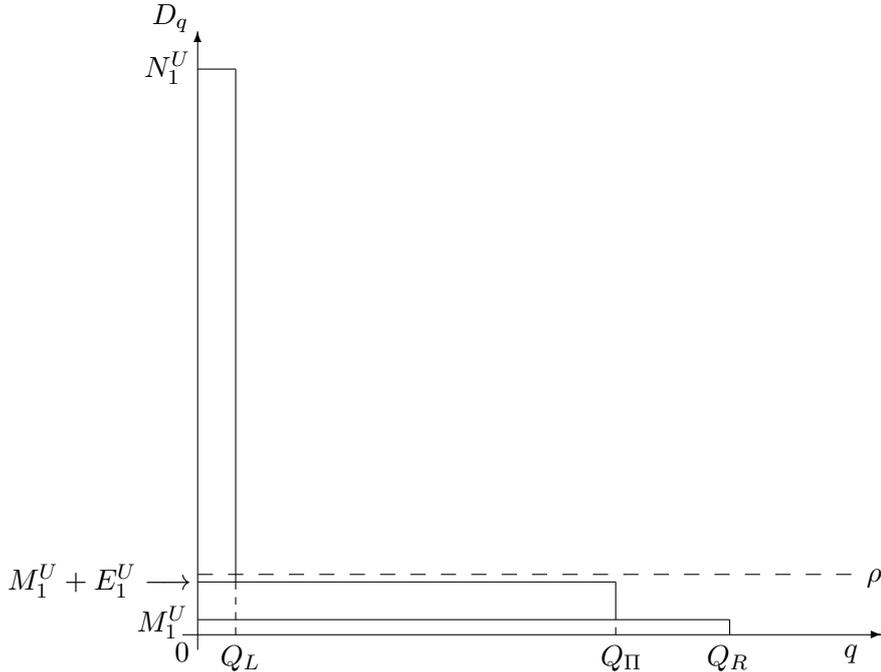


Figure 4: Uruguay manufacturing sector in 1940. The vertical axis measures the amount of manufactures produced while the horizontal axis identifies the type of manufacture. The intervals $[0, Q_L]$, $[0, Q_{\Pi}]$ and $[0, Q_R]$ represent the types of commodities demanded by, respectively, workers, entrepreneurs and landowners. All entrepreneurs earn the same profits.

entrepreneurs and make positive profits. These effects further foster industrialization and growth in New Zealand. They can be easily seen by slightly modifying Figure 5: Q_L is larger and Q_R is smaller while entrepreneurs' demand for manufactures expands for most commodities.²⁴

In conclusion, the predictions of our model are consistent with the facts reported in section 2 and 3.²⁵ In 1870 the similarities between Uruguay and New Zealand would have suggested that, if anything, Uruguay was hardly going to perform worse than New Zealand. However, we have shown that the important institutional differences in the

²⁴Note that a reduction of entrepreneurs' demand is possible for some commodities produced with the IT because a greater λ may imply a lower income for some entrepreneur. More precisely, a greater λ reduces the variety of commodities demanded by landowners and, hence, the revenue of some producers. However, this is always more than compensated by the extra revenue of the remaining entrepreneurs.

²⁵Note that under assumptions (i), (ii) and (iii) the predicted rental-wage ratio in New Zealand is systematically lower than that predicted under (i) and (ii). Therefore, perfect convergence of the rental-wage ratios is lost. However, under these three assumptions, the two ratios become more and more similar between 1870 and 1940. We do not believe that this is an issue. As already noted in section 2, data on the rental-wage ratios may not be fully comparable because absolute values may not be comparable. Therefore, the important feature to match is the fact that the rental/wage ratio in Uruguay performed worse than in New Zealand and not that the two ratios had become almost equal in 1940.

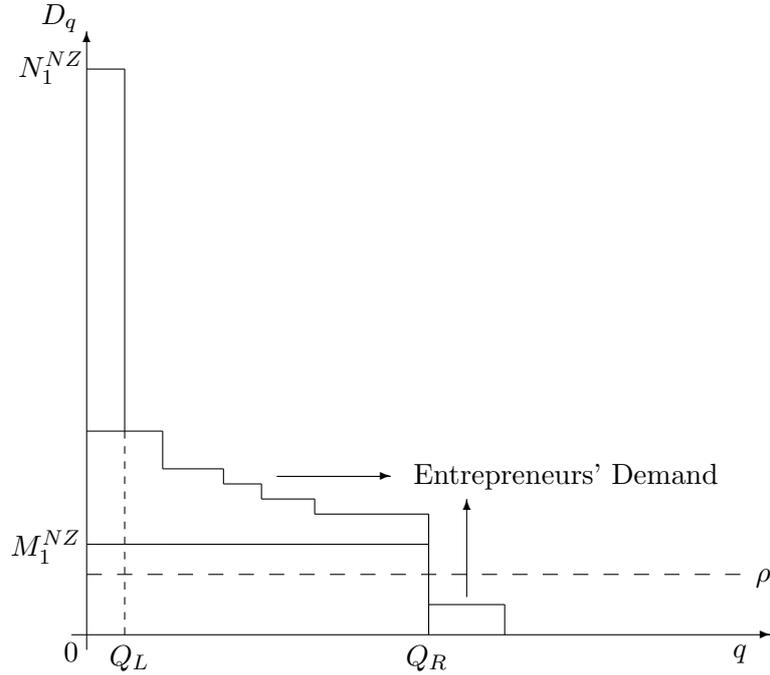


Figure 5: New Zealand manufacturing sector in 1940. The vertical axis measures the amount of manufactures produced while the horizontal axis identifies the type of manufacture. The intervals $[0, Q_L]$ and $[0, Q_R]$ represent the types of commodities demanded by, respectively, workers and landowners. Since not all entrepreneurs earn the same profits, the variety of commodities that they demand can vary across entrepreneurs.

agricultural sector had the potential to generate the subsequent observed divergence.

4.4 International trade

Our model can be extended to include international trade. In particular, it can be shown that the distributional and institutional differences discussed above also play a crucial role in shaping the impact of international trade in agricultural products on growth and industrial takeoff. This is indeed the relevant case for New Zealand and Uruguay since, as we pointed out in Section 2 (see Table 1), both countries were small open economies where non-industrial exports – which were mostly agricultural – accounted for a share of about 20% of GDP.²⁶

Suppose that the international demand for agricultural goods increases. Since domestic demand is fixed and inelastic, in order to meet the greater demand exporters are required to increase agricultural production, and this is achieved through an increase of labor in the agricultural sector.²⁷ Under the assumptions of our model, this change has

²⁶According to our data, industrial exports of the non-food sector were negligible. Raw materials are included in non-industrial exports.

²⁷In this illustrative discussion, it is assumed that all necessary conditions for producing tradables

two main effects: i) agricultural wages tend to decrease because of decreasing marginal productivity of labour, and ii) the total sum of rents increases because of both a greater revenue and a lower wage paid. Hence, in the manufacturing sector, some basic markets no longer receive workers' demand – workers are now poorer – while other markets receive new demand from landowners – who are now richer. The overall effect in terms of industrialization crucially depends on the capability of landowners' demand to foster industrialization, which in turn depends on the distribution of land ownership. If, for instance, the number of landowners is low, their income significantly increases, but their demand is spread over many luxury goods. For the sake of the argument, let us consider Figure 4 (i.e. Uruguay in 1940). The increase in landowners' income means that Q_R shifts to the right, while the reduction in wages produces a shift of Q_L to the left. The latter change results in a contraction of the industrial sector and then in an increase in the difference $\rho - (M_1^U + E_1^U)$, which make industrialization more problematic in further markets. Consider instead Figure 5 (i.e. New Zealand in 1940): since the number of landowners is sufficient to induce the adoption of IT, it follows that all markets receiving landowners' demand can industrialize. The greater income due to greater export revenues induces the industrialization of a new wave of markets. The latter effect can easily more than offset the negative effect due to the decline in workers' demand, generating a net increase in both industrialization and income.

In conclusion, the sketched extension of our model suggests that adding international trade in agricultural products would reinforce the main point of the paper. In particular, the extended model suggests that industrial development in New Zealand was more positively influenced by export revenues thanks to a more even distribution of land ownership; by contrast, land concentration in Uruguay was an impediment to the exploitation of the gains in terms of industrialization.

We conclude this section by referring to compelling historical evidence in support of the highlighted mechanism, which is provided by the case of Colombia in the second half of the nineteenth century (see Harbison, 1970, for more details on this). Between 1850 and 1870, Colombia experienced a boom in export revenues accruing from tobacco. This boom did not induce any significant industrial growth. Later on, between 1880 and 1915, a coffee-driven export boom took place in the same country. This boom, instead, was beneficial to the Colombian industry as a whole. The key difference between the two booms is the different size of the estates used for production: while tobacco was traditionally cultivated in a relatively small number of huge estates, coffee was produced in many small and medium sized allotments. Since only the second export boom rewarded a substantial proportion of the population, only this boom succeeded in increasing the domestic demand for basic industrial products.

are met and that imports play no significant role. Moreover, we abstract from the extra labour force which is needed to meet demand.

5 Final Remarks

In this paper we have proposed a model of early industrialization which can account for the different economic performances of New Zealand and Uruguay between 1870 and 1940. The main novelty of our contribution lies in the demonstration that the divergent paths of Uruguay and New Zealand 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. In particular, we advanced the idea that such institutional differences crucially affected industrial development – and more in general economic growth – through their impact on income distribution.

The basic intuition behind our model is the following. Agricultural institutions which induce a more even distribution of land property rights and agricultural product are also more likely to produce a greater domestic demand for basic manufactures. Two main ingredients generate this outcome. First, in the early stages of industrialization consumers' preferences are often hierarchical in terms of goods variety – i.e. first very basic goods, then less basic goods, and finally luxuries. Second, early industrial production requires the incurring of fixed costs and shows increasing returns to scale. Therefore, having a substantial number of consumers with income above subsistence level generates the necessary demand for basic manufactures which makes industrial production profitable. By contrast, having a few very rich consumers would not have the same result, as they would demand a few goods of many varieties. Hence, agricultural institutions that foster the distribution of rents to a large number of landowners and that sustain wages beyond subsistence levels, also foster early industrialization and economic growth.

As an essential complement to our theoretical argument we have provided both motivating and supportive historical evidence. In particular, we have argued that Uruguay and New Zealand, although similar in many respects, showed substantial differences in the institutions governing both access to land and distribution of the agricultural product. In New Zealand the Crown adopted a policy that strongly facilitated access to land for white colonizers and the descendants of European immigrants. This in turn allowed for an increasing number of landowners, which expanded along with immigration and population growth. Conversely, in Uruguay land was heavily concentrated in the hands of a small group that benefited from massive transfers of public lands. Moreover, Uruguayan landowners seized a larger share of the agricultural product than their New Zealander counterparts. This resulted in a greater domestic demand for basic manufactures in New Zealand which, we argue, fostered industrialization and growth.

As a final comment, we would like to stress that some variables not considered in the paper – and which might have been relevant to the industrialization process – can be considered (at least partially) endogenous to the institutional framework of the agricultural sector. For instance, we abstracted from credit markets and hence from the role of credit rationing. Indeed, the possibility of using land as collateral in the credit market may have created relevant asymmetries in terms of access to credit (Deininger and Squire, 1996). One would expect that, thanks to land ownership, New Zealand's farmers could more easily obtain credit than their Uruguayan counterparts. In the

same vein, the existence of a highly developed system of technological diffusion in New Zealand can be understood as part of a broader effort for incorporating new land and settling new colonizers. Both aspects reinforce the idea that a more equal distribution of land ownership and income in New Zealand than in Uruguay, providing better grounds for industrialization, plays an important role in the asymmetric evolution of these two economies in the twentieth century.

In conclusion, we hope that the model and the evidence presented in this paper can offer a novel and parsimonious explanation of why New Zealand and Uruguay followed a different growth path between 1870 and 1940.

Appendix: Sources for the estimation of the Agricultural Product, Wages and Land Rent

New Zealand The estimation of total wages in New Zealand was based on:

1. Time series for the wages of rural workers as provided by Briggs (2003) (who in turn used Bloomfield (1984) series computed from census data).
2. Wages of rural workers obtained from Greasley and Oxley (1998, 2003).

The estimation of total rents was based on:

1. Land prices taken from Prichard (1970); Greasley and Oxley (2003). The series of the latter authors are deflated by the IPC series produced by Briggs (2003);
2. Total land occupied and exploited each year, identifying public and private lands in the total, as published by Prichard (1970).

The estimation of the agrarian product was drawn from Hawke (1985); Prichard (1970).

Uruguay The estimation of total wages was based on:

1. Series for rural workers elaborated on the basis of the CIDE (1967), Anuario Estadístico (1938), Censos Agropecuarios (1908, 1916, 1930, 1937 y 1943); and the series elaborated by Ardente et al. (2004); Bértola (2005).
2. Wages series of rural workers estimated by Bértola et al. (1998); Bértola (2005); Ardente et al. (2004).

The estimation of the volume of the land rent was based on:

1. Time series data for land prices provided by the PHES data bank, elaborated from Barrán and Nahum (s/f, 319) for the period (1886-1895); Barrán and Nahum (1973) for the period 1896-1905; Barrán and Nahum (1978) for the period 1906-1913; Balbis (1995) for the period 1916 and 1930; Vigorito and Reig (1986) for the period 1931-40.
2. Prices for rural leasing elaborated on the basis of PHS databank; Moraes (2001); Barrán and Nahum (1971) for the years 1908-1911; BROU (1933) for the years 1916 and 1930; Jacob (1981) for the year 1940.

The estimation of the agrarian output was based on Bértola et al. (1998) Bertino and Tajam (1999) and Bértola (2005).

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