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**Refrigeration and Distribution: New Zealand Land Prices and Real Wages
1873-1939***

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Abstract: The responses in New Zealand to the opportunities of refrigeration transformed farming in the Dominion during the half century from 1890. Closer settlement and the extension of the cultivated area combined with more intensive farming methods to increase land productivity and real GDP capita to the extent that living standards in New Zealand measured by the HDI ranked first in the world by 1913. In contrast, real wages in the Dominion stagnated. The refrigeration related trade boom had powerful income distribution effects that increased sharply the land rental-wage ratio during the years to 1920. Widely diffuse land ownership in New Zealand tempered the rise in income inequality, to set the Dominion apart from other land abundant economies of the periphery.

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INTRODUCTION

The opportunities provided by refrigeration had powerful effects on New Zealand's economy in the half-century before World War II. The rise of dairy and meat farming was associated with closer settlement, more intensive farming methods, and higher land productivity.¹ New Zealand's real GDP per capita fell during the 1870s and 1880s, but as the refrigeration boom took effect after 1890, real GDP per capita growth accelerated.² In 1913 the Dominion's real GDP per capita adjusted for purchasing power parity was among the highest in the world, and it ranked first in 1938.³ Trade influenced relative factor prices as well as productivity in New Zealand, although the distributional effects of the refrigeration boom are largely neglected in the Dominion's historiography.

The purpose of this article is to assess how the refrigeration related trade expansion in New Zealand after 1890 influenced income distribution, measured by the land rental-wage ratio, and real wages. We have shown elsewhere that real wage growth in the Dominion was fast in the period 1873-90, despite the stagnation of real GDP per capita during these years.⁴ In contrast, real wage growth slowed when real GDP per capita growth accelerated in the refrigeration era after 1890. The data in Table 1 show that real wage growth was only around half the pace of real GDP per capita growth between 1890-1939, and that the disparity was especially marked during the quarter century to World War One.

Over the years 1873-1939 New Zealand's real wage and real GDP per capita growth were similar, but income distribution initially favoured landowners during the refrigeration era after 1890. There was a land price boom between 1890-1920, while

¹ Hawke, *Adaptable Kiwis*, surveys these developments and -highlights the more vigorous responses in New Zealand than in Australia to the opportunities of refrigeration.

² Dowie, *A century old*, and Greasley and Oxley, *Measuring New Zealand's GDP*.

³ Maddison, *World economy*.

⁴ Greasley and Oxley, *Globalization and real wages*.

real wages stagnated over these years. However, land ownership in the Dominion became increasingly diffuse after 1890, which tempered the rise in income inequality associated with the rise in the rental-wage ratio. In the 1880s New Zealand's economic activity centred on the South Island, and on the export of wool, principally from the great pastoral estates. Thereafter, the economic frontier shifted northwards, stimulated by the export of dairy products and frozen meat, and the shift was accompanied by a rise in the social depth of land ownership. Refrigeration and dairying technology developments underpinned the drift north, but bringing more of the richer, wetter lands of the North Island into productive use also depended upon the construction of a transport infrastructure and on the pacification of Maori. By 1913 dairy products and frozen meat exports exceeded the value of wool exports, and they were twice as great in 1920.⁵

Table 1: New Zealand's Real Wages and Real GDP per capita 1873-1939 (% p.a.)		
	Real Wages	Real GDP per capita
1873-1890	1.64	-0.25
1890-1939	0.69	1.27
1890-1913	0.33	1.29
1913-1929	0.38	0.12
1929-1939	1.55	3.28
1873-1939	0.87	0.78
Sources: Greasley and Oxley, <i>Measuring New Zealand's GDP</i> , and Greasley and Oxley, <i>Globalization and real wages</i> .		

The move north of the farm frontier led to a diminution of the landed elite's position in the Dominion, despite the role played by the great estates in the early development of meat freezing. One perceptive analyst noted that New Zealand might have developed on the South American model, characterized by extensive pastoral

⁵ *Statistics of New Zealand*, 1920.

farming closely connected to the large-scale industrial processing of foodstuffs.⁶ Yet by the 1920s small and medium farms dominated, and the social spread of land ownership in New Zealand became wide.⁷ In 1890 much of the land in the South Island had been locked-up in large overvalued and under worked holdings.⁸ The opportunities for dairying and mixed farming on newly opened lands in the North Island diffused the issue of land monopoly that had loomed large in New Zealand political economy in the 1890s.⁹ A land price boom accompanied and facilitated subdivision, closer settlement, including in the South Island, and the more intensive dairy and mixed farming practices after 1890.¹⁰

Trade and migration disturbed factor price ratios, and thus the distribution of income in New Zealand and in many parts of the world in the second half of the nineteenth century.¹¹ Trade forces, by driving downwards wage-rental ratios in natural resource abundant economies, probably set in motion powerful forces of inequality in parts of Asia and in the southern cone of the Americas, given the concentration there of land ownership.¹² The discussion here adds New Zealand's distinctive experience to the debates surrounding the connections between trade and income inequality, by reporting a new land price series for New Zealand and by showing how the terms of trade drove the swings in the Dominion's rental-wage ratio over the years 1873-1939, to influence income distribution and real wages. In the longer term real GDP per

⁶ Condliffe, *New Zealand in the making*, p. 136.

⁷ Hawke, *The making of New Zealand*, p. 30. Land monopoly was associated in New Zealand with estates in excess of 10,000 acres. Gould, *The occupation of farmland*, shows that freehold estates of this size diminished from 7.8 million to 3.5 million acres between 1892 and 1910.

⁸ Condliffe, *New Zealand in the making*, pp. 141-3.

⁹ Downie Stewart, *Land Tenure and Land Monopoly*. The Land Act of 1892 was amended 68 times before 1908.

¹⁰ For example, rising land values encouraged the sale by subdivision of great estates.

¹¹ Lewis, *Growth and Fluctuations*, and O'Rourke, Taylor, and Williamson, *Factor price convergence*.

¹² Williamson, *Land, labor and globalization*.

capita and real wages moved together in New Zealand, but there were marked swings in income distribution within the years 1873-1939.

New Zealand's wage-rental record was idiosyncratic, with land prices languishing during the depression before 1890.¹³ Thereafter, land prices rose with the exports, and the higher prices, of dairy and meat products made possible by refrigeration. The moves towards wider land ownership in New Zealand were encouraged by public policy, and they enabled small and medium farmers to gain from the trade related rise in land prices.¹⁴ In contrast, wage earners gained less from the trade expansion. The analysis of real wages here extends our previous work, by considering the years up to 1939, and most especially by including land prices or the rental-wage ratio in the model. On the basis of time series tests we show that real wages over the years 1873-1939 moved closely with real GDP per capita, but that the swings in real wages within these years were powerfully influenced by income distribution as reflected by shifts in the rental-wage ratio. In contrast, we show that immigration had only modest influence on New Zealand real wages. The forces of globalization on New Zealand real wages were felt principally by shifts in the terms of trade influencing land prices, the rental-wage ratio, and income distribution, rather than by the immigration of workers depressing real wages.

¹³ The idea of a 1880s depression is firmly embedded in New Zealand's historiography, see, for example Simkin, *Instability of a dependent Economy*, and Sutch, *Colony or nation*, although Hawke, *The making of New Zealand* introduces a cautionary note, and real wage growth was substantial in these years.

¹⁴ Condliffe, *New Zealand in the making*, p. 256 argues that land speculation was the outstanding characteristic of New Zealand farming.

MEASURING NEW ZEALAND'S RENTAL-WAGE RATIO

Land prices in New Zealand

The recent historiography of wage-rental ratios adopts land prices as a measure of rental values.¹⁵ There have been several attempts to measure New Zealand land prices for years prior to 1939, notably those of Callaghan and Low.¹⁶ Crown land, following the extinguishing of Maori rights, was alienated in a variety of ways, including by sale of the freehold, and by various types of lease.¹⁷ Condliffe emphasizes that up to 1890 the great majority of Crown land transfers were of the freehold, especially for the better quality land.¹⁸ After 1890 public policy, partly stimulated by the opportunities for dairy farming arising from refrigeration, was directed towards unlocking the alleged “land monopoly” and promoting denser settlement and smaller farms.¹⁹ The measures included a graduated land tax which was heaviest on larger holdings, compulsory re-purchase of the great estates, and the provision of technical help and loans to settlers.²⁰ Additionally, the move to smaller farms was encouraged by the agricultural frontier shifting to the North Island, with dairy and mixed farms in the vanguard. The leasing of smaller acreages of Crown land was also facilitated by new legislation in 1892.²¹

Before 1892, “perpetual” leases were subject to renewal and revaluation after 21 years, and included a right to purchase the freehold. The system was then

¹⁵ O'Rourke, Taylor, and Williamson, Factor price convergence, discuss this approach.

¹⁶ Callaghan, *The course of land values in Canterbury*, Low, *Land prices and land valuation in New Zealand*.

¹⁷ Land policy in New Zealand was complex, section C of the various issues of *Appendices of the Journals of the House of Representatives*, details the various changes.

¹⁸ Condliffe, *New Zealand in the making*, p232.

¹⁹ Gould, *The twilight of the great estates*.

²⁰ An interesting feature of the 1891 Land Tax was the owners' self-assessment of land value, and the right of the state to purchase the land at the self-assessed value.

²¹ *New Zealand official yearbook*, 1896.

extended, by creating “leases in perpetuity”, (actually for 999 years) charged at 4% each year of the initial valuation, and not subject to revaluation. Secretary for Crown Lands, Percy Smith argued that such leases were practically the same as freehold, and carried rights of sale, sub-lease, mortgage, or disposition by will, although they had conditions, for example a requirement to occupy and improve the land.²² The system was intended to encourage closer settlement by keeping the capital cost of new farm formation low, and to encourage the improvement and the utilization of land.

Subsequent legislation gave leaseholders a right to purchase the freehold, and Condliffe estimated that by 1914 only around 25% of farm land remained genuinely leasehold, since maintaining this form of tenure fettered speculation in the rising rural land-market to 1920.²³ Average farm size fell after 1890, and activity in the rural land market accelerated.²⁴ Selling land had become cheap and simple in New Zealand after the Torrens system of land registration was adopted in 1870.²⁵ Titles to land were not held in the form of deeds, but by registration at a land office. The advantage was in providing secure titles at low cost and without survey, which diminished barriers to the frequent transfer of rural land. The data arising from land transfers under the registration system are an important source of price information, given the frequency with which rural land changed hands.

Callaghan measured Canterbury land prices for the years 1870-1914, distinguishing between agricultural and pastoral land, using a variety of sources, including the lease register for Canterbury College lands, sales’ reports in the

²² *Appendices to the Journals of the House of Representatives*, 1893 section C.

²³ Condliffe, *New Zealand in the making*, p. 239. The data appear to show leasehold was more commonplace, but they include the Crown pastoral leases, which were chiefly upland sheep pastures in the South Island, and such land was unsuited to closer settlement.

²⁴ The mean size of non-Crown pastoral lease farms fell from 489 to 353 acres between 1881 and 1906, though Gould, *The Occupation of Farm Land*, also notes regional variation.

²⁵ New legislation in 1870 effectively established the system, see *Appendices to the Journals of the House of Representatives*, 1871 section C.

Lyttleton Times, and, from 1896, the Crown's valuation rolls.²⁶ Condliffe and Rodwell extended the price series reported by Callaghan for years to 1925, although they refrained from distinguishing agricultural and pastoral land prices, arguing that land use often interchanged.²⁷ The chief advantages of the Canterbury data are that they are for rural land in what was, until the 1890s, New Zealand's principal farming-region.²⁸

Rather differently, Low utilized data from the annual reports of the Land Registrar to measure North Island land prices.²⁹ Arnold followed Low, and used land transfer registration data to estimate land prices in a variety of New Zealand provincial districts prior to 1914.³⁰ The recording of land transfers had quickly become established, with over 2000 transfers and 150,000 acres registered in 1874. Summaries of the transfers for each year are reported in the *Appendices to the Journal of the House of Representatives*. These data indicate; the number of transfers; the acres transferred, distinguishing country from town land; and the value of all transfers. It is not until 1915 that the payments recorded distinguished between the value of country and town land transferred each year, even though the acres of each type of land transferred is reported for earlier years.

Constructing land price series is typically hindered by variations in the quality of land that is sold each year. For New Zealand, however, the rural land market was highly active, reaching over 20,000 transfers and 2 million acres per annum between 1910-14, and average transfer prices are thus based on substantial information. However, for the years to 1914 there is a problem in using the registration data to measure rural prices since the reported average value of land transfers is a composite

²⁶ Callaghan, *The course of land prices in Canterbury*.

²⁷ Condliffe and Rodwell, *The course of rural land values*.

²⁸ *The New Zealand Population Census* of 1901 showed for the first time in forty years a slight preponderance of population in the North Island

²⁹ Low, *Land prices and land Valuation in New Zealand*.

³⁰ Arnold, *The market for finance in late nineteenth century New Zealand*.

of town and country land prices. In 1915, the first year that country and town values are distinguished in the Land Registrar's reports, country prices averaged £7.40 per acre and town land £473.18 per acre, while overall transfers averaged £9.20 per acre.

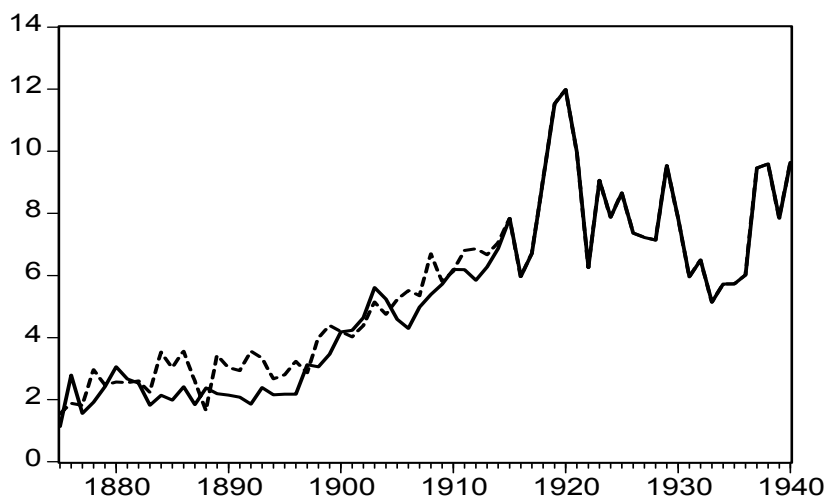
For the North Island, Low attempts to refine average land transfer values by adjusting for variations in the average size of land transfers each year. His rationale is that sales of larger acreages are usually of poorer quality land at a lower average price per acre. A similar adjustment is not made here. The new refrigeration technology promoted a shift to smaller land holdings from the 1890s, and this move was reinforced by public policy. Moreover, upland pastoral farms on the poorer quality lands of the South Island typically remained Crown leases, and do not affect the land transfer value data. More generally, subdivision and closer settlement encouraged by rising land prices did not change intrinsic land quality, and Low's deflating of average rural transfer prices on the basis of changes in the mean size of land transfers, embeds a downward bias in his preferred land price series.

For the years to 1914 when the land registry data conflate town and country land transfer values, the case for adjustment may appear stronger, since town lands had higher transfer values. For these years, Arnold attempts to adjust the average price of all transfers for variation in the average area of sale, following the procedures of Low, and her corrected series shows lower land price inflation. However, town land became a smaller proportion of total acres transferred in the years before the Great War, and accounted for less than 0.04% of acres transferred in 1913. It appears likely that Arnold's corrected series understate average land prices for years to 1914, for the same reasons that Low's series does for later years, namely that there was a trend to smaller farms. Fortunately, it is possible to check whether the unadjusted transfer price data correspond satisfactorily to the movement of rural prices for years

to 1915, by comparing their profile with the independent land price data available for Canterbury.

Figure 1 shows the Canterbury price series spliced in 1915 with the average price of rural land transfers, and also the overall transfers price data spliced at 1915 with the rural price data.³¹ The Canterbury rural price series and the composite land transfer price series show similar long-term shifts to 1914, even though there are disparities in individual years. It appears likely that both series offer a reasonable representation of rural land prices for the years to 1915. The Canterbury data show less deflation in the “depression” surrounding the 1880s, and highlight the effects of the financial crisis of 1887-9. In the years 1875-1914 the two series show remarkably close correspondence, suggesting that the Canterbury data provide a good indication of rural land prices more generally in New Zealand for the years to 1914. Accordingly, the land price data deployed here utilize the Canterbury data spliced with the average price for rural transfers in 1915.

Figure 1. Nominal Rural Land Prices (£ per acre).



— Composite land transfer price series spliced at 1915 with the average price of rural land
 - - - Canterbury land price series spliced at 1915 with the average price of rural land

³¹ The land transfer price data are from: *Appendices to the Journals of the House of Representatives*, section H.

The swings in the rural land market transfer volumes support the record shown by the price data. Nominal land prices rose during the 1870s, but subsequently stagnated until the mid-1890s. New Zealand then experienced a long land price boom to 1920, followed by deflation until the mid-1930s. Rural transfer volumes reached 0.5 million acres in 1875, and peaked at 1.6 million in 1883, but then declined for the rest of that decade. Transfers recovered to 1.3 million acres in 1892, but did not regain their 1883 level until 1905, when transfers exceeded 2.0 million acres. Apart from in 1909/10 transfers remained above the 2.0 million acre level until the start of World War One. Subsequently transfers peaked at 3.7 and 4.5 million acres in 1919 and 1920, but did not again approach these levels during the years between the world wars.

Real wages in New Zealand

The nominal wage series shown in Figure 2 is for non-agricultural labourers. This category of labour corresponds to that considered in Williamson's international comparisons of wage-rental ratios. The data for the years to 1913 are from Greasley and Oxley.³² These data are extended to 1939 with estimates for labourers' wages in building, baking, and brewing, and the wages of general hands in meat freezing and saw mills. The mean of these five series is used here to represent average labourer's wages, and the series is deflated by the consumer price series in Nesbitt-Savage.³³

Clinkard was responsible for initiating the collection of the post-1913 wage data, which are reported each year in *Statistics of New Zealand*.³⁴ They do not show actual wages; rather they are the minimum rates arising from the decisions of

³² Greasley and Oxley, *Globalization and real wages*.

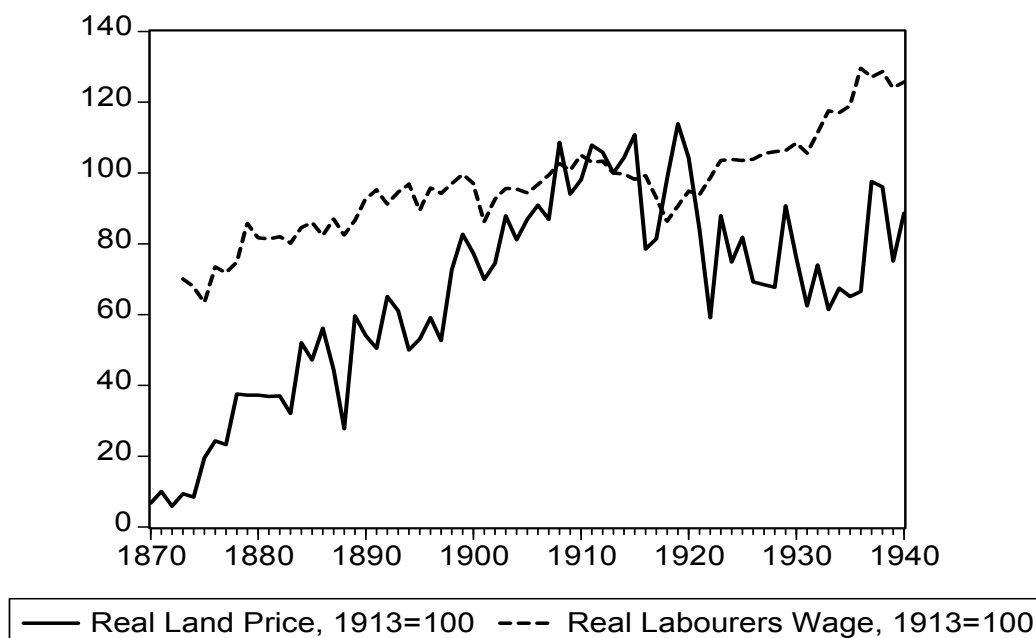
³³ Nesbitt Savage, *A long run consumer price index for New Zealand*

³⁴ Clinkard, *New Zealand official yearbook*, 1919, p. 860, and *Statistics of New Zealand*.

arbitration boards. As such they reflect the movement of wage rates in each of the five sectors, rather than actual levels. The arbitration courts met frequently, often several times within the same year when markets were volatile, and the awards probably correspond closely with average wage movements.³⁵ Figure 2 shows the average real wage series for the years 1873-1939, and also real land prices (combining the Canterbury and rural transfers data), utilizing the same deflator.

New Zealand real wages rose strongly to the early 1890s, averaging 1.8% p.a. growth in the twenty years from 1874. Thereafter, real wage growth slowed in the years to 1913, and struggled to regain pre-Great War levels in the 1920s, before showing faster 1930s growth. In contrast, real land price inflation chiefly occurred in the 1870s, and between the mid-1890s and 1920, when real prices tripled. Real land prices did not regain the levels of the post-Great War boom, or indeed pre-1914 levels during the years to 1939, although they did rise sharply in the mid-1930s.

Figure 2: Real Wages and Real Land Prices (1913=100).

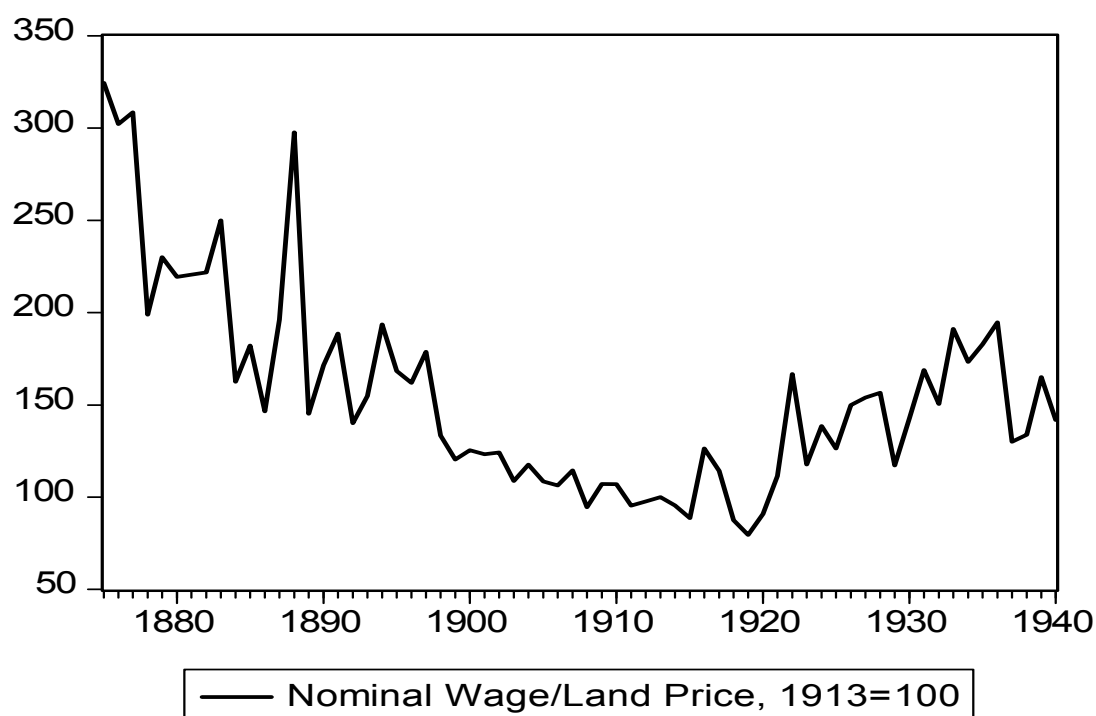


³⁵ Condliffe, *New Zealand in the making* p. 350 notes the frequency of changes 1919-22, and that the awards reflected market conditions.

The Wage-Rental Ratio

New Zealand's wage rental ratio, see Figure 3, generally fell to 1920, but the years between 1885-95 saw the downward trend interrupted, and land prices fell sharply during the banking crisis of 1887-9.³⁶ During the period between the world wars, relative factor price shifts generally favoured wages, with the wage-rental relativity returning to the 1890s ratio in the 1930s. However, there was a sharp land price rise in 1937, which returned the wage rental ratio to a level similar to that in the early 1920s..

Figure 3. Wage-Rental Ratio (1913=100)



New Zealand's wage-rental experience shows both similarities and differences with other land abundant economies over the years 1875-1939. Before the Great War, the decline in the ratio for New Zealand was less sharp than in the southern cone of

³⁶ These were also years of net outflows of migrants from New Zealand.

the Americas, and the Dominion's profile was most like that of her near neighbour across the Tasman, Australia. Even before taking into account more widely dispersed land ownership in New Zealand, the shifts in income distribution towards landowners in the Dominion during the years 1875-1913 appears less severe than in Uruguay or the Argentine, see Table 2. If uneven income distribution was a barrier to economic the longer-term economic development in the agricultural economies of the periphery, New Zealand, and Australia were less disadvantaged than the River Plate economies.³⁷

	New Zealand	Uruguay	Argentina	Australia	USA
1875/9	285.4	891.3	580.1 [#]	253.0	195.0
1885/9	202.4	400.2	337.1	216.3	182.1
1895/9	159.2	303.6	311.1	147.7	175.0
1905/9	110.8	167.8	135.2	97.9	132.7
1915/9	103.5	120.8	53.6	111.0	124.7
1925/9	147.1	150.2	51.0	115.1	160.1
1935/9	168.5	213.5	59.5	110.5	240.1

denotes 1883/4. Non-New Zealand data are from Williamson, Land, labor, and globalization.

There were greater disparities in wage-rental movements around the agricultural periphery following World War I. New Zealand's wage rental ratio rose sharply then, and the Dominion's experience was more akin to that of the USA and Uruguay, than that of Australia. The postwar deterioration in the relative position of landowners may not have been beneficial to the wider New Zealand economy. Wider spread land ownership in New Zealand, and the central importance of agriculture in

³⁷ Bertola and Porcile, Real wages and income distribution, highlight that uneven income distribution limited economic development in the southern cone.

the economy, in the context of the collapse of the rural land market, may have been an important force in protracting the Dominion's 'long depression' of the 1920s.³⁸

EXPLAINING REAL WAGES IN NEW ZEALAND

This section considers the effects of international forces, namely immigration and the terms of trade, and New Zealand's productivity, measured by GDP per capita, on real wages in the Dominion. Importantly, we consider how productivity gains were shared between wage and property income, by incorporating the rental-wage ratio and, also, real interest rates, measured by the nominal rate less nominal wage inflation, into the model.

The New Zealand real wage equations are formulated within a cointegration framework, estimated over the period 1874-1939. To certify the appropriateness of cointegration methods, unit root test results are shown in Table 3. The null of non-stationarity is rejected only in the case of interest rates relative to nominal wage inflation. By implication, real interest rates did not shape the permanent swings in real wages in New Zealand. There is much discussion in New Zealand's historiography that interest earners were advantaged over commodity producers.³⁹ The findings here run counter to that hypothesis, and show no permanent real wage effects of real interest rate shifts.

For real GDP per capita, the terms of trade, migration, and the rental-wage ratio, the cointegration results in Table 4 show that there are combinations of these variables that exhibit a long-run linear stationary relationship with real wages. However, the terms of trade did not statistically significantly influence real wages. It

³⁸ Greasley and Oxley, *The pastoral boom and long swings in New Zealand's economic growth*. Condliffe, *New Zealand in the making*, p. 268 highlights the problems created by the over optimism of smaller farmers' speculative land transactions, when prices fell after 1920.

³⁹ Hawke, *The making of New Zealand*.

was productivity (measured by GDP per capita), migration, and the rental wage ratio, that shaped the swings real wages in New Zealand between 1874-1939.

**Table 3: Unit Root Tests (Levels)
Augmented Dickey-Fuller¹**

Variable	1874-1939
Log Real Wages	-3.04
Log Real GDP per capita ²	-2.54
Log Terms of Trade	-3.13
Net Migrants /Population	-2.78
Real interest rate ³	-10.55*
Log Nominal Land Price/Nominal Wage	-2.84

* Denotes significant at 5% level

¹ Degree of augmentation in ADF determined by Akaike Information Criteria

² Includes Maori in population

³ Nominal interest rate – rate of wage inflation. The nominal interest rate is that earned by the trustee savings bank reported by J. Bere, G. R. Hawke, and D. Shepherd, The trustee savings banks.

**Table 4: Johansen-based Cointegration Results
Real Wages, 1874-1939
(VAR=1, Restricted intercept and no trend)**

H ₀	H ₁	Trace	Variable	Coefficient	SE [#]
r=0	r=1	96.55*	Intercept	2.20*	0.84
r≤1	r=2	47.79	Log Real GDP per capita	1.039*	0.21
r≤2	r=3	28.29	Log Terms of Trade	0.031	0.22
r≤3	r=4	14.11	Net Migrants /Population	-0.002*	0.0002
r≤4	r=5	4.97	Log Nominal Land Price/Nominal Wage	-0.56*	0.08

* Denotes significant at the 5% level. # Denotes standard error.

In the long run the results show a near one to one relationship between real wages and real GDP per capita.⁴⁰ Over the period 1873 to 1939 real wages rose by 0.87% p. a. and real GDP per capita by 0.78% p.a. Since the wage-rental ratio was similar in the 1880s and 1930s, distributional changes did not substantially upset the

⁴⁰ GDP per capita provides a good indicator of GDP per worker over these years since participation rate shifts were modest. The occasional census data show labour participation was 41.0% in 1874, 41.6% in 1896, and 43.2% in 1936, see Bloomfield, *New Zealand handbook*. The increase is chiefly due to a rise in female participation.

balance between real wages and real GDP per capita over this period. Within these years there were marked discrepancies between GDP per capita and real wage growth, most obviously during the years of the long stagnation of real wages during the thirty years from 1890. The results in Table 4 show that shifts in the rental-wage ratio substantially explain the plateau in New Zealand real wages between 1890-1920, when real GDP per capita rose strongly. The rental-wage ratio rose around 100% over these thirty years, sufficient to depress real wages by 56%, all else equal, in the long run, according to the estimated coefficient for the rental-wage ratio. Of course real wages did not fall by this magnitude because of the rise in real GDP per capita.

While shifts in the terms of trade did not directly influence real wages, their movement was crucial, as we show below, for the rental-wage ratio, and thus labours' share of income.⁴¹ Higher immigration did tend to reduce real wages, but the effects were small, since New Zealand's highest rates of immigration were during the Vogel boom of the 1870s. Over the next 60 years lower immigration rates tended to increase slightly real wages in New Zealand. The coefficient in Table 4 shows that a doubling of the migration rate reduces real wages by 0.02% in the long run. In the years 1920-27, net immigration was around 10-14,000 per year, similar to levels between 1900-14, but well below the 25-38,000 of 1874/5. New Zealand experienced net out migration in 1928, and between 1932-37. The cointegration results show that real wages between the world wars did benefit from less immigration, but the size of the effect is near zero.

The stagnation of New Zealand real wages in the thirty years after 1890, when real GDP per capita growth accelerates, indicates that there was a dislocation in the

⁴¹ The terms of trade data are from Briggs, *Looking at the numbers*, based on McIlraith's measures of farm and non-farm prices for years to 1914. Using Easton's alternative measure does not materially affect the results in Table 3.

functional distribution of income, which coincided with the refrigeration boom and the economic frontier shifting to the North Island, and to more intensive dairy and meat farming. Much of the increase in GDP per capita resulted from a rise in the cultivated area, chiefly land sown with grasses, and from higher land productivity. The number of cattle per cultivated acre more than doubled between 1890 and 1939.⁴² The shift in income distribution, however, shows that landowners benefited, almost exclusively, from the rise in the terms of trade and the higher land productivity in the years of the refrigeration boom between 1890- 1920.

International evidence shows that shifts in the terms of trade had a variety of implications for wage-rental ratios and income distribution between 1870-1939, with the land abundant economies of Asia experiencing the sharpest rise in income inequality.⁴³ Shifts in the terms of trade of these economies were magnified in the wage-rental ratio, as trade increased sharply the relative value of the abundant factor of production, land.⁴⁴ Rather unexpectedly, Williamson did not find evidence of a magnification effect for Australia, Uruguay, or Argentina.

Models of the wage-rental ratio postulate a negative relationship with the price of farm goods relative to manufactures (effectively the terms of trade), with a coefficient in excess of unity if the magnification effect applies, and also that rises in the capital-labour ratio and total factor productivity tend to increase wages, and falls in the land-labour ratio tend to increase rental values.⁴⁵ In part, the lack of empirical evidence for the magnification effect in countries of recent European settlement may be due the difficulties of measuring the relevant variables.⁴⁶

⁴² *Farm production.*

⁴³ Williamson, Land, labor, and Globalization

⁴⁴ The theoretical foundations 'magnification effect' were first articulated by Jones, A three factor model.

⁴⁵ O'Rourke, Taylor, and Williamson describe this model.

⁴⁶ For example, Williamson, *op cit*, uses urbanization rates as a proxy for the capital stock.

In the case of New Zealand, estimation of a rental-wage model is hindered by an absence of capital stock data, and thus also of indicators of total factor productivity.⁴⁷ Accordingly, the results in Table 5 incorporate, in addition to the terms of trade, a time trend to capture the effects of the missing variables. The results show a strong magnification effect, and indicate that a 10% rise in the terms of trade increased the rental-wage ratio by 19%. The trend variable has a negative sign, which is expected since accumulation and productivity tend to increase wages relatively, although the coefficient is not statistically significant.

Table 5: Johansen-based Cointegration Results
Rental/Wage ratio, 1874-1939
 (VAR=2 Linear deterministic trend (restricted))

H ₀	H ₁	Trace	Variable	Coefficient	SE [#]
r=0	r=1	40.02*	Trend	-0.006	0.004
r≤1	r=2	11.66	Log Terms of Trade	1.94*	0.56

* Denotes significant at the 5% level. # Denotes standard error.

The strength of the estimated magnification effect shows why New Zealand real wages levels were unchanged between the early 1890s and 1920, despite the sharp rise in the Dominion's real GDP per capita. Nor would its existence have been a surprise to contemporary analysts in the Dominion. Scholefield noted that land suitable for dairying changed hands over and over again at steadily increasing prices, and he speculates that the land was only made to pay with the unpaid labour of farmers' families.⁴⁸ Had real wages simply followed from rise in real GDP per capita, they would have risen strongly between 1890-1920. However, New Zealand's terms of trade rose by around 60% over these thirty years, sufficient, according to the results in

⁴⁷ Dowie's capital stock data only cover the years 1870-1900. Data are available for public works spending, notably on the transport infrastructure, and show rapid growth, especially in the 1920s.

⁴⁸ Scholefield, *New Zealand in evolution*, p. 154. Condliffe, *New Zealand in the making*, and Sutch, *Colony or nation*, also highlighted that land values tended to run in front of product prices.

Table 5, to increase the rental-wage ratio by 114%. This is close to the actual rise in the rental-wage ratio between 1890-1920, which, as we have seen, kept real wages stagnant. The distributional shifts, measured by the rental-wage ratio, meant that landowners reaped virtually all of the gains from higher productivity between 1890 and 1920.

Refrigeration had powerful effects on New Zealand's economy. By allowing long distance trade in dairy products and meat, refrigeration underpinned a transformation of New Zealand farming that raised land productivity and real GDP per capita. The refrigeration related trade boom had the particular effect of increasing the relative value of land, the Dominion's abundant factor of production. The rise in land prices, and the shifts in the wage-rental ratio were sufficiently strong between 1890 and 1920 for the gains from higher real GDP per capita to accrue principally to landowners. After 1920 income distribution shifted in favour of workers, but real wages remained stagnant through the 1920s in the absence of real GDP per capita growth. Rather ironically, the social depth of land ownership in the Dominion meant the collapse of the rural land market after 1920 contributed powerfully to a long depression surrounding the 1920s.⁴⁹ Real wage growth resumed strongly in the 1930s, when a change in monetary regime promoted wider recovery, included in the hard-pressed and heavily indebted farm sector⁵⁰.

CONCLUSION

New Zealand's economy underwent substantial transformation in the early decades of the twentieth century, stimulated by rising farm prices in the world

⁴⁹ Greasley and Oxley, *The pastoral boom and long swings*. Fleming, *agricultural support policies*, lays more stress on the deterioration in export prices.

⁵⁰ Greasley and Oxley, *Regime shift and fast recovery*.

economy and the opportunities offered by refrigeration. In response, the Dominion moved away from extensive wool farming to closer settlement and to intensive dairy or mixed farming, including of lambs for the frozen meat trade. Coincidentally, the farming frontier shifted northwards, as Maori land rights were extinguished and the transport infrastructure was developed around the wetter, more fertile lands of the North Island. New Zealanders developed a prosperous economy based on the long distance trading of refrigerated commodities, and had, as measured by the Human Development Index, the highest living standards in the world in 1913.⁵¹

Trade underpinned the prosperity of New Zealand's economy, but also exerted powerful income distribution effects, which benefited the owners of land in the years to 1920. The results here show that shifts in the terms of trade were magnified in the rental-wage ratio by a factor of around two. New Zealand's terms of trade improved sharply between 1890 and 1920, and, consequentially, so did land prices. Concomitant with the land price boom was a marked restructuring of land ownership in the Dominion, in which small and medium size farm owners became dominant. This group benefited greatly from rising land values to 1920. In contrast, wage earners gained little from the improved terms of trade, with real wages showing no discernible upward trend between 1890 and the 1920s, despite the profound changes in New Zealand's economy and the rise in real GDP per capita.

Ostensibly, New Zealand's experience resembles that of other land rich economies of the periphery in Asia and Latin Americas, where the gains from trade especially benefited the land owning classes. But New Zealand's case was idiosyncratic.⁵² A distinctive characteristic of New Zealand from around the turn of the twentieth century is the extent to which small and medium farmers became the

⁵¹ Crafts, Human development index.

⁵² Greasley and Oxley, *Growing apart*, and Greasley and Oxley, *Outside the club*.

owners of the land. The Dominion's historiography tends to downplay the role of public policy in this process, stressing instead the shifts in farming practices engendered by refrigeration. The implication, however, is that the distribution of income was less extreme in New Zealand than elsewhere on the agricultural periphery because of the social depth of land ownership in the Dominion.⁵³ Consequentially, New Zealanders gained in greater depth than the populations of agricultural economies elsewhere from trade and rising land prices in the years to 1920.

A corollary to the close association between farm and general prosperity in New Zealand is that the subsequent reversals in the terms of trade and land prices in the 1920s had deeply depressing consequences in the Dominion, both for landowners and for workers' real wages. The collapse of land market activity played a large role in depressing New Zealand's real GDP per capita during the 1920s. Consequentially, there was little scope for higher real wages in the 1920s, despite the distributional shifts then favouring labour. Higher real wages awaited the economic upturn of the 1930s, which was facilitated by manipulating the currency to raise relative farm incomes, although the policy had the wider objective of promoting general economic recovery.⁵⁴

⁵³ Public policy also attempted to aid urban workers, for example by tariffs, and latterly by direct intervention in the labour market. Galt, *Wealth and its distribution*, reports idiosyncratically even wealth distribution in New Zealand, although Shanahan, *The distribution of personal wealth*, argues Victoria had a similar profile.

⁵⁴ Copland, *New Zealand exchange*.

DATA APPENDIX (1913=100)

Year	Nominal Wage	Real Wage	Real Land Price
1875	75.48852	63.42777	19.54992
1876	85.26957	73.46529	24.31149
1877	84.02182	71.79098	23.26425
1878	88.60041	74.77452	37.60184
1879	85.40598	85.75217	37.27921
1880	84.69681	81.72730	37.26004
1881	84.09655	81.36998	36.88293
1882	86.71399	82.04376	37.00259
1883	84.12757	80.17852	32.08317
1884	86.06897	84.56678	52.04579
1885	82.97675	85.99724	47.20245
1886	78.35834	82.31281	56.16356
1887	76.68481	86.97265	44.35566
1888	73.68952	82.55492	27.73038
1889	74.74975	86.60202	59.64860
1890	78.08623	92.63390	54.02963
1891	83.13783	95.29496	50.50215
1892	74.91435	91.23050	65.10996
1893	77.41865	94.55917	61.07002
1894	77.64670	96.84334	50.01271
1895	70.81125	89.44388	53.15155
1896	78.56347	95.76856	59.13941
1897	76.96608	94.19218	52.70883
1898	79.88524	96.99791	72.73272
1899	79.29661	99.65383	82.74460
1900	78.85215	96.97953	77.32482
1901	74.44803	86.21214	69.93969
1902	81.82241	92.58753	74.50416
1903	84.06130	95.64531	87.87004
1904	83.83079	95.47074	81.18539
1905	84.88890	94.33370	86.92039
1906	87.95010	96.73730	90.93325
1907	91.77370	99.44158	86.89873
1908	95.00233	102.6705	108.6066
1909	93.39048	100.7527	93.99731
1910	98.53654	105.0237	98.14122
1911	97.32405	102.9781	107.9047
1912	100.5752	103.3713	105.8330
1913	100.0000	100.0000	100.0000
1914	101.1749	99.64619	104.3399
1915	104.1528	98.16837	110.8181
1916	113.0866	99.22615	78.52609
1917	115.0967	93.01612	81.43284
1918	119.2657	86.38048	98.60501
1919	137.6544	90.68350	113.9310
1920	163.5623	94.88147	104.3012
1921	166.9125	93.75107	84.03604
1922	156.4898	98.63235	59.14616
1923	160.0633	103.5187	87.96325
1924	163.7857	103.7589	74.89887
1925	164.2324	103.5124	81.86325
1926	165.7213	103.9220	69.30274
1927	166.9125	105.4700	68.47144
1928	167.8059	106.0345	67.70242

1929	167.8059	106.3057	90.72224
1930	167.8059	108.5261	76.02899
1931	150.9062	105.5917	62.51935
1932	146.5882	111.3800	74.02673
1933	147.5560	117.5229	61.45114
1934	148.8216	117.0258	67.51301
1935	157.1598	119.0473	65.13817
1936	175.7718	129.5794	66.54340
1937	184.6311	127.0365	97.64258
1938	192.6715	128.6381	96.08328
1939	194.3094	124.0475	75.12199
1940	205.1043	125.7533	88.69370

Sources: as for Figure 3.

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