THE
ECONOMIC HISTORY REVIEW

Economic History Review, 62, 2 (2009), pp. 324–349

The pastoral boom, the rural land market, and long swings in New Zealand economic growth, 1873–1939[1]

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Higher farm and manufacturing productivity associated with refrigerated exports led to New Zealand's attainment of the world's highest Human Development Index in 1913. Local responses to export opportunities increased the social depth of land ownership and fostered intensive growth. Closer settlement meant that land-related income gains spread widely, but land market volatility also created instability. New Zealand had the world's highest GDP per capita in 1938, but it experienced long swings in its growth rates. Dramatic swings in rural land market activity engendered by the pastoral boom contributed greatly to a long depression in the 1920s; subsequently a new monetary regime facilitated fast recovery.

Long-standing debates surrounding the development of peripheral, natural resource-abundant economies during the era of wider industrialization and world trade growth after 1870 have been re-invigorated by a variety of recent perspectives, including those linking global trade expansion to income inequality around the periphery; those associating colonial institutions with reversal of economic fortunes; and those viewing natural resource abundance as a curse rather than a boon; ideas associated respectively with Williamson, Acemoglu, and Sachs.[2] This article draws upon these ideas, and upon the earlier staple export-led economic growth historiography, to consider how refrigerated exports shaped New Zealand's economic development, both during the years of global economic expansion to 1914 and during the global economic retreat of the 1920s and 1930s.

New Zealand offers a case study that reveals the potential benefits and the possible downsides of specializing upon export staples and helps to inform the wider debates by highlighting the centrality of local responses to global opportunities.[3] Incomes per capita in New Zealand were among the highest in the world in both 1913 and 1938, but its income fluctuations and long depression of the 1920s and early 1930s led to doubts in New Zealand surrounding the long-term

[1] We thank Price Fishback, Kris Inwood, Martin Shanahan, John Singleton, Jeffrey Williamson, and those who attended the Fifth World Cliometrics Conference, Venice, 2004; the EHSANZ Conference, Brisbane, 2006; the Fourteenth IEHA Congress, Helsinki, 2006; and seminars at the University of York, 2005, University of Arizona, 2006, and Harvard University, 2006, for their helpful comments. The financial support of the Association of Commonwealth Universities, the British Academy, the Leverhulme Trust, and the Royal Society of New Zealand Marsden Fund (grant UOC108) is gratefully acknowledged.

[2] Williamson, 'Land, labor, and globalization'; Acemoglu, Johnson, and Robinson, 'Reversal of fortune'; J. D. Sachs and A. M. Warner, 'Natural resource abundance and economic growth', NBER working paper 5398, Cambridge (1995).

[3] Kravis, 'Trade as a handmaiden'.

efficacy of staple export specialization and to insular economic policies there after 1938.[4] In earlier years, notably during the 1920s, the 'drift to the towns' was often lamented, given the widely held belief that primary production underpinned the Dominion's prosperity, and such sentiments meant that policy responses to the early 1930s depression favoured farmers.[5] Eventually, though, New Zealand turned to import substituting industry promoting policies, and these have counterparts throughout much of the less-industrial world. Collectively these policies reflected the widespread doubts that export staples were a route to prosperity for the periphery.

Nevertheless, historians and development economists have keenly contested the claim that staple exports provided prosperity for the less-industrial world. New Zealand's refrigeration-related pastoral export boom has not been prominent in these debates, although Schedvin argued that New Zealand became caught in a 'staple trap'.[6] His interpretation, however, lays stress on the post-1945 growth record of New Zealand, when insular protectionist policies influenced its economic structure and efficiency. Much of the wider debate evolved from discussions of Canadian economic development, stimulated by Innis and Macintosh.[7] Chambers and Gordon used prairie land rents in the case of Canada's wheat boom to measure the consequences for per capita income, but they denied the importance of staple exports for intensive growth in Canada, and expressed scepticism about whether natural resource-intense exports, including minerals as well as farm products, typically favour economic growth per capita.[8] Others, including Altman, Caves, Green and Sparks, Bertram, and Schedvin, contend that economy-wide productivity was augmented by Canada's wheat boom, and these analysts argue that intensive growth was promoted by higher labour utilization; immigration-linked scale economies; linkages to transport, finance and processing; and induced technological progress. These effects are not captured by Chambers and Gordon's model.[9]

A further strand of the staple export-led growth debate highlights inimical connections with income inequality. Baldwin, for example, argued that cotton states in the USA were enmeshed in a vicious circle of poverty associated with uneven income distribution.[10] More recent analyses, including those of Huff and Williamson, show that the late nineteenth- and early twentieth-century staple export booms deterred industrialization, and set in motion powerful forces of inequality in the natural resource-abundant economies of the periphery, by depressing wages relative to property income, which may have been barriers to economic development.[11] Their findings are supported by those of Sachs and

[4] Hawke, *Making of New Zealand*, p. 163.

[5] Fisher, 'Drift', was a dissenting voice. For a wider discussion, see *New Zealand Highway*, which includes comments by Condliffe and by Nash. Endres, 'Structural economic thought', discusses Fisher's dissent from the Economic Committee's 'Report'.

[6] Schedvin, 'Staples and regions', p. 556.

[7] Innis, *Fur trade*; idem, *Cod fisheries*; Macintosh, *Economic background*.

[8] Chambers and Gordon, 'Primary products'.

[9] Altman, 'Staple theory'; Caves, 'Export-led growth'; Green and Sparks, 'Population growth'; Schedvin, 'Staples and regions'; Bertram, 'Relevance'.

[10] Baldwin, 'Patterns of development'.

[11] Huff, 'Boom or bust'; Williamson, 'Land, labor, and globalization'.

Warner, who identify rent seeking behaviour and exchange rate appreciation as possible deleterious consequences of natural resource abundance.[12]

In contrast, Acemoglu et al. postulate that extractive institutions rather than natural resource endowments are the chief barrier to economic development, and he associates European colonial settlement with the creation of new institutions that enabled and promoted wider participation in accumulative or innovative activities.[13] The nuances of the individual settler economies often disappear in contrasts of indigenous people's productivity with that of the European settlers. Acemoglu's perspectives, though, are potentially relevant for understanding differences between the settler economies to the extent that their varying institutions stimulated or retarded the development of enterprise in depth. New Zealand policies, for example in relation to land settlement, provide obvious contrasts with the settler colonies of the Americas' southern cone, although the greater social depth of land ownership in New Zealand may not, as we shall see, have obviated rent seeking.

Our case study of New Zealand from 1873 to 1939 casts the staple export-led intensive growth hypothesis in a more favourable light, but highlights the importance of local responses to trading opportunities. However, the Dominion's heightened prosperity was interrupted by a long depression that spanned the 1920s and early 1930s. We show that New Zealand's post-1890 refrigeration-related pastoral export boom was associated with raised farming and manufacturing productivity. Patterns of land ownership were transformed, with the consequence that the higher rental incomes generated by staple exports spread widely. New Zealand's land market, though, was volatile, and the social depth of land ownership engendered by the export of refrigerated staples meant that land market volatility translated into wider macroeconomic instability and led to a long depression between the world wars. Our analysis highlights that New Zealand's refrigerated export boom impacted powerfully on its land market with consequences both for income distribution and for the swings in economic growth. Articulation of the linkages between trade expansion, the land market, income distribution, and economic growth in New Zealand shows that staple export booms may have varied and sometimes idiosyncratic consequences, related to the form of the exports and to how local institutions and the organization of production respond to the opportunities arising from the staple trades.

I

Prior to the refrigeration era, New Zealand's economic activity focused on the South Island and on the export of wool from the great estates using farming methods that needed relatively little labour. Average incomes per capita in the Dominion around 1870 were high compared to the rest of the world, but were falling, and the prospects for economic development appeared uncertain.[14] The form of staple exports promoted by refrigeration was important in enabling higher economy-wide productivity. When staple exports were dominated by wool in the years to 1890, New Zealand's intensive growth prospects appeared less strong. Immigration was encouraged in the 1870s by a policy of assisting passage, and by

[12] Sachs and Warner, 'Natural resource abundance' (see above, n. 2).
[13] Acemoglu, Johnson, and Robinson, 'Reversal of fortune'.
[14] Dowie, 'Century old estimate'; Greasley and Oxley, 'Outside the club'.

public works—notably railway building.[15] Yet by the end of the 1880s, New Zealand experienced net emigration, urban unemployment, discontent surrounding sweated conditions in the clothing trades, and an unrequited hunger for land among the settlers. Much of New Zealand's historiography for the years from 1890 highlights the role of refrigeration-related pastoral exports in transforming the country's economic prospects, which led, for example, to the Dominion attaining living standards measured by the Human Development Index (HDI) that ranked first in the world in 1913.[16]

In New Zealand, the opportunities of refrigeration led to a distinctive staple export boom, of dairy and meat products, which increased both the occupied and cultivated areas and the size of the Dominion's economy.[17] Our objectives are to gauge how much intensive growth was also promoted by New Zealand's pastoral export boom, and to consider whether or not the boom created instability, most especially via its impact on the land market. There are several possible reasons why refrigeration-related pastoral exports raised incomes per capita. Dairying or mixed farming led to more intensive land use, and to higher farm productivity. Moreover, the shifts in farm production away from wool to dairy and meat were accompanied by organizational moves to smaller farms and more widespread land ownership, which set New Zealand apart from, for example, Uruguay and Argentina. A broadly based, active land market possibly stimulated an enterprising economy in the Dominion, but also raised the prospect of land trafficking and rent seeking among land holders, which some contemporaries connected to the long depression of the 1920s.[18] Finally, dairy production and meat freezing involved substantial off-farm processing, and in the case of butter and cheese this was associated with large-scale cooperative factories, which raised manufacturing and distribution productivity.

Gauging how New Zealand's refrigeration-related pastoral export boom influenced economy-wide productivity and the swings in its economic growth are the chief concerns of this article. A strong element in the historiography of primary producers' economic development associates their fortunes with the vagaries of the terms of trade. The analysis here looks more closely at the particular responses within the Dominion to the opportunities of refrigeration. The key issues are how land ownership and land market activity changed; and what the consequences were for incomes per capita and for macroeconomic stability. Closer settlement after 1890 was stimulated by shifts towards dairy and mixed farming, and by government policy. A distinctive characteristic of New Zealand was the extent that the optimism and the higher productivity generated by the refrigeration-related pastoral boom was capitalized into higher land prices in the years to 1920. Subsequent fluctuations in rural wealth, especially in light of the social depth of land ownership, may have translated into wider economic instability, most especially during the 1920s when land transactions and prices fell.

[15] Hawke, *Making of New Zealand*, p. 45.
[16] Condliffe, *New Zealand in the making*; Crafts, 'Human development index'.
[17] Critchell and Raymond, *Frozen meat*; Philpott, *History*.
[18] L. Bertola and G. Porcile, 'Real wages and income distribution', unpublished paper presented to the Australasian economic history conference, Wollongong, Dec. 2000, and G. R. Hawke, 'Adaptable Kiwis or drought: responses to refrigeration in Australia and New Zealand', Australian National Univ. working paper in economic history 34, Canberra (1985), provide contrasts between Uruguay and New Zealand.

Table 1. *New Zealand's real GDP per capita (% per annum)*

1873/5–1889/91	*1889/91–1911/13*	*1911/13–1927/29*	*1927/29–1937/39*	*1889/91–1937/9*	*1873/5–1937/9*
–0.47	1.49	–0.18	3.09	1.26	0.83

Sources: Greasley and Oxley, 'Measuring New Zealand's GDP', pp. 365–6; idem, 'Regime shift', p. 707.

II

In 1938, New Zealand's GDP per capita, adjusted for purchasing power parity, was the highest in the world, but the Dominion's development was accompanied by long swings in economic growth.[19] Real GDP per capita fell in the years to 1890, when wool dominated staple exports. Thereafter, in the 40 years between 1890 and 1938, New Zealand's real GDP per capita growth averaged around 1.26 per cent per annum, but there were marked swings around the mean growth rate, which are shown in table 1.[20] In particular, New Zealand experienced a 30-year boom from around 1890, a long depression centred on the 1920s, and a remarkably fast recovery during the 1930s. Accordingly, the Dominion's GDP per capita, corrected for purchasing power differences, was 97.2 per cent of the US level in 1913, but this relativity fell to 76.3 per cent in 1929 and rose to 105.5 per cent in 1938.[21]

Technological changes promoting exports of dairy products and frozen meats from New Zealand transformed the farming landscape, patterns of land ownership, and the organization of manufacturing in the Dominion. In the following sections of this article, three strands of evidence are used to address our two key objectives: to gauge the connections between refrigeration-related pastoral exports, and both the prosperity and the instability of New Zealand's economy. These three strands are: estimates of rural land rental values and an assessment of what caused their growth; an appraisal of the size and productivity of the manufacturing sector, highlighting the role of pastoralism-linked processing and the rise of a New Zealand system of mass production; and an articulation of the relationship between GDP per capita and the forces causing its long swings, estimated using a modern time-series approach, which shows how land market collapse shaped the long depression of the 1920s. First, however, we consider how ownership of land and its use in New Zealand were transformed by refrigerated exports.

Farm staple export booms typically extend margins of cultivation, but New Zealand's went much deeper. The rise of dairying and meat farming invigorated the rural land market, created closer settlement, and led to more intensive land use and higher farm productivity. Before 1890, there were strong barriers to closer settlement, connected in the South Island to the extensive wool-sheep holdings of alleged land monopolists, and in the North Island to the less penetrable landscape and the hostile Maori. Land policy, and debate surrounding how to promote more intensive settlement, dominated New Zealand's political economy during the 1880s.[22] Expansion northwards of the farm frontier during the refrigeration era

[19] Greasley and Oxley, 'Growing apart'.

[20] See also fig. 3, below. Real wage growth, however, slowed after 1890, showing that refrigeration may have influenced income distribution.

[21] Maddison, *World economy*, p. 186.

[22] Downie Stewart, 'Land tenure'. 'One person one vote' in New Zealand dates from the abolition of plural voting in 1889 and female suffrage in 1893.

after 1890, supported by the subdivision of estates in the south, broke the land congestion. The number of land holdings in New Zealand almost doubled from 43,777 to 84,076 over the period 1891–1921, and their average size fell.[23]

Land monopoly was associated in New Zealand with estates in excess of 10,000 acres, but these accounted for only 3.5 million acres of occupied land in 1910, compared to 7.8 million acres in 1892.[24] One contemporary analyst noted that New Zealand might have developed on the South American model, characterized by extensive pastoral farming closely connected to the large-scale industrial processing of foodstuffs.[25] Yet by 1920, small and medium-sized farms dominated, with 44.1 per cent of holdings being in the 100–1,000 acre range.[26] Public policies, including a graduated land tax and compulsory repurchases, were directed towards dismantling the great estates, and they reinforced the effects of the dairy and meat export boom in promoting closer settlement. The mean size of farms (excluding the pastoral runs leased from the Crown) fell from 489 to 353 acres between 1881 and 1906, although there was regional variation.[27] Dairy farms, for example, were smaller, with a mean of 162 acres in 1925.[28] The move to closer settlement had important implications for rural land market activity and farm productivity.[29]

The rise of land holdings, however, does not equate straightforwardly to wider land ownership. Around the turn of the twentieth century, around half of all occupied land was held freehold, 16.3 million of the 35.8 million acres in 1902/3, and generally this was the more fertile land. A variety of lease tenures co-existed, of which Crown pastoral leases (chiefly up-country extensive wool-sheep runs) at 8.7 million acres were quantitatively most important. However, there were other forms of tenure for Crown, native, and other public and private land, including leases in perpetuity arising from the Land Settlement Act of 1892.[30] Liberal governments' legislation of the 1890s was intended to promote closer settlement via the purchase of land from the extensive freehold estates and from Maori. The state had purchased around 2.1 million acres under the Land for Settlement legislation by 1921. In contrast, around 3.1 million acres of Crown leaseholds, from the 1877 and 1885 Land Acts and later legislation, had been converted to freehold by 1921.[31]

Selling freehold land was cheap and simple in New Zealand after the Torrens system of land registration was adopted in 1870.[32] Registration at a land office provided secure title; in effect, one insured by the state, at low cost, which diminished barriers to the frequent transfer of rural land. Transfer registration did not fully replace the use of deeds; one estimate reckons that deeds accounted for

[23] *Statistics of New Zealand*.
[24] Gould, 'Occupation of farm land'.
[25] Condliffe, *New Zealand in the making*, pp. 141–3.
[26] *Statistics of farm production* (1922).
[27] Gould, 'Twilight of the great estates'.
[28] H. L. Russell and T. Macklin, 'Intensive dairying in New Zealand and Wisconsin', Agricultural experimental station report 377, Univ. of Wisconsin, Madison (1926), p. 22.
[29] The implications of land market volatility for wider economic instability are considered in a later section.
[30] Lloyd-Prichard, *Economic history*, pp. 133–8, provides an overview of land ownership and tenure in New Zealand, while Jourdain, *Land legislation*, and Percy Smith, 'Land system', provide full details of the complexities.
[31] *Statistics of New Zealand*.
[32] The system is described in *Appendices to the journals of the House of Representatives* (1871), section C. Rankin, 'Comment'.

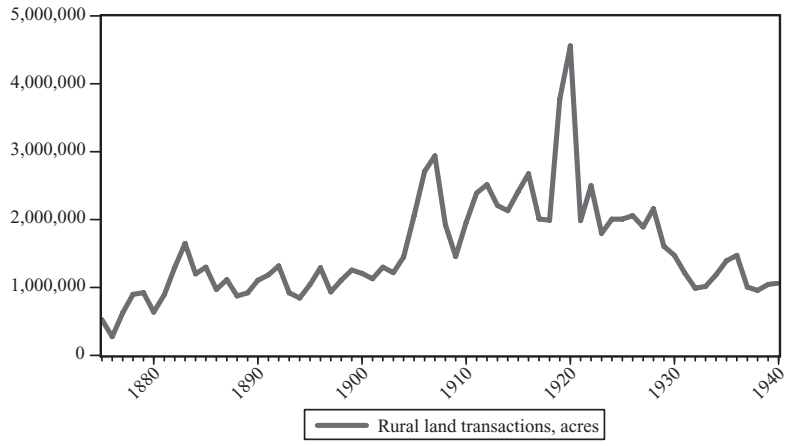

Figure 1. *Volume of rural land transactions*
Source: Summaries of transactions are reported each year in *Appendices to the journals of the House of Representatives* (1871–1939), section H.

around 18 per cent of freehold land titles in 1920.[33] However, registration became the norm for recording sales and provides a reasonable indicator of land market activity. Rural land transfer registrations generally exceeded one million acres each year in the 1890s, and then gathered pace (see figure 1). McIlraith's famous chart of prices in the Dominion includes an annotation labelling 1903–8 as a land boom, and transactions peaked at near three million acres during these years.[34] Transfers returned above two million acres per year during the First World War, and hit 4.5 million acres in 1920.

Around 28.4 million acres of rural land transferred ownership in the period 1910–20, equal to around 70 per cent of occupied land in 1920, and a higher percentage of the freehold. These data include, but are not dominated by, state purchases of freehold and the conversion of some Crown leases to freehold. There were around 77,000 registered rural land transactions in the period 1915–21, a time when New Zealand had 135,000 farmers and an occupied population of around 0.5 million.[35] One contemporary analyst estimated land transfers during 1915–20 equated to around 90 per cent of the freehold land registered under the Torrens system. The surge in land transfers during the postwar boom was especially strong in the North Island, where Williams estimates that 70 per cent of transactions occurred.[36] That these transfers took place at high prices has led New Zealand's farming historians, including Evans, to highlight the ensuing burden for the farm sector during the deflation of the 1920s.[37]

A variety of forces influenced land market activity. The quantity of land held freehold rose from 12.4 to 19.6 million acres during the period 1891–1921. The increase was dwarfed by rising transactions volumes, which shows that freehold

[33] Belshaw and Williams, *Agricultural organization*, p. 189.
[34] McIlwraith, *Course of prices.*
[35] The workforce data are taken from G. R. Hawke, 'Disaggregation of the New Zealand labour force, 1871–1936', Victoria Univ. of Wellington working paper in economic history 79/1, Wellington (1979).
[36] Williams, 'Land tenure'.
[37] Evans, *History of agricultural production.*

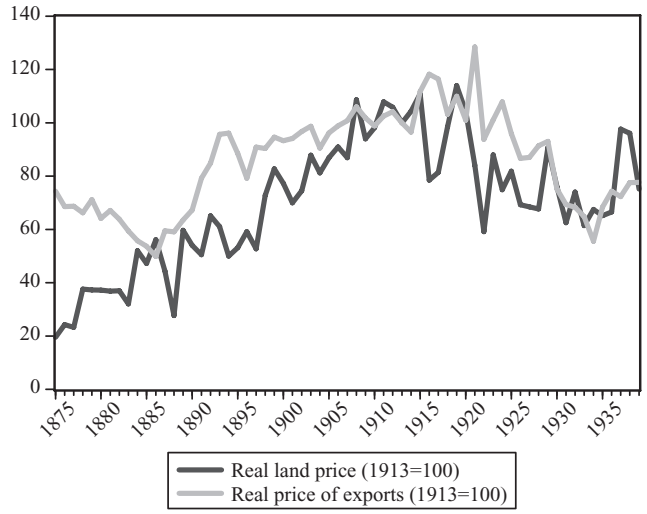

Figure 2. *Real land and export prices (1913 = 100)*

Sources: Land prices: Greasley and Oxley, 'Refrigeration and distribution', pp. 43–4. Export prices: Bloomfield, *New Zealand handbook*, pp. 267–9. The price deflator is from Nesbit-Savage, 'Long run consumer price index' (see n. 60, below).

land turned over frequently. Alongside the rise in transfer volumes was sharp price inflation, much of which occurred before the First World War. Rural land prices in real terms doubled between 1895 and 1913 (see figure 2). The opportunities arising from the refrigerated trades and rising export prices spurred the land market, but the strength of activity was accentuated by local circumstance, policy, and possibly trafficking. Closer settlement was promoted by governments, which directly contributed to land transfers by the purchase of freehold land from the great estates. In part this was possible because of extensive overseas borrowing by the state at relatively low interest rates, especially after the Colonial Stock Act of 1900 granted trustee status to colonial bonds.[38] State advances also facilitated land purchase by settlers, although such finance did not dominate the mortgage market. More important perhaps were debt-financed public works—notably railway construction (the Auckland to Wellington line was completed in 1908) and road building—that stimulated land markets. Rather differently graduated land taxes reinforced land transfers within families, as a desire for tax avoidance added to transfers connected to inheritance, leading Prime Minister Seddon to doubt whether land taxes had promoted closer settlement.[39] Some transfers may also have been motivated by farmers' desires to assemble portfolios of land types. Condliffe, however, forcibly argued that speculation and land trafficking played an important role in the land boom to 1908. He contended that prices were inflated beyond the productive capacity of the land, and that farmers were diverted from striving for productive efficiency by rent seeking.[40] The boom, though, did falter,

[38] For the wider context, see Ferguson and Schularit, 'Empire effect'. In New Zealand the Colonial Stock Act was regarded as the most useful form of imperial preference; see Belshaw and Williams, *Agricultural organization*, p. 150.

[39] Cited in Gould, 'Twilight of the great estates', p. 2.

[40] Condliffe, *New Zealand in the making*, pp. 253–7.

which Hawke attributes to tighter money conditions following the New York bank suspensions of 1907 and the subsequent raising of British interest rates.[41] New Zealand's land boom may have largely run its course by 1910, but it was given a further twist by the impact of the First World War.

Rising world commodity prices during the war, and most especially in the postwar boom, reinvigorated land markets around the periphery. In New Zealand the effects were amplified by schemes to resettle returning soldiers. Land transfers peaked at around 4.5 million acres in 1920; thus more than 10 per cent of occupied land in the Dominion changed hands in one year. Some of the activity was associated with land sales to returning soldiers, funded by the government, which provided £22.6 million to 22,500 potential land buyers in the already inflated land market of 1919–20.[42] Around 1.4 million acres were transferred under the soldier settlement schemes. Not all were successful; a report of 1923 estimated that 18 per cent of recipients had failed, and that another 23 per cent were in difficulty.[43] Sometimes the schemes attempted unsuccessfully to extend the cultivated area, and not all returning soldiers had the capacity to farm the land. Capital values of land sold to soldiers were reduced in the 1920s, but many walked off the land. However, soldier settlement did not dominate land transfers in the postwar boom; around 1.4 million acres were taken by discharged soldiers, while 4.5 million acres of freehold were transferred in 1920 alone.

All those who bought land at high prices during the postwar boom would be hard hit by deflation during the 1920s. Farmers on the North Island, which had witnessed the sharpest rise in land holding from the 1890s, given the stimulus that refrigeration had given to dairy farms, were probably hardest hit. Williams argues that as much as 21 per cent of freehold land on the North Island changed hands in a single year after the First World War.[44] Neither land transactions nor the real price of rural land regained their 1920 levels until after the Second World War.

New Zealand's rural land market boomed in the period 1895–1920, but so did production and productivity. New Zealand's invigorated land market during the refrigeration era was accompanied by a rise in the largely freehold cultivated area (chiefly sown grasses) from eight million acres in 1890 to 18 million in 1920, and to 19.7 million in 1939.[45] The cultivated area does not equate identically to occupied land or farmland in New Zealand, since pastoral farming was also undertaken on native grassland, especially on the high country wool farms of the South Island. However, the extension of the cultivated area was central to the rise of refrigeration-related dairy and meat farming productivity. More intensive farming methods utilizing better quality sown grasses increased the numbers of animals per acre, and raised the yields from individual animals.[46] By 1939, there were 31.3 million sheep and 4.6 million cattle in New Zealand, and 1.6 million people.

New Zealand's refrigeration-related pastoral boom heightened farm productivity. Central to the productivity rise was the increased capacity of the land to support animals. A myriad of efforts by farmers, ranging through land clearance,

[41] Hawke, *Making of New Zealand*, p. 98.
[42] *New Zealand official yearbook* (1923).
[43] Jourdain, *Land legislation*, p. 46.
[44] Williams, *Land tenure*, p. 187.
[45] *Statistics of farm production* (1940).
[46] Gould, 'Pasture formation'.

Table 2. *Sheep and cattle per acre and per capita*

	Sheep per 100 acres[a]	*Sheep per capita*	*Cattle per 100 acres*[b]	*Cattle per capita*
1891	56.8	28.7	9.9	1.3
1911	68.5	23.7	12.5	2.0
1921	53.4	19.0	17.2	2.6
1929	66.7	19.8	18.2	2.3
1939	74.6	19.7	23.3	2.8

Notes:
a Occupied and includes lambs.
b Cultivated and includes dairy cows.
Sources: Statistics of farm production (1955).

ploughing, and the selection of grasses and animals, underpinned the rise of land productivity.[47] The work and enterprise of the farmers was supported by state-provided education and regulation, especially that directed towards improving the quality of dairy production. The consequences were most dramatic in the case of cattle, where the number of animals per cultivated acre doubled over the years of the pastoral boom (see table 2). Additionally, cheese and butter production per dairy cow rose, from 0.33 hundredweights per animal in 1895, to 2.17 in 1921 and 2.89 in 1929.[48] The sheep flock increased less quickly, and its size fell relative to the human population, but the flock's growth exceeded that of occupied land. The composition of the sheep flock also shifted, away from breeds most prized for their wool to those valued for their meat, which realized the higher financial returns for farmers during the refrigeration era.[49]

Two key themes emerge from surveying how the refrigeration boom impacted on New Zealand farming and on its rural land market. Land transfers and prices rose, but so did land productivity. Intensive settlement and a rise in the social depth of land ownership made possible higher land productivity, but also made possible intense land trafficking. The next sections gauge the extent to which New Zealand's incomes per capita were raised by export staples, but they also assess whether land market volatility contributed substantially to the Dominion's long depression of the 1920s.

III

During technologically created staple export booms, Chambers and Gordon postulate that labour and other resources are attracted to the new export sector without affecting factor returns elsewhere in the economy; that new settlement occurs; and that the farm frontier extends until rents at the margin of cultivation return to zero. The rise in rent shows, for Chambers and Gordon, the intensive growth effects of the Canadian wheat boom. New Zealand's experience does not accord well with the assumptions of Chambers and Gordon's theoretical model, since economy-wide productivity was influenced by the economic transformations associated with the refrigeration-related staple boom.[50]

[47] Evans, *History of agricultural production.*
[48] *Statistics of farm production* (1955). A supplement to the report of this year shows historical data.
[49] Hawke, *Making of New Zealand*, p. 86.
[50] Chambers and Gordon, 'Primary products'.

New Zealand's dairy and meat export boom had powerful effects on land-derived incomes, and thus on GDP per capita. The rise in implicit rental values for New Zealand's cultivated land reflects to an extent that the investment needed to create cultivated grassland and the work of family farmers was capitalized into higher land prices. It is also likely that higher productivity in the processing of milk and meat in factories, and investment in transport, influenced land values, and thus rent estimated by de-capitalizing land values. Chambers and Gordon's theoretical model incorporates a much narrower concept of economic rent, defined to gauge the effects, on certain assumptions, of simply extending the margin of cultivation. In the New Zealand context, the consequences of the refrigeration-related pastoral boom went much deeper, impinging on economy-wide productivity. Land rental values provide evidence for gauging the wider consequences of New Zealand's refrigeration-related pastoral boom, but our estimates of the rise in New Zealand land rents differ from the theoretical concept used by Chambers and Gordon.

There have been several attempts to measure New Zealand land prices for years prior to 1939, and new data are reported here as figure 2.[51] These data are partially based upon the land transfer records, which provide an important source of price information, given the frequency with which rural land changed hands.[52] Variations in the quality of land sold each year typically hinder the construction of land price series. For New Zealand, however, the rural land market was highly active, and average transfer prices are based on substantial information. Callaghan, however, measured Canterbury land prices for the years 1870–1914 using other sources, including the lease register for Canterbury College lands, and these data are used for the years to 1915 when the land registry data conflate the values (but not the volumes) of urban and rural transfers.

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. Country land price levels, however, do not equate to prices of the cultivated land that underpinned the growth of dairy and meat exports. In 1891, only 8.4 million acres of the 31.9 million acres occupied in New Zealand were cultivated. Concomitant with the staple-export boom was a rise in the cultivated area to 18.1 million acres by 1921. Average land prices, though, given the volume of market activity, should reasonably reflect price movements, including those of cultivated land. These data show that New Zealand experienced a long real land price boom to 1919, followed by deflation until the mid-1930s (see figure 2). In real terms, land prices doubled in the period 1890–1913, but they fell by around 40 per cent during the long depression of the 1920s.

In order to gauge the rise in rents, measured here by de-capitalized land values, associated with the staple boom, it is necessary to define its onset. New Zealand's dairy exports were modest prior to 1890, partly because of technological and shipping capacity barriers. Frozen meat was first shipped from New Zealand in

[51] Callaghan, 'Course of land values'; Low, *Land prices.* Full details of the construction of the new series may be found in Greasley and Oxley, 'Refrigeration and distribution'.

[52] The recording of land transfers was quickly established, with over 2,000 transfers and 150,000 acres registered in 1874.

Table 3. *Gauging the pastoral boom's effect on New Zealand's GDP per capita*

	Cultivated land value (£m)	*Cultivated area (million acres)*	*Rental values per capita (£)*	*Land value per acre (£)*	*Nominal GDP per capita (£)*
1890	129.92	8	11.75	16.24	43.09
1914	618.28	16.4	32.54	37.77	72.49
1919	1072.36	17.4	54.07	61.63	144.13
1929	969.76	19	39.59	51.04	110.91

Sources: National income: Greasley and Oxley, 'Measuring New Zealand's GDP', pp. 365–6. The construction of the other data is described in the text.

1882, and meat export values initially led those of dairy products. However, the rural land market remained fragile during the 1880s, especially during the banking difficulties of 1888. Export prices (see figure 2) as well as land prices began their long upswing in the early 1890s; and using 1890 as the start date for the refrigeration-related pastoral boom is appropriate, and avoids the possible bias of unusually depressed land prices in some earlier years.

The price of cultivated land was substantially higher than the average price of country land, which includes great areas of upland grazing. One approach to measuring the price of cultivated land involves using the occasional data available for dairy farms. Following the boom surrounding the First World War, dairy land prices in New Zealand stabilized at around £46.3 per acre in 1925.[53] The estimates of average land prices in figure 2 are used to project this benchmark price to the years shown in table 3. The land price data, in conjunction with the estimates of the cultivated area, show how the nominal value of cultivated land rose in the Dominion during the pastoral boom years.[54] Rental values, as measured by cultivated land values de-capitalized by the mortgage rate, are also shown.[55]

New Zealand's real GDP per capita rose by around 1.5 per cent per year from 1890 to 1914. Over the same period, the estimated nominal rental value of New Zealand's cultivated land relative to its population rose by £20.8, and its nominal GDP per capita by £29.4. Thus around 70 per cent of the rise in aggregate income per capita is associated with the rise in cultivated land rentals during the key years of the refrigeration-related pastoral boom. This finding accords well with estimates which show a low real wage growth in New Zealand of 0.33 per cent per annum for the years 1890–1913, which equates to only around 25 per cent of the real GDP per capita growth rate.[56]

While land rents were the dominant force behind aggregate income per capita growth during the years of the refrigeration-related pastoral boom, it should be remembered that our measure of rent encapsulates a variety of possible forces related to staple exports, including elements of investment and work that were capitalized in higher land prices. The results, however, show how profoundly the post-1890 staple export boom influenced New Zealand's income per capita by transforming the farming economy, which was reflected in the rise in the value of

[53] Russell and Macklin, 'Intensive dairying' (see n. 28, above).

[54] Occupied area data are reported in *Statistics of New Zealand* for years to 1920, and *Statistics of farm production* thereafter.

[55] Mortgage rates are reported in *New Zealand official yearbooks*.

[56] Greasley and Oxley, 'Globalization and real wages'.

cultivated land. Subsequently, the decline in rental values during the 1920s was associated with a fall in GDP per capita. We will return to the issue of instability later, following a more detailed look at the implications of the refrigeration-related pastoral boom for the manufacturing sector.

IV

New Zealand's pastoral export boom did not crowd out manufacturing employment, which changed little from 19.4 per cent of overall employment in 1890, to 19.7 per cent in 1910, and 20.7 per cent in 1925.[57] Furthermore, there was a marked rise in the share of manufacturing employment that was in factories, much of it connected to the processing of refrigerated products. Hawke estimated the relative shifts of factory and handicraft employment in New Zealand.[58] He reported that 'industrial' (in other words, factory) employment rose from 10.2 per cent to 13.3 per cent of overall employment over the period 1890–1925. The fastest growth of factory employment during these years was for primary product processing. Meat freezing and dairy products combined accounted for 11.6 per cent of factory employment in 1938, compared to 7.2 per cent in 1890.

Factories are defined in the Dominion's statistics to include manufacturing establishments employing at least two workers, but various establishments, including bakeries, butchers, and smithies, were explicitly excluded from the returns.[59] The censuses, and subsequently the annual statistical reports of factory production, show gross production values, employment, and sometimes the cost of materials used, to provide a basis for measuring manufacturing productivity. Overall, factories employed 25,600 people in 1890, with a gross output of £8.8 million, or £343.8 per head. By 1938, gross factory output per worker had risen to £629.3, in 1890 prices, and employment to 102,500.[60] Manufacturing labour productivity thus rose by 1.27 per cent per annum in the period 1890–1938, almost exactly matching real GDP per capita growth in New Zealand.

The particular concern of this article is to estimate manufacturing productivity for meat freezing and dairy products, in order to gauge the productivity spill-over of the pastoral boom. Together, these sectors accounted for around 12 per cent of factory employment in 1938, while they accounted for 42 per cent of gross manufacturing output, and 16 per cent manufacturing value added in the same year. The increased importance of dairy factories and of freezing works heightened the size and scale of factory production in New Zealand, and led to higher productivity (see table 4).

In 1890, the Dominion had 43 meat freezing factories, but only 38 in 1938, while employment rose by around five times and real gross output by around 14 times over the same period. In the case of meat freezing, gross output per worker in 1890 prices grew by 0.92 per cent per annum in the years 1890–1938,

[57] Hawke, 'Disaggregation' (see n. 35, above).

[58] *Census of New Zealand, 1867–1916* (quinquennial from 1881) included a factory production data appendix, and from 1918–19 annual *Statistics of factory production* were published in the Dominion. Hawke, 'Disaggregation' (see n. 35, above), makes use of these data.

[59] *Statistics of factory production* (1929).

[60] R. Nesbit-Savage, 'A long run consumer price index for New Zealand', department of economics working paper, Univ. of Waikato, Hamilton (1993), provides the deflator used here.

Table 4. *Output and employment in dairy and meat-freezing factories*

		Meat freezing		
	Gross output (£m)	Value added (£m)	Labour	Output/Labour (£ 1890)[a]
1890	1.5	n.a.	1,568	956.6
1928	15.3	3.0	6,139	1,335.7
1938	20.7	3.8	7,897	1,481.6
		Butter and cheese		
	Gross output (£m)	Value added (£m)	Labour	Output/Labour (£ 1890)[a]
1890	0.15	0.05	271	553.5
1928	21.9	3.5	4,167	2,807.8
1938	27.3	2.4	3,944	3,904.7

Notes: a Based on gross output converted to 1890 prices. N.a.: not available.
Sources: Census of New Zealand (1891), *Statistics of factory production* (1929); *Statistics of factory and building production* (1939).

a productivity growth rate below the economy-wide average. In part, the relatively slow productivity growth may have been due to an aging of the capital stock; most freezing works in use in 1938 were built before the First World War, and no new works were constructed after 1922. However, the value added by meat freezing works rose more quickly than gross output, as an increasing variety of products, including pelts, skins, wool, and fertilizers, were marketed.[61] The ratio of value added to gross output in freezing factories was 18.3 per cent in 1938, compared to 10.9 per cent in 1910. Value added is not known for earlier years, but if its 1910 ratio to gross output is assumed for 1890, real value added per worker from 1890 to 1938 rose by 2.01 per cent per annum, comfortably above the economy-wide average.

New Zealand dairy factories were generally constructed later than the freezing works and became dominated by cooperative enterprises. Of the 429 dairy factories operating in 1938, 95 per cent were cooperatives.[62] In 1890, the average gross output of the Dominion's 74 dairy factories was £2,027, which increased, in 1890 prices, to £35,897 by 1938. Cooperative dairy factories were thus smaller than the corporate freezing works, and in 1938 the value of buildings, machinery, and land per dairy factory was £8,391, compared to £142,000 for the freezing works.[63] Cooperative dairy factories in New Zealand, though, were large by international standards, and averaged, for example, three to four times the output volumes of Wisconsin creameries and cheese factories by the 1920s.[64]

Russell and Macklin show that scale economies were realized in New Zealand dairy factories; they estimate that butter production costs ranged from 3.9 to 7.7 cents per pound, depending on plant size, and they emphasized the degree of factory rationalization within the Dominion compared to Wisconsin.[65] Average dairy factory output volumes in the Dominion were 760,928 pounds in 1928,

[61] *Statistics of factory and building production* (1938–9), p. 65.
[62] Ibid., p. 66.
[63] Ibid., p. 66.
[64] Russell and Macklin, 'Intensive dairying', p. 24 (see n. 28, above).
[65] Ibid., p. 25.

compared to 85,904 in 1890.[66] The largest New Zealand factories in the Waikato region produced around six million pounds of butter annually in the mid-1920s, whereas at Barron, Wisconsin, the largest plant in the USA, capacity was around 2.5 million pounds.[67] Gross output per worker in New Zealand dairy factories, in 1890 prices, rose from £553.5 in 1890 to £3,904.7 in 1938, an average of 4.2 per cent per annum, although valued added per worker grew less quickly.

The New Zealand system of dairy mass production integrated farm and factory operations. Most importantly, the process of cream separation shifted to a large extent from the factory to the farm. Home-based cream separation reduced transport costs, especially in the areas where wheeled transport was difficult. The challenge for the factories was to ensure the quality of their farm-produced supplies. As on-farm cream separation grew after 1905, so did the testing of the supplies to the factories, and tests became compulsory in 1914.[68] By 1935, 95 per cent of cream separation took place on the farms, and the higher value of the materials supplied to the factories partly explains why value added grew less quickly than gross output.[69] Additionally, cooperative dairy factories paid relatively high prices to farmers for milk and cream during the 1930s, and the ratio of factory value added to gross output fell from 16.9 per cent in 1928 to 8.8 per cent in 1938. Even so, real value added per dairy factory worker in the years 1890–1938 grew by 1.31 per cent per annum, although real value added labour productivity growth during 1890–1928 was higher, at 2.36 per cent per annum.

Higher productivity spilled from the farm to the factory during the pastoral boom. Since New Zealand dairy farmers by the 1920s also received 81 per cent of the London wholesale price of butter, transport and distribution was also carried out efficiently.[70] In some respects, distinguishing between the farm and the factory is invidious under New Zealand's system of mass-producing dairy products. Heightened dairy production was facilitated by intensive settlement and the cultivation of grass, machine milking, and the on-farm centrifugal separation of cream. Machine milking forged ahead more quickly in New Zealand than in the USA, and was quickly incorporated with the direct transfer of milk to the receiving tanks of farm-based machine-powered cream separators.[71] The large cooperative dairy factories were supplied by their farmer-owners, and mass-produced standardized high quality butter and cheese.[72]

Any estimate of the contribution made by higher productivity in dairy and meat freezing factories to New Zealand's real GDP per capita needs assumptions about the course that would have been taken by manufacturing productivity in the absence of the pastoral boom. For the period 1890–1928, we have estimated real value added per worker in dairy and meat freezing factories at 2.36 and 2.01 per cent per annum, respectively. Manufacturing generally experienced productivity growth of around 1.27 per cent per annum, almost exactly matching the

[66] *Statistics of factory production* (1928–9), p. 56.
[67] Russell and Macklin, 'Intensive dairying', p. 25 (see n. 28, above).
[68] Philpott, *History*.
[69] *Statistics of factory and building production* (1938–9), p. 68.
[70] Russell and Macklin, 'Intensive dairying', p. 33 (see n. 28, above). Wisconsin dairy farmers received a lower proportion of wholesale prices in the US market despite the shorter transport distances.
[71] Philpott, *History*, p. 147. The labour shortages of the First World War encouraged machine-milking.
[72] The price premium realized by Danish butter on the London market disappeared by the 1920s; see Greasley and Madsen, 'Tale of two peripheries'.

Dominion's real GDP per capita growth from 1890 to 1938 of 1.26 per cent per annum. Since employment in dairy and meat factories accounted for around 12 per cent of factory employment in 1928, the productivity growth of other factories averaged roughly 1.0 per cent per annum. If all manufacturing had averaged a 1.0 per cent per annum productivity growth, rather than being augmented by higher pastoral product processing productivity, and manufacturing share of total employment had remained around 20 per cent, New Zealand's real GDP per capita growth rate from 1890 to 1938 would have been reduced by around 5.0 per cent.

This modest estimated manufacturing productivity-increasing effect of the pastoral boom stems from the relatively low employment within dairy and meat factories, and the narrow productivity growth differential between manufacturing and the wider economy. The results, however, show that New Zealand's staple export boom raised factor returns in manufacturing, and increased the size of the factory sector in New Zealand. Productivity in transport and distribution were also likely to have been raised by the pastoral boom. Nevertheless, the principal returns from staple exports took the form of higher returns for landowners. These were considerable, and had powerful income and wealth distribution effects within New Zealand.[73] The increase in the social depth of land ownership engendered in the Dominion by the pastoral boom meant that the gains from rising land prices to 1920 spread widely. In the next section, the implications for economic instability will be considered.

V

A staple export boom, by raising farming and manufacturing productivity, underpinned New Zealand's internationally high GDP per capita in the years to the Second World War. Now we consider how the pastoral boom drove the long swings in the Dominion's economic growth and, in particular, contributed to the long depression of the 1920s. Most analyses of instability among primary producers emphasize the destabilizing role of exogenous export price shocks.[74] Much of New Zealand's historiography highlights the importance of the terms of trade for the contours of the Dominion's prosperity.[75] The perspective offered here differs, and lays more stress on the endogenous forces set in motion by the pastoral boom, connected to rural land market volatility and farm productivity, in shaping the long swings in New Zealand's economic growth.

There are several possible, intertwined links between the volatility of the rural land markets and the long swings in New Zealand's economic growth. Contemporaries blamed 'land-trafficking' for over-inflating the land market and causing the long depression around the 1920s.[76] Land market volatility directly influenced the net wealth of the rural economy, and shifts in landowners' prosperity trans-

[73] Greasley and Oxley, 'Refrigeration and distribution', and Greasley, Inwood, and Singleton, 'Factor prices', consider more fully the implications for the wage–rental ratio.

[74] C. Blattman, J. Hwan, and J. G. Williamson, 'The terms of trade and economic growth in the periphery, 1870–1993', NBER paper 9940, Cambridge (2003).

[75] Easton, *In stormy seas*; Fleming, 'Agricultural support policies'.

[76] Belshaw, 'Economic position of the farmer'; Condliffe, *New Zealand in the making*.

mitted to the wider economy via their spending.[77] The economic fortunes of a substantial proportion of New Zealanders were directly tied to the vagaries of the rural land market; around 28 per cent of the occupied population were farmers and 44 per cent of the population lived in rural areas in 1921. The contention investigated here is that the source of New Zealand's prolonged 1920s depression principally resided in the volatility of the rural land market.

The terms of trade had powerful effects on the land rental–wage ratio in New Zealand, with a magnification factor of around two.[78] Thus, the Dominion's farmers' productivity advantages were capitalized to an unusual degree in higher land values. Land prices directly influenced farmers' income because their financial success was often linked to frequent sales of land. In 1920, there were 84,706 farm holdings in New Zealand, compared to 43,777 in 1890, but in 1915–21 alone there were around 77,000 rural land transfers. The higher prices paid for land after 1890 were easily recouped by re-sale before 1920. One contemporary analyst postulated that the easy profits from selling land tempered farmers' productive efforts.[79] Any strategy by small and medium-scale farmers of relying on land sales as a form of income was undermined by the fall in land prices after 1920. Additionally, net new mortgage commitments rose sharply to 1920, leaving the new borrowers with heavy real debts when prices fell.[80]

Post-First World War rural optimism in New Zealand resembled that observed by Johnson for the USA, although the deleterious consequences of its collapse in the Dominion were accentuated by the greater importance of farming there.[81] Indeed, Russell and Macklin argue that speculation in dairy land in New Zealand was very much worse than in Wisconsin, and even went further than in the US corn-belt.[82] They estimated for 1925 that dairy land values in Wisconsin were two-thirds of the New Zealand level, and that land value interest accounted for 37.5 per cent of total dairying costs in New Zealand, but only 22.2 per cent in Wisconsin. The Dominion capitalized its efficiency advantages into higher land values, which did not realize returns to the farmer unless the land was re-sold at a higher price.

There are many references to debt-ridden farmers walking off their lands, and in 1927 New Zealand experienced the highest outflows of migrants since the pre-pastoral boom decade of the 1880s.[83] However, the amount of land under cultivation rose slightly in the 1920s, and Hussey and Philpott estimate that farm output volumes rose by 33 per cent in the period 1921–9.[84] Farmers during the 1920s generally kept producing, and in greater quantities, but their spending was constrained by a reduction in their net wealth and by their inability to sustain their accustomed route to financial success: selling land.

The troubles of the farmers had potentially damaging implications for other sectors of the economy, which were not offset by distributional changes in the

[77] For example, 50 dairy factories were opened in 1919–20, compared to 24 for the years 1923–38.
[78] Greasley and Oxley, 'Refrigeration and distribution'.
[79] Condliffe, *New Zealand in the making*, p. 268.
[80] Bloomfield, *New Zealand handbook*.
[81] Johnson, 'Postwar optimism'.
[82] Russell and Macklin, 'Intensive dairying' (see n. 28, above).
[83] Greasley and Oxley, 'Regime shift'.
[84] D. D. Hussey and B. P. Philpott, 'Productivity and income of New Zealand agriculture, 1921–67', agricultural economics unit, Lincoln College, report 59, Christchurch (1969).

1920s that benefited non-farm incomes. The wage–rental ratio increased, but urban wage-earners gained little as real wages in the Dominion stagnated along with real GDP per capita in the 1920s.[85] If the land market collapse depressed New Zealand's real GDP per capita through the long depression of the 1920s, it also depressed real wages, and the troubles of the farm sector spilled over to the urban economy.[86]

The combination of land market volatility, more widespread land ownership, and higher farm productivity possibly set in motion powerful forces which drove the long swings in New Zealand's GDP per capita, including the long depression of the 1920s. However, the role of export prices and the possibility that the 1920s downswing was exacerbated by monetary deflation spilling over from Australia via a common trans-Tasman banking system are also considered in the time-series model estimated in the following section. Certainly heavily indebted farmers were hit hard by deflation after 1920, and consequentially New Zealand's escape from the long depression needed a new inflationary monetary regime, which raised relative farm prices.[87]

VI

The relationships among New Zealand's real GDP per capita, farm productivity, land market volatility, and other variables, including export prices and monetary conditions, are investigated within a vector error correction model (VECM). Normalized on real GDP per capita, the model includes the volume and the real price of land transactions; farm productivity measured by cattle and sheep per capita; income distribution measured by the wage–rental ratio; the real price of exports; a currency-based monetary aggregate; land in cultivation; and real public works spending. The unit root tests reported in table 5 show that the null of non-stationarity is not rejected at conventional significance levels for any of the variables.

Furthermore, a cointegrating relationship exists between the variables, other than for cultivated area per capita (see table 6). The statistical results show that long swings in New Zealand's economic growth were driven by farm productivity, land market volatility, prices of exports, monetary conditions, income distribution, and public spending. The absence of a role for shifts in the cultivated area is puzzling, but may have been caused by the inclusion of direct productivity measures in the model. Land in cultivation, principally sown grasses, certainly influenced farm productivity. Farm productivity itself, measured by cattle and sheep per capita, did move with real GDP and the other significant variables in the cointegrating relationship.

The particular concern here is to make use of the estimated cointegrating relationships to understand the forces shaping New Zealand's long depression of the 1920s. On the basis of endpoint estimates, real GDP per capita growth averaged –0.18 per cent per annum over the years 1911/13–1927/8, and the chief

[85] Greasley and Oxley, 'Refrigeration and distribution'.

[86] Greasley and Oxley, 'Globalization and real wages', consider the relation between GDP per capita and real wages in New Zealand.

[87] We consider elsewhere (Greasley and Oxley, 'Regime shift') how a new monetary regime promoted the 1930s recovery.

Table 5. *Unit root tests (log levels): 1874–1939 Adjusted Dickey-Fuller (ADF)*

Variable	*ADF*[a]
Real GDP per capita[b]	–2.54
Real price of land	–3.07
Nominal wage/nominal land price	–2.84
Real price of exports	–2.43
Cultivated land area per capita	–2.66
Real notes and coins per capita	–0.39
Cattle per capita	–3.00
Sheep per capita	–2.82
Rural land transfers per capita	–2.43
Real public works expenditure per capita	–3.24

Sources: Notes and coins: D. K. Sheppard, R. Guerin, and S. Lee, 'New Zealand monetary aggregates and the total assets of a leading group of financial institutions', Victoria Univ. of Wellington money and finance group working paper 11 (Wellington, 1990), pp. 29–50. Public works spending: Bloomfield, *New Zealand handbook*, p. 423. Price deflator: Nesbit-Savage, 'Long run consumer price index' (see above, n. 60). Otherwise see text.
a Degree of augmentation in ADF determined by Akaike Information Criteria.
b Includes Maori in population.

Table 6. *Johansen-based cointegration results: log real GDP per capita, 1875–1939 (VAR = 1, linear deterministic trend)*

H_o	H_1	*Max eigen*	*Variable (Log)*	*Long run coefficient*
$r = 0$	$r = 1$	91.62*	Constant	–15.10
$r \leq 1$	$r = 2$	68.27*	Rural land transfers per capita	0.34*
$r \leq 2$	$r = 3$	44.33	Real export price	0.43*
$r \leq 3$	$r = 4$	37.19	Cattle per capita	0.79*
$r \leq 4$	$r = 5$	23.33	Nominal wage/nominal land price	1.05*
$r \leq 5$	$r = 6$	21.92	Real land price	0.62*
$r \leq 6$	$r = 7$	7.752	Real coins and notes per capita	0.29*
$r \leq 7$	$r = 8$	5.227	Sheep per capita	0.64*
$r \leq 8$	$r = 9$	1.755	Real public works per capita	0.08*

Notes: * Significant at the 5% level. VAR: vector auto regression.
Sources: Johansen, 'Statistical analysis'; otherwise as for tab. 5.

negative influences were the declines in rural land transfers, export prices, land prices, sheep per capita, and money (see table 7). The long-run coefficients were estimated within a multivariate framework, but they offer a guide to the force of the various adverse influences on real GDP per capita during the long depression. Ostensibly, the land market-related variables (that is, the volume and the price of land transfers) had the most substantial adverse effects, but care needs to be taken when interpreting the role of land prices.

In the long run, increases in the wage–rental ratio are associated with higher real GDP per capita. The rise in the wage–rental ratio was thus a positive growth influence in the 1920s, whose net effect was diminished by the offsetting effects of lower land prices. On balance, therefore, relative factor price shifts did not exert an especially powerful force on falling GDP per capita growth in the 1920s. Neither did farm productivity, although Condliffe's suggestion of faltering farm productivity gains some support. Our measure highlights the capacity of the land to carry animals relative to the human population, and shows that rising cattle numbers

Table 7. *Real GDP per capita and the long depression, 1911/13–1927/9*

	Actual 1911/13–1927/9 (% per annum)	*Long Run (LR) coefficients (from tab. 6)*	*GDP per capita predicted by LR coefficient (% per annum)*
Rural land transfers per capita	–3.12	0.34	–1.06
Real export price	–0.75	0.43	–0.32
Cattle per capita	1.16	0.77	0.89
Wage–rental ratio	1.70	1.05	1.78
Real land price	–2.23	0.62	–1.38
Real coins and notes per capita	–0.27	0.30	–0.08
Sheep per capita	–1.56	0.64	–0.99
Real public works per capita	2.19	0.08	0.18

Sources: As for tab. 5.

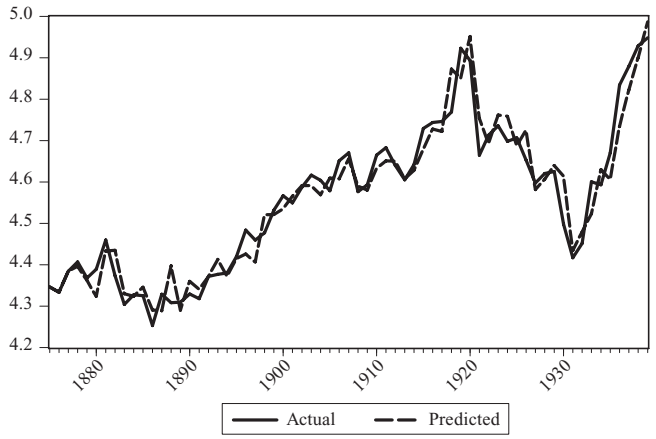

Figure 3. *Log of New Zealand real GDP per capita (1913 = 100)*

were to an extent offset by fewer sheep per capita, with the overall effect that lower 'productivity' slightly diminished real GDP per capita. Lower real export prices had clear adverse effects, but the restoration of the public works programmes after the First World War is associated with higher real GDP per capita. Money was essentially neutral over the period 1911/13–1927/9, with its substantial effect occurring during the 1930s.[88] Overall, the collapse of rural land market transfer volumes is shown as the most potent depressing influence of the 1920s. The overall predictions of the estimated cointegrating relationship and actual real GDP per capita are illustrated in figure 3.

It is possible to make use of additional information in the estimated VECM to shed further light on the key drivers of the long 1920s depression, by considering the statistical causality between the variables, and by gauging the relative force that innovations in each variable have within the multivariate system. The results illustrating the direction of Granger causality are reported in table 8.[89] Two influ-

[88] For details, see Greasley and Oxley, 'Regime shift'.

[89] The estimation method used to ascertain the direction of causality follows Toda and Yamamoto, 'Statistical inference'.

Table 8. *Granger causality, Toda and Yamamoto, 1875–1939*

	Real GDP per capita	*Rural land transfers per capita*	*Real price of exports*	*Cattle per capita*	*Nominal wage/ nominal land price*	*Real price of land*	*Real notes and coins per capita*	*Sheep per capita*	*Real public works per capita*
Real GDP per capita	—	⇐	<≠>	⇐	⇒	<≠>	⇒	⇒	⇒
Rural land transfers per capita		—	<≠>	⇐	<≠>	<≠>	⇒	<≠>	⇐
Real price of exports			—	⇒	⇒	⇒	⇒	<≠>	⇐
Cattle per capita				—	<≠>	<≠>	<≠>	⇒	<≠>
Nominal wage/ nominal land price					—	⇔	<≠>	<≠>	<≠>
Real price of land						—	<≠>	<≠>	<≠>
Real notes and coins per capita							—	<≠>	⇒
Sheep per capita								—	⇒
Real public works per capita									—

Notes:
⇒ Unidirectional causality from variable in the rows to variable in the columns.
⇐ Unidirectional causality from variable in the column to variable in the rows.
⇔ Bidirectional causality.
<≠> No causality identified.
Sources: Toda and Yamamoto, 'Statistical inference'; otherwise as for tab. 5.

Table 9. *Variance decomposition: GDP per capita*

Impact period (years)	Real GDP per capita	Country transfers per capita	Real export price	Cattle per capita
2	89.90133	3.393338	1.663924	0.034170
5	68.05704	8.749442	1.252529	1.884413
10	61.71812	10.08896	1.609689	1.839798
Impact period (years)	Real notes and coins per capita	Real land price	Wage–rental ratio	Sheep per capita
2	2.663620	0.266146	0.883255	0.861617
5	17.13314	0.195124	0.587506	0.694624
10	22.19274	0.142721	0.307076	0.375990
Impact period (years)	Real public works per capita			
2	0.332594			
5	1.446181			
10	1.724905			

ences are shown to lead real GDP per capita; namely farm productivity as measured by cattle per capita, and rural land market activity indicated by the volume of transfers. In the context of the long depression, the results in table 7 show that the net effect of these two variables reduced real GDP per capita by –0.17 per cent per annum between 1911/13 and 1927/9, a figure close to the actual negative growth.

A number of other features emerge from the causality results. The role of trade in real GDP per capita is shown to operate via other variables. Thus, real export prices lead productivity (cattle per capita), the price of land (and the wage–rental ratio), and money, and therefore export prices are linked to real GDP per capita by their influence on farm productivity. Interestingly, in the case of the two productivity measures, cattle per capita leads, suggesting that the rise of dairying crowded out sheep. Condliffe's view that public works led land market activity gains support from the causality results, but public works also led real export prices, pointing to investment in the transport infrastructure promoting New Zealand's overseas trade.[90]

Finally, the relative forces of individual component innovations in the vector auto regression (VAR) are shown in the variance decomposition results in table 9. This decomposition separates the variation in an endogenous variable into the component shocks to the VAR. Thus, the variance decomposition provides information about the relative importance of each random innovation in affecting all of the variables in the VAR.[91] Other than the impact of real GDP per capita innovations on itself, the two most powerful forces are shown as the volume of land transfers and the narrow measure of money. Money has a powerful effect, but most of the variation in the money variable occurred in the 1930s, and we show elsewhere that the effect on real GDP per capita was powerful at that time.[92] Otherwise, the variance decomposition reinforces the finding that the volume of

[90] Condliffe, *New Zealand*, p. 271.

[91] The particular factorization used to orthogonalize the innovations here is Cholesky (see Lutkepohl, *Introduction*, p. 462). Although there is some sensitivity to the ordering of the variables in the VAR, the qualitative results presented remain unchanged.

[92] Greasley and Oxley, 'Regime shift'.

land market activity had powerful effects on New Zealand's real GDP per capita, and, in particular, on the long depression of the 1920s.

VII

Modern debates surrounding global commodity market integration, extractive institutions, and natural resource abundance have fostered renewed interest in the impact of staple exports on economic growth and income distribution. The case of New Zealand's pastoral export boom offers evidence favourable to the staple export-led intensive growth hypothesis, but highlights the importance of the local response to global trading opportunities. The Dominion's rural landscape was transformed by wider land ownership and more intensive farming methods after refrigeration made possible the mass export of dairy products and frozen meat. Additionally, higher productivity within farming spilled over to manufacturing and services. In consequence, New Zealand had the highest GDP per capita, adjusted for purchasing power, in the world in 1938. The Dominion's staple export boom also set in motion forces of instability, which led to long swings in New Zealand economic growth and to a prolonged depression in the 1920s.

New Zealand's pastoral export boom did more than extend the Dominion's margin of cultivation; it substantially raised farm productivity and real GDP per capita. The contours of New Zealand's economic development after 1890 were shaped by the idiosyncratic responses within the Dominion to the opportunities of international trade facilitated by refrigeration technology. Most especially, an increase in the social depth of land ownership accompanied the pastoral export boom, which set New Zealand apart from many other resource-abundant primary exporters of the periphery. Closer settlement was encouraged and to an extent engineered by the state's willingness to foster wider property ownership and the rise in land holdings that underpinned a shift to more intensive farming methods in New Zealand. The statistical results show that higher farm productivity, made possible by closer settlement, was a leading influence on real GDP per capita.

The productivity gains associated with staple exports spread beyond the farm sector. Rather than crowd out manufacturing, New Zealand's pastoral export boom increased factory-based employment. Pastoral product processing promoted a shift in New Zealand from handicraft to factory-based manufacturing, and was associated in meat freezing with a rise in corporate enterprise, and in dairying with cooperatives. The scale and productivity of the freezing works rose sharply after 1890. Furthermore, a distinctive New Zealand system of mass production of dairy products that integrated the farm and the factory, and facilitated efficient marketing, emerged.

The closer settlement of New Zealand led to higher farm productivity, but also heightened land market activity. Land market institutions within New Zealand—the simple and secure systems for transferring freehold titles, the easy access to British capital, the taxation of great estates, and the schemes for settling the land densely—all promoted a rise in land holdings. Land markets boomed in the period 1890–1920, partly because of the technological stimulus provided by refrigeration, but also because of the idiosyncratic response within the Dominion to the new opportunities. For some contemporaries, the land boom amounted to

land-trafficking. Land market volatility was a powerful force for instability, given the increase in the social depth of land ownership during the pastoral boom. A central theme in New Zealand's economic history highlights the vulnerability of the Dominion's economy to external shocks, particularly those connected to export prices. Our perspective differs, and emphasizes that farmers' efficiency or revenue advantages were capitalized into higher land prices. The statistical results show that the collapse of rural land transactions after 1920 led to prolonged depression.

New Zealand's economic development shows that export staples can provide a strong positive stimulus to intensive growth. Land was abundant relative to the size of the population.[93] What was more distinctive about New Zealand was the extent to which refrigeration-related staple exports promoted deep changes in economic organization and efficiency that heightened economy-wide productivity. Not all staples have the capacity to stimulate economic transformation. The prospects for transforming the rural landscape, intensifying settlement, and raising farm productivity were modest when wool dominated New Zealand's staple exports before 1890. However, refrigeration did not guarantee economic transformation; rather, it made intensive growth possible. New Zealand's remarkably high income per capita depended on the responses to opportunities shaped by technological changes. Those responses led to higher land productivity and stimulated factory employment to process dairy and meat products, benefiting productivity further. They also led to swings in land transactions that led to a long depression around the 1920s. Yet in 1938, New Zealand was a remarkably prosperous economy. The decisions thereafter to promote broadly-based industrialization by insular protectionist policies can be linked to beliefs in the Dominion that staple exports were associated with instability, although contemporary diagnosis laid more stress on outside forces than on the effects of home-grown land market volatility.

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Date submitted *27 July 2005*
Revised version submitted *2 May 2007*
Accepted *21 February 2008*

DOI: 10.1111/j.1468-0289.2008.00440.x

[93] The European population was around 237,000 in 1869, and the Maori population possibly around 50,000. A century earlier, at the time of Cook's first visit in 1769, the Maori population may have been 200,000. Hawke, *Making of New Zealand*, p. 19, considers the range of estimates of the Maori population.

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